Appendix I1

Management Plans

- Incinerator Waste Management Plan
- Landfarm Design and Management Plan
- Operation & Maintenance Manual - Sewage Treatment Plant
- Tailings Storage Facility – Operation, Maintenance and Surveillance Manual
- Dewatering Dikes – Operation, Maintenance and Surveillance Manual
- Groundwater Monitoring Plan
- Fish Habitat Offsetting Plan : Phaser Lake Addendum
- Blast monitoring Program
- Oil Handling Facility: oil Pollution Emergency Plan
- Meadowbank Habitat Compensation Monitoring Plan
- Emergency Response Plan
- Landfill Design and Management Plan
- Transportation Management Plan: All Weather Access Road

MEADOWBANK GOLD PROJECT

Incinerator Waste Management Plan

In Accordance with Water License 2AM-MEA1525

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

Version 7
March 2017

EXECUTIVE SUMMARY

This Incinerator Waste Management Plan (IWMP) describes the performance limits, waste management protocols, operation, monitoring and record keeping requirements for the incinerator and waste oil burning furnaces. This plan was developed in support of Agnico's renewal application for a Type A Water License from the Nunavut Water Board (NWB). Agnico's water license 2AM-MEA1525 was renewed on July 23, 2015. This updated IWMP is a component of the Meadowbank Environmental Management System. This IWMP will be maintained by Agnico to reflect the current operations at the Meadowbank Gold Project, permit requirements and regulatory setting. The IWMP will be reviewed on a regular basis and revised by Agnico when necessary to ensure that the project staff, operators and regulatory bodies are kept aware of any changes to project operations. Any changes in operation/procedures are communicated to all applicable Meadowbank Departments.

The main objective of waste management relating to the primary incinerator and waste oil furnaces is to minimize the amount of solid waste to be incinerated by implementing an effective waste segregation and reuse (in the case of waste oil) program to ensure that only appropriate types of waste are incinerated. The primary objective of incineration is to eliminate materials from the landfill that could create odours, attracting wildlife to the landfill site or to the Meadowbank camp; as well as to avoid the generation of leachate caused by the decomposition of putrescible materials. The primary incinerator is a dual chamber, high-temperature incinerator and is used to dispose of solid waste from the accommodation camp, kitchen, shops, and offices that cannot be landfilled. The materials to be incinerated will be limited to putrescible waste such as paper, wood, food packaging and food waste. In addition, a number of small waste oil burning furnaces will be utilized in order to recycle used petroleum products such as heavy lubricants and engine oil. Ash produced from the incineration process will be disposed of in the on-site landfills provided it meets criteria as stated in Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities (GN, 2011). A protocol is implemented for testing incinerator ash and contingent measures for alternate disposal of ash if quality is unsuitable for landfilling.

The incinerator at Meadowbank is manufactured by Eco Waste Solutions. The incinerator is designed to ensure the emissions meet Canadian Council of Ministers of the Environment (CCME) Canada-wide Standards for Dioxin and Furans (CCME, 2000a) and the CCME Canada-wide Standards for Mercury Emissions (CCME, 2000b). In addition to the incinerator technology, the implementation of a waste management and segregation plan will further limit emissions of dioxins and furans from the incinerator. Compliance with the performance limits is confirmed by stack testing conducted once every two years (providing that the waste stream has not changed). Should an exceedance of the CCME Standards occur, Agnico will change the frequency of stack testing to once per year for 5 years then return to biannual testing following ECCC approval. An investigation related to the cause of the exceedance (thoroughly check the waste stream).

In order to demonstrate compliance with performance limits, an annual incineration management report will be prepared and submitted to the NWB (as part of the water license annual report), Government of Nunavut (GN), Environment and Climate Change Canada (ECCC), and NIRB. The quantity of materials incinerated on site during operations and a record of performance temperatures together with results from stack testing and ash monitoring, will be included within the annual report.

IMPLEMENTATION SCHEDULE

As required by Water License 2AM-MEA1525, Part B, Item 11, the proposed implementation schedule for this Plan is outlined below.

This Plan will be implemented immediately (March 2017) subject to any modifications proposed by the NWB as a result of the review and approval process. This document will supersede the Incinerator Waste Management Plan Version 6 – 2016.

DISTRIBUTION LIST

Agnico – General Mine Manager

Agnico – Environment Superintendent

Agnico – Environmental Coordinator

Agnico – Environmental Technician

Agnico – Site Services Superintendent

Agnico – Field Services Supervisor

Agnico – Incinerator Operator

DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
1	08/10/08	3 & 6	5 & 13	Revised to consider best management practices for ash
		App 1		Technical specifications for primary incinerator included
2	09/05/12	1; 3.3; 4.1	1; 7; 8	Revised to include regulatory comments
3	12/11/16			2012 Comprehensive Review
4	12/11/16	ES; 3.1, 6.1	II, 5, 13	Stack testing will be completed biennially
		5.5	12	Adjusted quantities for mass reduction
		APP III		Include Procedure for Loading Incinerator
5	14/07/21	All	All	2014 Comprehensive Review
6	16/03/31	All	All	2016 Comprehensive Review
7	17/03/31	3.1	5	Add details regarding the stack testing frequency following an exceedance

Prepared by: Environmental Department

Approved by:

Jamie Quesnel
Environmental Superintendent - Nunavut

Table of Contents

SECTION 1. INTRODUCTION 1
1.1 PROJECT OVERVIEW 1
1.2 INCINERATOR LOCATION 1
SECTION 2. REGULATORY CONTEXT 3
2.1 BACKGROUND INFORMATION 3
2.1.1 Dioxins and Furans 3
2.1.2 Mercury 3
2.1.3 Used Oil and Waste Fuel 3
SECTION 3. PERFORMANCE LIMITS 5
3.1 PRIMARY INCINERATOR 5
3.2 USED OIL 5
3.3 INCINERATOR ASH 7
SECTION 4. INCINERATOR OPERATION 8
4.1 PRIMARY INCINERATION 8
4.1.1 Emissions 8
4.1.2 Dust/Odour Control Measures 8
4.1.3 Staffing and Equipment 8
4.1.4 Operator Training 9
4.2 USED OIL INCINERATOR and FURNACES 9
SECTION 5. WASTE MANAGEMENT 10
5.1 APPROACH 10
5.2 ACCEPTABLE WASTE FOR INCINERATION/WASTE OIL FURNACES 10
5.3 UNACCEPTABLE WASTE FOR INCINERATION 11
5.4 WASTE VOLUMES 12
5.4.1 Solid Waste 12
5.4.2 Used Oil 12
5.4.3 Incineration Ash 12
5.5 WASTE INCINERATION RATE 12
SECTION 6. MONITORING AND TESTING 14
6.1 INCINERATOR EMISSIONS TESTING 14
6.2 WASTE OIL TESTING 14

6.3 ASH TESTING 14
SECTION 7. MAINTENANCE 15
SECTION 8. REPORTING 16
8.1 NATIONAL POLLUTANT RELEASE INVENTORY 16
8.2 GREENHOUSE GAS EMISSIONS 16
SECTION 9. PLAN REVIEW AND CONTINUAL IMPROVEMENT 18
SECTION 10. REFERENCES 19

LIST OF TABLES

Table 3-1 Emission Standards for Solid Waste Incinerators 5
Table 3-2: Summary of Used Oil and Waste Fuel Guideline 6
Table 3-3: Used Oil Impurity Limit 7
Table 3-4: Guidelines for Solid Waste/Process Residuals Suitable For Landfill 7
Table 6-1: Summary of Incinerator Emissions Testing 14
Table 8-1: NPRI Incineration Reportable Substance List 16

LIST OF FIGURES

Figure 1-1 Incinerator and Waste oil furnaces locations 2
Figure 5-1: Process Flow Chart for Waste Incineration 13

LIST OF APPENDICES

APPENDIX I: Technical Specifications: Eco Waste Solutions Incinerator
APPENDIX II: MBK-SIT-0011 – Incinerator Loading

SECTION 1. INTRODUCTION

1.1 PROJECT OVERVIEW

This Incinerator Waste Management Plan (IWMP) describes the performance limits, waste management plans, operation, monitoring and record keeping requirements for the primary incinerator and onsite waste oil burning furnaces.

This update to the 2015 IWMP (Version 6) is a component of the Meadowbank Environmental Management System. The objectives of this Plan are summarized as follows:

1. To define the operating procedures to be used in the incineration of appropriate non-hazardous solid waste generated at the Meadowbank Mine;
2. To define acceptable/non-acceptable types of solid waste to be placed in the Meadowbank incinerator; and
3. To define operating and monitoring requirements for the incinerator and waste oil burning furnaces.

Agnioc will be responsible for managing and implementing this IWMP.

The primary incinerator is required for the disposal of solid waste from the accommodation camp, kitchen, shops, and offices that cannot be landfilled at the Meadowbank Gold Project Site. The incineration of waste will ensure that no waste which could attract wildlife and/or create leachate (putrescible materials) is disposed at the onsite landfill. The materials to be incinerated will be limited to putrescible waste such as paper, food packaging and food waste. A number of small waste oil burning furnaces, to provide space heating, will be utilized in order to recycle used petroleum products such as heavy lubricants and engine oil. The waste oil burning furnaces have been included within this IWMP.

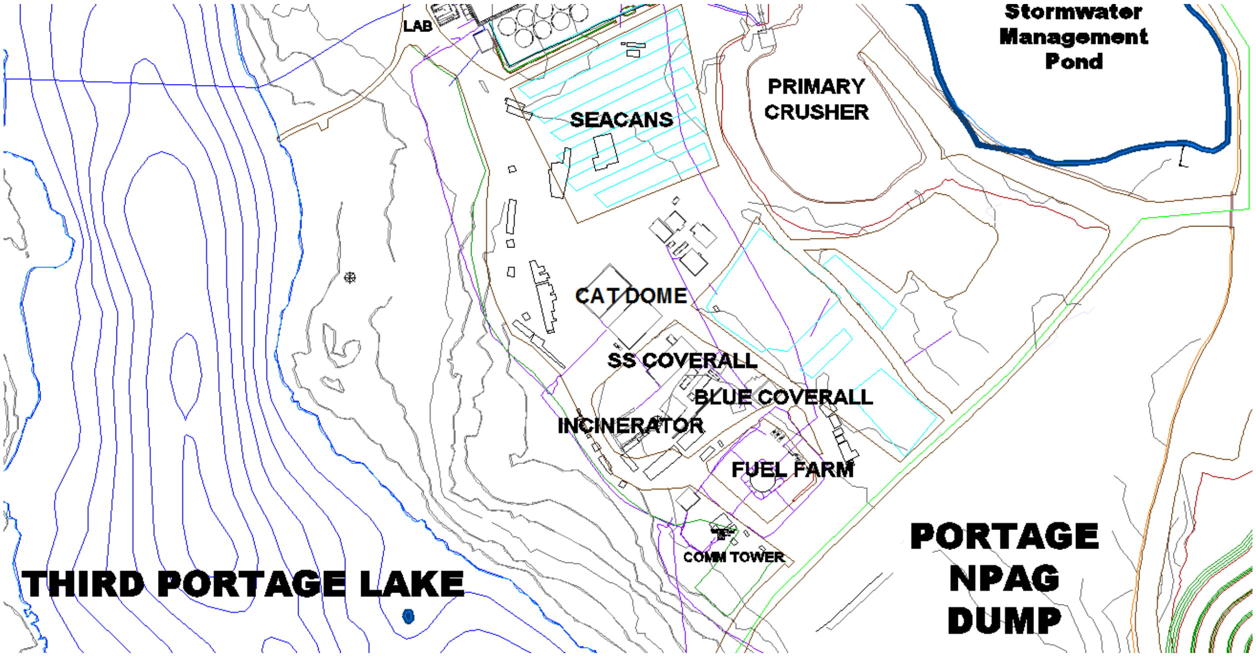
Ash produced from the incineration process is disposed of within the on-site landfill according to the GN Environmental Guideline for Industrial Waste Discharges (GN, 2011). The incinerator ash will be tested to confirm its suitability for landfill disposal (Section 3.3 and 6.3). If monitoring indicates the ash is not suitable for landfilling, it will be buried within the Tailings Storage Facility (TSF). Materials buried within the TSF are expected to freeze over a period of time, resulting in permafrost encapsulation (Golder, 2014).

The camp is currently accommodating ~520 persons on any given day during operations, and the expected life of operation of the incinerator is until 2020 (Golder, 2014).

1.2 INCINERATOR LOCATION

The primary incinerator is located away from the plant site and accommodations complex, adjacent to the fuel storage facility. Thirteen waste oil burning furnaces were installed on site at the cat dome, SS coverall and, blue coverall to provide space heating (see Figure 1-1). One waste oil burner is also located in the incinerator.

Figure 1-1 Incinerator and Waste oil furnaces locations



SECTION 2. REGULATORY CONTEXT

The following section outlines the regulatory context related to solid waste incinerators and waste oil furnaces, and discusses how the regulations apply to the incinerator and waste oil furnaces at the Meadowbank site.

Performance parameters for the incinerator at Meadowbank will be in accordance with the emission guidelines set out by the Canadian Council of Ministers of the Environment (CCME) Canada-wide Standards for Dioxins and Furans (CCME, 2000a) and the CCME Canada-wide Standards for Mercury Emissions (CCME, 2000b).

Best management practices regarding the management of used oil and waste fuel are provided in the Environmental Guideline for Used Oil and Waste Fuel (GN, 2012). Agnico will ensure used oil is managed and controlled according to these guidelines.

Ash produced from the incineration and waste oil burning process will be disposed of according to the Nunavut Environmental Guideline for Industrial Waste Discharges (GN, 2011).

2.1 BACKGROUND INFORMATION

2.1.1 Dioxins and Furans

Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), commonly known as dioxins and furans, are toxic, persistent, bioaccumulative, and result predominantly from human activity. Due to the extraordinary environmental persistence and capacity to accumulate in biological tissues, dioxins and furans are slated for virtual elimination under the CEPA, the federal Toxic Substances Management Policy (TSMP) and the CCME Policy for the Management of Toxic Substances (CCME, 2000a).

2.1.2 Mercury

Mercury is a naturally occurring substance, which is transformed through biological processes to methyl mercury, a persistent substance which bioaccumulates in the food chain and is particularly toxic to humans and wildlife. Mercury levels originate from a combination of naturally-occurring mercury and anthropogenically emitted mercury. Under a variety of regional, national, bi-national and internal programs, treaties and agreements, mercury is being targeted for emissions reductions consistent with the CCME Policy for the Management of Toxic Substances, which identifies that mercury shall be managed through its lifecycle to minimize release (CCME, 2000b).

2.1.3 Used Oil and Waste Fuel

According to GN Environmental Guideline for Used Oil and Waste Fuel (GN, 2011) ‘used oil’ means engine, turbine and gear lubricating oil, hydraulic and transmission fluid and insulating coolant (i.e. transformer fluid) that is unsuitable for its intended purpose due to the presence of impurities or the loss of original properties, but does not include waste oil derived from animal or vegetable fat or a petroleum product spilled on land or water. ‘Waste fuel’ means a flammable or combustible petroleum hydrocarbon, that is unsuitable for its intended purpose due to the presence of impurities or the loss of original properties, and includes gasoline, diesel and fuel oil, aviation fuel, kerosene, naphtha, but does not include paint, solvent or propane.

SECTION 3. PERFORMANCE LIMITS

3.1 PRIMARY INCINERATOR

Agnivo selected a Primary Camp Waste Incinerator (model no, ECO 1.75TN 1P MS 60L) from Eco Waste Solutions, which is designed to comply with the regulations in Table 3-1, where the maximum emissions are expressed as a concentration in the exhaust gas exiting the stack of the facility. The specifications of the incinerator are available in Appendix I. In addition to incinerator technology, the implementation of the waste management plan is designed to limit emissions of dioxins and furans from the incinerator.

Table 3-1 Emission Standards for Solid Waste Incinerators

Emissions	Sector	Units	Guideline Maximum	Reference guideline
Dioxins and Furans	Municipal Waste	pg I-TEQ/m^3	80	CCME, CWS 2000a
Dioxins and Furans	Sewage Sludge Incineration	pg I-TEQ/m^3	80	CCME, CWS, 2000a
Mercury	Municipal Waste	µg/R m^3	20	CCME, CWS, 2000b
Mercury	Sewage Sludge Incineration	µg/R m^3	70	CCME, CWS, 2000b

Notes Stack concentrations are corrected for 11% oxygen

At Meadowbank, the primary incinerator may be subject to either Municipal or Sewage Sludge standards based upon the total amount of waste type incinerated (>50% as one type) or upon the territorial designation of facility type. According to the Canada Wide Standards “municipal solid waste’ includes any waste that might be disposed of in a non-secure landfill site if not incinerated (i.e., non-hazardous wastes regardless of origin), but does not include “clean” wood waste.

Compliance to these performance limits will be confirmed by stack testing performed by an external contractor once every two years. Should the performance limits above be exceeded then an investigation will be undertaken to determine the cause of the exceedance. In most cases exceedances will be related to improper waste being fed into the incinerator. Following the exceedance, Agnico will conduct annual stack testing until five has been accumulated with all results reported below the Level of Quantification (emission standard), then stack testing frequency may be revised to a biennial. The return to biennial testing will be done following approval from ECCC.

3.2 USED OIL

Agnico manages used oil and waste fuel according to the GN Environmental Guideline for Used Oil and Waste Fuel (GN, 2012).

Table 3-2 summarizes some main points of the guideline that pertain to waste oil generated on site, as per the Environmental Guideline for Used Oil and Waste Fuel (GN, 2012).

Table 3-2: Summary of Used Oil and Waste Fuel Guideline

As per 'Used Oil and Waste Fuel Management Regulations'	
Disposal	Waste oil/Waste fuel will not be disposed of directly into the environment
Storage	Storage is not acceptable for the long-term management of these wastes except under extraordinary circumstances and should be considered as a temporary measure only. Store used oil and waste fuel in its original container or another container certified by the Canadian Standards Association for this purpose. Containers should be located so as to enable their physical inspection for damage or leakage and should be protected from the sun, weather and physical damage. Waste oil/Waste fuel will be stored as per the *Hazardous Materials Management Plan* (Version 3, October 2013)
Sampling and Analysis	Waste oil will be tested for: ***Flash point*** ***Existence and amount of each impurity Listed in Table 3-3***
Burning	Open burning used oil and waste fuel should be avoided. Used oil and waste fuel appliances should not be operated on property that is zoned residential. Waste Oil that exceeds guidelines will not be burned.
Records	The following is recorded in association with the incineration of used oil: ***Volume of Used oil generated*** ***Volume of used oil incinerated/consumed*** ***Name and Address of person in charge, management or control of the used oil*** ***A summary of maintenance performed on incinerator or processing equipment*** ***The destination of the used oil products shipped from the facility (if any)***

Table 3-3 summarizes the maximum level of contaminants in used oil that can be used as fuel for the incinerator or consumed by the waste oil burning furnaces as stipulated within the GN Environmental Guideline for Used Oil and Waste Fuel (GN, 2012). Under the regulations blending of used oil that exceeds one of more of the criteria listed in Table 3-3 is not allowed.

Table 3-3: Used Oil Impurity Limit

Impurity	Units	Maximum Level Allowed in Used Oil
Cadmium	ppm	2
Chromium	ppm	10
Lead	ppm	100
Total Organic Halogens (as chlorine)	ppm	1000
Polychlorinated biphenyls	ppm	2

3.3 INCINERATOR ASH

Ash resulting from the incineration of solid waste is disposed of in the landfill and tested for metals according to the GN Environmental Guideline for Industrial Waste Discharges (GN, 2011). Ash that does not meet these guidelines will be buried within the Tailings Storage Facility (TSF). Table 3-4 summarizes the guidelines for metals parameters based on leachate test results.

Table 3-4: Guidelines for Solid Waste/Process Residuals Suitable For Landfill

Parameter	Concentration maximum (mg/L)
Arsenic	2.5
Barium	100
Cadmium	0.5
Chromium	5
Lead	5
Mercury	0.1
Selenium	1
Silver	5
Zinc	500

NOTE: Standards based on leachate test results

SECTION 4. INCINERATOR OPERATION

4.1 PRIMARY INCINERATION

The controlled-air batch (dual chamber) incinerator used at Meadowbank is based on the principals of pyrolysis (starved-air burning condition) and complete oxidation (high temperature, excess oxygen and sufficient time). The incineration system is a two-stage process. In the first stage, waste is converted to gas in the primary chamber at approximately 650 to 850^{o}C. At this temperature any potentially infectious material is destroyed. This process is self-fueling until the volume is reduced by 90%. Gases from the primary chamber enter the secondary chamber of oxygen rich and turbulent conditions, which is typically at a higher temperature – around 1000^{o}C. Combustion is complete after a minimum retention time. A used oil burner is used in the secondary chamber to reduce the quantity of fuel needed for the operation of the incinerator.

Critical process parameters and process control data as per the incinerator operation specifications such as temperature, combustion air flow and burner output are computer controlled to maintain optimal combustion conditions. These parameters are recorded daily and the records are kept for at least 2 years.

For an incinerator capacity suitable for the predicted volumes of waste to be generated at the Meadowbank site the total particulate matter (PM) generated is extremely low (confirmed through stack testing). Therefore dust collection technologies such as bag house filters are not being employed, and no fly ash is generated. Ash residual from the incinerator is generated and is removed daily.

4.1.1 Emissions

The Eco Waste Solutions Incinerator used by Agnico is designed to meet performance limits described in Section 3.1. The Primary incinerator has been designed by Eco Waste Solutions using good engineering practice to ensure required dispersion of gases to meet applicable air quality standards/objectives.

The incinerator stack design incorporates appropriate sampling ports (with caps where necessary) at appropriate locations to allow for stack testing to be undertaken during incinerator operation.

4.1.2 Dust/Odour Control Measures

Modern incinerators are commonly designed such that the non-turbulent atmosphere in the primary burn chamber reduces the formation of particulate matter. Therefore, the need for additional dust and /or odour control measures is not required.

4.1.3 Staffing and Equipment

The computerized incinerator requires one person to operate and monitor the equipment for approximately 1 to 1.5 hours per day (for ash removal, loading and start-up). Operators are not required to be in attendance during the rest of the operation, as it is a fully automated process. This incinerator is designed so that the operators are not exposed to high temperatures during loading or ash removal due to complete cool down after the burn cycle. Also, the waste is not allowed to combust until the chamber is sealed thus isolating the worker from smoke and high temperatures. The operating procedure for the incinerator loading can be found in Appendix II.

4.1.4 Operator Training

Operator training was initially provided by an experienced technician from the incinerator supplier/manufacturer (Eco Waste Solutions). Training for operation of the incinerator is now given by the supervisor in charge of the incinerator.

4.2 USED OIL INCINERATOR and FURNACES

Used oil is used as auxiliary fuel at the secondary chamber at the incinerator. This used oil burner at the incinerator has the capacity to handle approximately 200,000 liters of used oil per year. This used oil burner will reduce the amount of fuel used in the incinerator.

Thirteen (13) waste oil furnaces were installed in the existing blue coverall, cat dome and site services coverall to provide space heating. One waste oil burner is also located at the incinerator. These waste oil furnaces/burners have an aggregate capacity to handle approximately 410,000 liters of waste oil per year, however more may be put in service to expand the waste reduction program and minimize the shipment of this material south each year. The source of the waste oil will be from oil changes on the mining equipment and light vehicles as well as oil changes on mechanical gearboxes within the mill. The waste oil is filtered onsite prior to use as a fuel source.

In accordance with the Interim Closure and Reclamation Plan (Golder, 2014), salvageable buildings and surface structures, including the primary incinerator and used oil furnace, will be dismantled and demobilized from the site. No structural material will be incinerated during the closure phase of the mine.

SECTION 5. WASTE MANAGEMENT

The amount of waste will be reduced through purchasing policies that focus on reduced packaging and on-site diversion and segregation programs. At Meadowbank the main objective of the waste management plan relating to incineration is to minimize the amount of solid waste to be incinerated by following an effective waste segregation and reduction program to ensure that only appropriate types of waste are incinerated.

Figure 2 provides a schematic diagram for the management of solid waste and used oil produced on site.

5.1 APPROACH

A waste segregation and reduction program is implemented at the site (i.e. the separation of non-food waste items suitable for storage and subsequent transport and disposal or recycling). This will allow materials that are unsuitable for incineration to be either landfilled on site or hauled offsite to a licensed disposal/recycling facility. The waste segregation program will also document the quantities and types of materials that are incinerated. In addition Agnico is now incorporating a waste reduction strategy for materials that originally were being incinerated. For example styrofoam coffee cups and plastic lids were eliminated from general site use in 2012 and replaced with stainless steel mugs and re-washable plastic cups. Other materials will be considered during the life of mine for elimination from the incinerator waste stream.

5.2 ACCEPTABLE WASTE FOR INCINERATION/WASTE OIL FURNACES

Acceptable wastes for incineration, in the primary incinerator as per the operational instructions, include the following:

- Organic matter including food;
- Food containers and wrappings including plastics that are contaminated by food;
- Paper and cardboard; and
- Dead animals (small size only).

Acceptable wastes for incineration in the used oil furnaces include the following:

- Waste oils; and
- Flammable or combustible petroleum hydrocarbons unsuitable for its purpose due to the presence or contaminants or loss of original properties (such as gasoline, diesel fuel, aviation fuel, kerosene, naptha or fuel oil).

5.3 UNACCEPTABLE WASTE FOR INCINERATION

Materials that are not listed above are unacceptable for incineration. These materials include, but are not limited to:

- Uncontaminated plastics, including chlorinated plastics;
- Inert materials such as concrete, bricks, ceramics, ash;
- Bulky materials such as machinery parts or large metal goods such as appliances (shipped south and recycled in an accredited facility);
- Radioactive materials such as smoke detectors;
- Potentially explosive materials such as propane tanks, other pressurized vessels, unused or ineffective explosives;
- Other hazardous materials such as organic chemicals (PCBs, pesticides), other toxics (arsenic, cyanide);
- Electronics (shipped south and recycled in an accredited facility);
- Batteries (shipped south and recycled in an accredited facility);
- Asbestos;
- Dry wall;
- Vehicles and machinery (shipped south and recycled in an accredited facility);
- Fluorescent light bulbs;
- Whole tires; and
- Any materials containing mercury.

Unacceptable wastes for incineration in the used oil furnace include the following:

- Used oil that exceeds the Maximum Impurity Limits for parameters listed in Table 3.3;
- Waste oil with a flash point of less than 37.7 deg C;
- Paint;
- Solvents; and
- Propane.

5.4 WASTE VOLUMES

5.4.1 Solid Waste

The quantity of waste being incinerated is averaging 1,750 kg per day during operations with a camp size of ~520 persons during operations.

5.4.2 Used Oil

The quantity of used oil generated from the servicing of machinery and generators is estimated at approximately 400,000 liters per year (Meadowbank Gold Project – 2015 Annual report).

5.4.3 Incineration Ash

The quantity of ash from the incinerator is approximately 240 tonnes/year, assuming that the incineration process results in a 63% reduction in mass. Assuming the ash has a total density of 1.2 tonnes /m^3, then a volume of approximately 200 m^3 /yr of ash will require disposal. Incinerator ash will be disposed of in the onsite approved landfill.

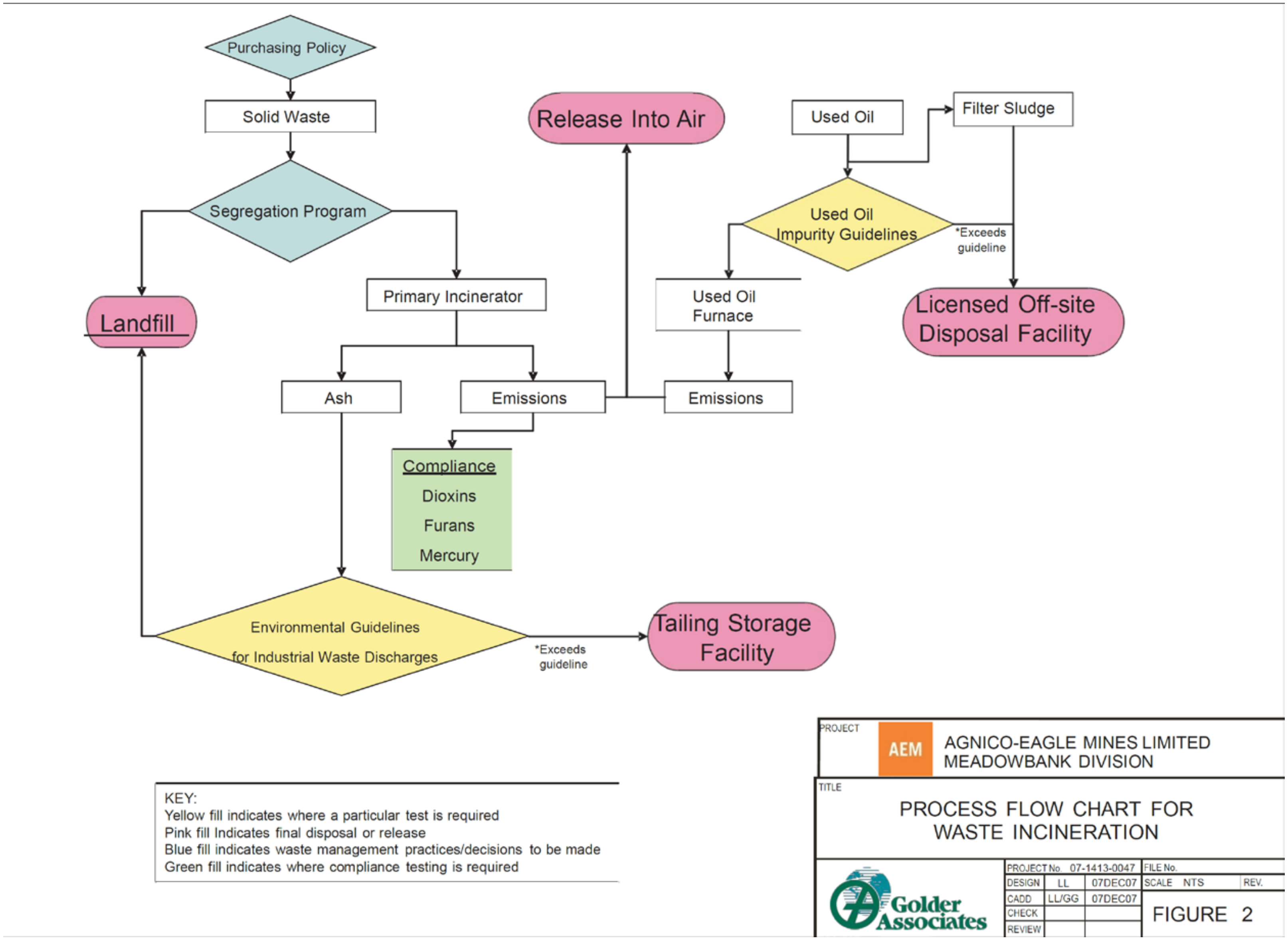
5.5 WASTE INCINERATION RATE

The incinerator has an approximate incineration capacity of 1,750 kg / h based on a 10 hour burn cycle. If this cannot be achieved the primary chamber can be used as storage. According to the Eco Waste Solution, the type of waste that is used will never exceed the weight limit. To ensure maximum efficiency, 3 quarters of the chamber has to be filled to ensure that the gas outlet of the primary chamber is never blocked.

The system has a sizable front door for easy access to manually load feed waste into the unit with a front end loader. Dry waste (paper, cardboard) and wet waste (organic matter including food) will be layered to ensure proper combustion and maximum efficiency according to the incinerator operational instructions.

The batch cycle for the Primary Chamber typically lasts approximately 10 hours for the burn cycle and is followed by a cool down of approximately 6 hours. The Secondary Chamber operates with a retention time of approximately 2 seconds.

Figure 5-1: Process Flow Chart for Waste Incineration



SECTION 6. MONITORING AND TESTING

The following presents the monitoring and testing plan for the incinerator.

6.1 INCINERATOR EMISSIONS TESTING

The incinerator stack incorporates appropriate sampling ports at appropriate locations, in right angle configuration, to allow for stack testing to be undertaken during incinerator operation. Table 6-1 summarizes the frequency of testing that is completed.

Table 6-1: Summary of Incinerator Emissions Testing

	Frequency	Number of Tests Required	Relevant Guideline
Furans and Dioxins	Biennial	3	CCME, CWS 2000a
Mercury	Biennial	3	CCME, CWS 2000b

6.2 WASTE OIL TESTING

No sampling frequency for waste oil is specified in the GN Environmental Guideline for Used Oil and Waste Fuel (2012). To ensure compliance with the Guideline parameters, Agnico will sample the waste oil feedstock twice a year. Waste oil that does not meet the regulation impurity limits is drummed and shipped off site as hazmat to a re-refining facility or licensed disposal facility. Agnico may increase the testing frequency of the waste oil if any exceedance to GN Environmental Guideline for Used Oil and Waste Fuel (GN, 2012). (Section 3.2 above)

6.3 ASH TESTING

The purpose of sampling ash is to determine its acceptability for disposal in the landfill, pursuant to the GN Environmental Guidelines for Industrial Discharge (2011). No sampling frequency is specified in this guideline. To ensure compliance with the Guideline parameters, ash will be sampled twice a year by Agnico. Should an exceedance be measured, an investigation will be undertaken to identify the cause and eliminate the source for this exceedance. Agnico may increase the testing frequency of the ash following an exceedance. Ash with metals concentrations exceeding the GN Guidelines will be buried within the Tailings Storage Facility (TSF); materials buried within the TSF are expected to freeze over a period of time, resulting in permafrost encapsulation (Golder, 2014). If deemed necessary, the ash will be packaged in drums and sent to a licensed hazardous waste disposal facility in the south.

SECTION 7. MAINTENANCE

Maintenance of the incinerator is scheduled annually. This maintenance is performed to evaluate the insulation and structural integrality of the incinerator. This is done to ensure the incinerator is functioning at its optimal standard.

When maintenance is performed, 4 small single chambered incinerators are used to incinerate the waste that would normally be disposed in the Eco Waste main unit, to prevent a back log of putrescible waste which would attract wildlife.

SECTION 8. REPORTING

In order to demonstrate compliance with performance limits, an annual incineration management report will be submitted as an Appendix in the Meadowbank Gold Projects Annual Report to the NWB, Government of Nunavut (GN), Environment and Climate Change Canada (ECCC), and NIRB. The quantity and type of materials incinerated on site during operations, together with results from stack emission testing, waste oil testing and ash monitoring, are to be included within the annual report.

8.1 NATIONAL POLLUTANT RELEASE INVENTORY

The National Pollutant Release Inventory (NPRI) is a Canadian database containing information on the annual on-site release of specific substances to the air, water and land from industrial and institutional sources (EC, 2007). The NPRI provides a list of tracked substances and requirements for reporting incinerator emissions. Table 8-1 lists the substances under the NPRI that Meadowbank is required to report annually. In addition, there are certain substances as indicated in Table 8-1 that may require reporting depending on the quantity of incinerator emissions. Whether or not reporting is necessary will depend on results of the periodic stack emission testing data and the quantity of annual emissions calculated with emission factors.

Table 8-1: NPRI Incineration Reportable Substance List

Substance Name	Notes
Hexachlorobenzene	Required to Report
Dioxins and Furans	
Carbon Monoxide	Required to Report if released to air from facility in a quantity of 20 tonnes or more per annum
Oxides of nitrogen	
Sulphur dioxide	
Total Particulate matter with diameter <100 microns	
Particulate matter with diameter less than or equal to 10 microns (PM10)	Required to Report if released to air from facility in a quantity of 0.5 tonnes or more per annum
Particulate matter with diameter less than or equal to 2.5 microns (PM2.5)	Required to Report if released to air from facility in a quantity of 0.3 tonnes or more per annum

8.2 GREENHOUSE GAS EMISSIONS

Agnico is committed to reporting greenhouse gas emissions (GHG) in support of Canada's Voluntary

Challenge Registry; currently termed the Canadian GHG Challenge Registry. Agnico has developed a baseline and monitoring system for GHG to evaluate and report on progress in improving efficiency and reductions in GHG.

SECTION 9. PLAN REVIEW AND CONTINUAL IMPROVEMENT

This Incinerator Waste Management Plan will be maintained by Agnico to reflect the current operations at the Meadowbank Gold Project, permit requirements and regulatory setting. The Plan will be reviewed on a regular basis and revised when necessary to ensure that the project staff, operators and regulatory bodies are kept aware of any changes to operational procedures.

The latest Incinerator Waste Management Plan will be made available at all times by Agnico for review by the NWB, Government of Nunavut, and Environment Canada.

SECTION 10. REFERENCES

CEPA, 1999. Canadian Environmental Protection Act. March 31, 1999

Canadian Council of Ministers of the Environment (CCME), 2000a. Canada-Wide Standards for Dioxins and Furans, May, 2000

Canadian Council of Ministers of the Environment (CCME), 2000b. Canada-Wide Standards for Mercury Emissions, June 2000

Canadian Council of Ministers of the Environment (CCME), 2001, Canada-Wide Standard for Waste Incineration – Stack Testing Requirements.

Government of Nunavut, 2011. Environmental Guideline for Industrial Waste Discharges. April 2011.

Government of Nunavut, 2012. Environmental Guideline for Used Oil and Waste Fuel. June 2012.

Environment Canada (EC), 2007. National Pollutant Release Inventory (NPRI). http://www.ec.gc.ca/pdb/npri/npri_home_e.cfm

Golder (Golder Associates Ltd.), 2007. Final Report On Landfill Design and Management Plan, Meadowbank Gold Project Nunavut, *Project 06-1413-089/9000, Doc. No. 458, Rev. 0,* submitted to Meadowbank Mining Corporation, dated August 27, 2007.

Golder (Golder Associates Ltd.), 2014. Interim Closure and Reclamation Plan, Meadowbank Gold Project, *Project 13-1151-0131.* Submitted to Meadowbank Division on January 7 2014.

Letter from Nunavut Impact Review Board to Cumberland Resources Ltd, dated December 30, 2006
Re: Meadowbank Gold Mine Project Certificate; Nunavut Land Claims Agreement Article 12.5.12.

National Guidelines for Hazardous Waste Incineration Facilities - Design and Operating Criteria, Volume 1, March 1992, (CCME).

APPENDIX I

TECHNICAL SPECIFICATIONS:
ECO WASTE SOLUTIONS INCINERATOR MODEL NO. ECO 1.75TN 1P MS 60L

TECHNICAL DATA SHEET

Technical Data

Supply all technical data for each item applicable, in the format shown on the following pages. Include drawings necessary for a technical evaluation of each item.

Equipment Number	TBD
Equipment Description	Camp Waste Incinerator
Manufacturer	Eco Waste Solutions
Model Number	ECO 1.75TN 1P MS 60L
Total Installed Weight, kg	44,500 kg (estimated with building)
1 Waste Incinerator	
Waste classification: (TYPES)	1. Camp Waste
	2. Sewage Sludge
	3. Waste Oil
Mixed waste charge classification: Break-down of each type of waste (%)	1. Camp Waste - 75%
	2. Sewage Sludge - 25%
	3. Waste Oil - N/A charged into secondary
****Emissions:**	
SO_2 (mg/m^3)	50 mg/m^3
CO (mg/m^3)	7 mg/m^3
NOx (ppm)	$<$ 50 ppm
VOCs μg/m^3	50 - 2000 μg/m^3
Particulate (mg/m^3)	20 mg/m^3
PM_{10} (g/s)	N/A
Dioxins/Furan (pg I-TEQ/m^3)	$<$ 80
Mercury (μg/Rm^3)	N/A - Materials cotaining Mercury to be excluded from incinerator waste stream
Flue Gas Temperature (°C)	1000°C
Flue Gas Flow Rate (kg/s)	1.996 kg/s (max)
Incineration capacity: (kg/h)	175 kg/h (10 hour burn)
Charge per cycle: (kg)	1750kg
Burning rate: (kg/h)	175 kg/hr average
Off-time per cycle: (h)	6 hr cool down
Heat value: (kJ/kg or BTU/lb)	5125 BTU/lbs (Solid and Sewage sludge mixed waste)

**The emission estimates provided are given as volumetric concentrations or pollutants; as per test reporting standards. Estimates are based on previous air emission tests.

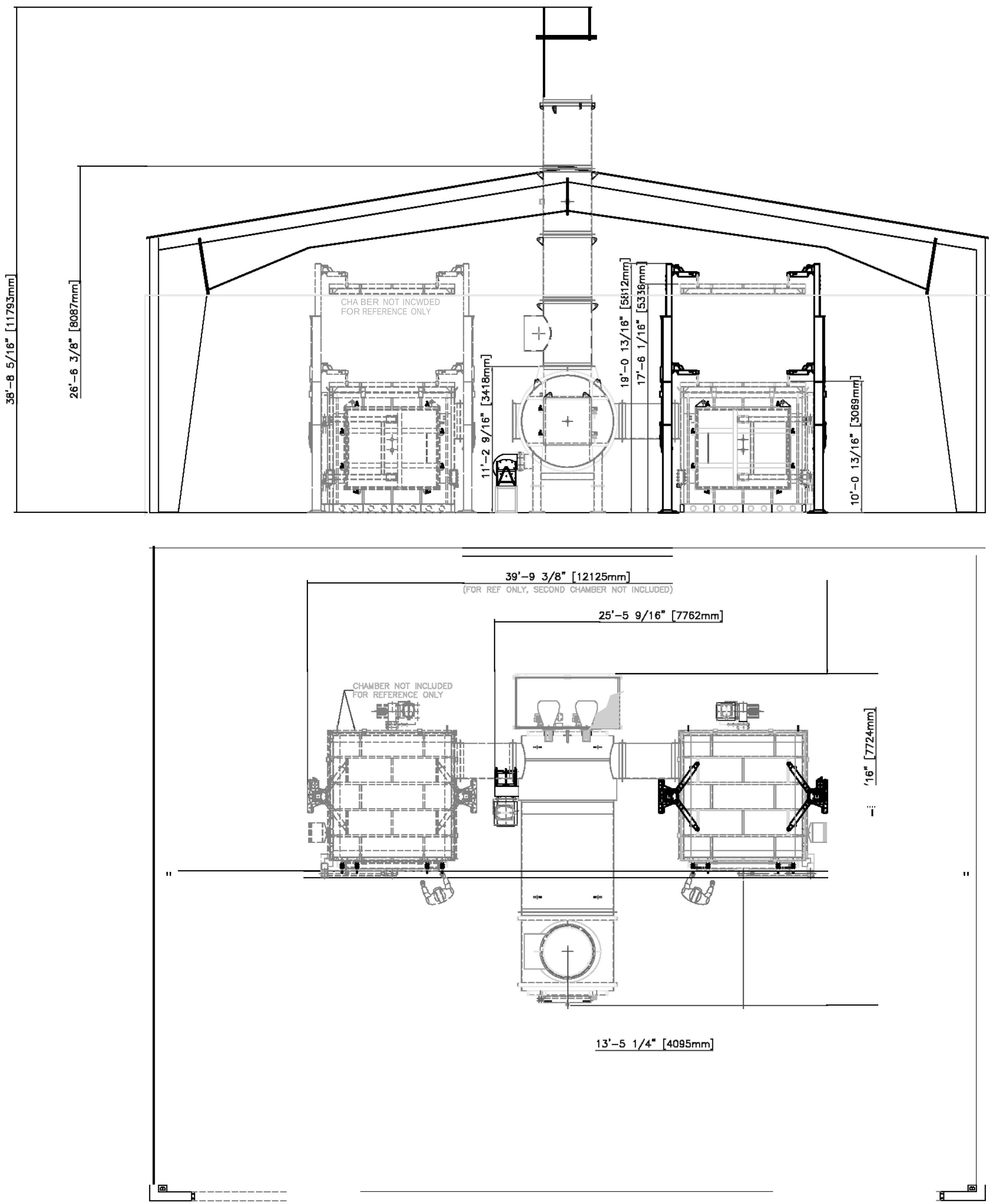
	Fuel mixing ratio with waste oil (if applicable)	N/A
	Capability to burn waste oil with loading rate (kg/h)	60.6 kg/h (8 hour liquid burn)
	Applicable auxiliary burner.	N/A
	Incinerator to bear CSA label?	All electrical components CSA or UL approved. Approval of complete incinerator package at additional cost..
	Temperature: Primary chamber (°C):	705°C
	Temperature: Secondary chamber (°C):	1000°C
	Burner Efficiency:	High
	Internal Volume of Primary Chamber:	2.43(l) x 2.43(w) x 2.29(h) m
	Internal Volume of Secondary Chamber:	1.83 (dia) x 5.49(l) m
	Destruction efficiency	95% DRE
	Tested Emission results (rates)	- See Section 1 (Emissions)
	Stack internal diameter (mm)	965mm
	Height of Stack (m)	7.62m
	Stack materials of construction	Refractory Lined - Mild Steel (44W HSLA)
	Spark Arrester length (mm)	1092mm
	Spark Arrester open area (m^2)	0.425m^2
	Burner System	Primary Burner - Riello RL28/2
		Secondary Burner - Qty(2) Riello RL100/M
		Liquid Waste Burner - Eco Waste Solution Liquid Waste Oxidizer
	Valve Train	N/A - Integrated in Burners
	Charging System	N/A - Batch System
	Charging opening size	1.78m (w) x 1.43m(h)
	Charging Chute size	N/A - no chute
	Ash Removal System	N/A - Manual
	Expected ash production per cycle (kg)	200kg (estimated)
	Maximum Capacity of ash removal system	N/A
2.	**Materials of Construction**	
	External Casing	Mild Steel (44W HSLA)
	Spark Arrester	Stainless Steel (SS 304)
	Insulation in Primary Chamber	Walls - Ceramic Fibre Blocks (152mm (6") Thick)
		Floor, Door Sills & Breech entrance - Castble (101 - 152mm (4-6") Thick)
	Insulation in Secondary Chamber	Walls - Ceramic Fibre Blocks (152mm (6") Thick)
		Breech exit & Stack Entrance - Castable - (76 -152mm (3-6") Thick)
	Insulation in Stack (materials and thickness)	Insulating Castable (76mm (3") Thick)
	Charging Chute	N/A
	Paint System Used	Carboline - Silicon Zinc Primer, Silicon Finish
	Dry Film Thickness of Paint	Primer - 2 mils (50 micron)
		Final Coat - 2 mils (50 micron)
	Primary Chamber Burner Rating	$(663 - 1266) \times 10^3$ KJ/hr
	Secondary Chamber Burner Rating	$(1582 - 6119) \times 10^3$ KJ/hr
3.	**BLOWERS**	
	Blower Manufacturer	New York Blower
	Primary Chamber Blower Capacity (m^3/hr)	2696
	Primary Blower Pressure (kPag)	0.25
	HP/ RPM	1.15 hp @ 2200rpm
	Secondary Chamber Blow Capacity (m^3/hr)	4247
	Secondary Blower Pressure (kPag)	0.5
	HP/ RPM	1.9hp @ 4900 RPM
4.	**CONTROL SYSTEM**	
	Please list all instrumentation and details including CSA approval and labelling:	- Please See Appendix A (Attached)

5. INCINERATOR BUILDING (if applicable)	
Overall Length (mm)	12 192mm
Overall Width (mm)	12 192mm
Overall Height (mm)	6420 mm
Shipping Dimensions (mm)	6660 x 3050 x 914 mm
6. DIMENSIONS	
Overall Length (mm)	6 858 mm
Overall Width (mm)	7 188 mm
Overall Height (mm)	11 049 mm
Shipping Dimensions (mm)	**Largest Pieces (L x W x H) mm**
	Primary Chamber - 3403 x 3225 x 2895
	Secondary Chamber - 6172 x 2413 x 2794
	Shipping Container - 12 000 x 2438 x 2591
7. WEIGHTS (KG)	
Incinerator	20 275 kg
Stack	4082 kg
Blowers & Burners	400 kg (Blowers) 580 kg (Burners)
Total Weight	25 337kg

FOR: REVIEW ONLY.

BILL OF MATERIAL

IIM.	QIY.	DESCRII'TION	WEIGHT kg.



REV.	DESCRII'TION	APPROVED

THIS DOCU ENT IS THE PROPERTY OF ECO BURN INC. AIID SHALL NOT BE USED, COPIED DR TRANSFERRED TO OTHER DOCUMENTS WITHOUT PRIOR WRITIEN PERMISSIOII OF ECO W>.S1E SOLUTIONS.

DRAWN: J.S.	DAIE: 19-08-0B	BCO WASTE !, !: TIONS
CHECKED:	DAIE:	

PROJECT NAI.IE: HATCH – MEADOWBANK	CUSTOLIER P.O.
PROJECT NUMBER: MDB-S-268	CUSTOMER EQUIPMENT.

SCALE: JOB NO.: OB-2MS	TITLE: BUILDING DRAWING HATCH MEADOWBANK
THIRD ANILE	DWG. NO. MDB-EC01.75TN1PMS60L-XXX REV.

APPENDIX II

ANNUAL COMPLIANCE AND REPORTING TEMPLATE

Appendix 2
Annual Report for
Incinerated Waste Management

Contact Information			
Company Name:			
Contact Name:		**Position**	
Contact Email:			
Address			
City/Town:		**Province:**	
Postal Code:			
Telephone:		**Fax:**	

Incinerator Data and Information

Name of Emission Unit	

Type of Process	

Description of Process	

Description of Material Produced from incineration	

Manufacturer of Emission Unit	

Model No.	

Dates of Commencing:	**Date**
Construction	
Operation	
Modification	

Operating Information	**Hour/day**	**Days/week**	**Weeks/year**
Maximum Operating hours			
Average Operating hours			

Annual Throughput	Dec-Feb (%)	Mar-May (%)	Jun-Aug (%)	Sep-Nov (%)

Incinerator Charging Rate	Maximum (kg/day)	Average (kg/day)	Annual (tonnes/year

Appendix 2
Annual Report for
Incinerated Waste Management

Waste Description	Maximum Rates		Average Rates	
Type of Waste Material	kg/day	tonnes/year	kg/day	tonnes/hour

Fuel Usage Data	Maximum	Typical
Firing rate		

Fuel Type	

Sector Determination:	Check Applicable Box
Municipal Waste Incineration	
Sewage Sludge Incineration	

Stack Emissions Tests For Compliance (must be corrected for 11% oxygen)

	Date	Test 1	Test 2	Test 3	Average	**Compliance (check)**
Furans and Dioxins						
Mercury						

Provide Test method details:

Appendix 2
Used Oil Impurity Limits

Contact Information			
Company Name:			
Contact Name:		Position	
Contact Email:			
Address			
City/Town:		Province:	
Postal Code:			
Telephone:		Fax:	

Volume of Used Oil Generated:	

Volume of Used Oil incinerated/Cons	

Sample Analysis:

Flash Point:	

Impurity	Units	Maximum Level Allowed	Sample #			
Cadmium	ppm	2				
Chromium	ppm	10				
Lead	ppm	100				
Total Organic Halogens (as chlorine)	ppm	1000				
Polychlorinated biphenyls	ppm	2				
Ash content	%	-				

Volume of Products Produced from Used Oil Use:

Maintenance Performed on Incinerator:

Destination of Used Oil not Incinerated:

Appendix 2
Guidelines for Ash Testing
Environmental Guidelines for Industrial Waste Discharges

Parameter	Concentration maximum (mg/L)	Sample Number		
Ammonia Sulphide	100			
Benzidine	100			
Benzyl Chloride	100			
Enthalamine	100			
Ethylenediamine	100			
Maleic Anhydride	100			
Potassium Permanganate	100			
Quinoline	100			
Strychnine	100			
Tetrachloroethanes	100			
Arsenic	2.5			
barium	100			
Cadmium	0.5			
Carbon tetrachloride	0.5			
Chromium	0.5			
Cyanide (free)	20			
DDT	3			
Endrin	0.02			
Heptachlor + Heptachlor epoxide	0.3			
Lead	5			
Lindane	0.4			
Mercury	0.1			
Methoxychlor	10			
Methyl ethyl Ketone	200			
Metolachlor	5			
PCBs	50*			
Selenium	1			
Silver	5			
Tetrachloroethylene	3			
Toxaphene	0.5			
Trialomethanes	10			
2, 4, 5-TP (Silvex)	1			
Zinc	500			

* based on concentration by mass

APPENDIX II

MBK-SIT-0011 – INCINERATOR LOADING

Incinerator Loading

		PROCEDURE NUMBER:	**MBK-SIT-0011**
People concerned	• **Agnico-Eagle employees working on the AWPR**	**Prepared by**	Site Services
		Approved by	Roger Sauvé, Site Services General Foreman
Issuing date :	2011-11-30		

This procedure corresponds to the required minimum standard. Each and every one also has to comply with the rules and regulations of the Nunavut Government in terms of health and safety at work.

Objective:

To load the incinerator

Concerned departments:	Required equipment
Site services	• Proper Protective Equipment: mask, glasses, fire retardant coveralls, welding gloves, rechargeable mask, face shield

Impacts			
Health & Safety	Process/Quality	Costs	Environment

Incinerator Loading

Procedure	Risks/ Impacts
1. There are 2 BLUE ash bins, one of which has an ORANGE spray on it. There is a sign on the yard which indicates a cold and hot side. The one with the cold side could be dumped into the roll off. 24 hours after ash deposition	Prevent incident and /or accident
2. After the dumping of the ash bin, inspect the roll off bin to ensure there is no red hot ash that will start a fire	
3. If there is smoke or red ash seen, ask the team leader to arrange for the small water truck located in the incinerator to give it a good spray of water to avoid a fire	
4. Bring empty ash bin into the incinerator building for the new batch	
5. Go outside of the incinerator and move the ash bin from the hot side to the cold side	
6. Close the breaker switch to the OFF position for the primary chamber and lock it using Ensure a "Zero State of Energy" and follow lock-out- Tag out Standard MBK- HSS-0010	
7. Turn on the primary chamber exhaust vacuum system	
8. Open the door and make sure the burn is good; If not: call the supervisor or team leader	
9. Tie the door in the open position for safety	

10. Empty the chamber and remove all ashes using large shovels into the ash bin	
11. When taking out the fresh ash bin, make sure to put on the hot side of the sign	
12. Once the chamber is completely cleaned, load the bottom row with medium wet bags	
13. Put two layers of contaminated cardboards and contaminated rags	
14. Put one row of dry garbage bags	
15. Put two more layers of cardboard and rags	
16. Put one row of dry to wet bags	
17. Continue the same way and finish with the wet bags on top and no cardboards (this will help keep the flames from coming up and also prolong the life of the chamber since the flames are not in direct contact with the top wall of the chamber, it will also cut down on having to reset the burner which is caused by the flame being high at the top)	
18. Close the door and make sure all the locking latches are in proper position	

19. Turn off the primary chamber exhaust vacuum system	
20. Unlock the primary chamber breaker and turn it to the ON position	
21. Start the burning cycle - Never open the door after the start - If the burner does not start, call team leader or supervisor	
22. Do not store any flammable products around the primary and secondary chambers within the marked area - Never add any accelerant into the chamber to help the start	

MEADOWBANK GOLD PROJECT

Landfarm Design and Management Plan

In Accordance with Water License 2AM-MEA1525

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

Version 4
March, 2017

EXECUTIVE SUMMARY

General Information

The Landfarm Design and Management Plan (LDMP) describe the design features and operational procedures for the landfarm constructed at the Meadowbank Gold Project site for the storage and treatment of petroleum hydrocarbon contaminated soil.

Annual Review

The LDMP will be reviewed and updated if necessary. Completion of the review of the LDMP will be documented through signatures of the personnel responsible for reviewing, updating and approving the LDMP.

Record of Changes

A record will document all significant changes that have been incorporated in the LDMP subsequent to the latest review. The record will include the names of the persons who made and approved the change, as well as the date of the approval.

Distribution List

Agnico Eagle Mines Limited will maintain a distribution list for the LDMP providing information about all parties that receive the plan including mine personnel, departments, and outside agencies.

IMPLEMENTATION SCHEDULE

As required by Water License 2AM-MEA1525, Part B, Item 11, the proposed implementation schedule for this Plan is effective immediately (February 2017) subject to any modifications proposed by the NWB as a result of the review and approval process.

DISTRIBUTION LIST

Agnico Eagle – Environmental Superintendent
Agnico Eagle – Environmental Senior Coordinator
Agnico Eagle – General Mine Manager
Agnico Eagle – Energy and Infrastructure Superintendent
Agnico Eagle – Field Services Supervisor
Agnico Eagle – Engineering Superintendent

DOCUMENT CONTROL

Version	Date	Section	Page	Revision
1	08/10/08	2		Remediation guidelines used and the parameters measured
		7		Details on storage and treatment options for metals, solvents, glycol and heavy oils; Measures to prevent damage to the liner during mechanical operation
		4		Contingency plans for exceedances in the amounts of contaminated soil and/or snow/ice
		5		Details describing the design components/specifications of the spillway
		8		Contingency planning and monitoring of sump volumes during the snowmelt period
2	12/10/22	All	All	Comprehensive revision to original plan
3	13/02/28	All	All	Further detail and rationale provided
4	17/02/20	All	All	Comprehensive review. Add detail regarding the Landfarm #2

Prepared By: Meadowbank Environment Department

Approved By: Jamie Quesnel
Environmental Superintendent

TABLE OF CONTENTS

1 Introduction 6
1.1 Background 6
1.2 Objectives 6
2 Spill Prevention 7
2.1 Spill Management Documentation 7
2.2 Spill Severity 7
3 Landfarm Design 8
3.1 Background 8
3.2 Location 8
3.2.1 Proximity of Surface Water 12
3.2.2 Proximity of Groundwater 12
3.3 Design 12
3.3.1 Soil Volume Requirements Landfarm 2 12
3.3.2 Design Specifications 12
4 Landfarm Operation and Maintenance 14
4.1 Management Responsibility 14
4.2 Acceptable Materials 14
4.2.1 Contaminants 14
4.2.2 Grain Size 15
4.3 Contaminated Soil Additions 15
4.3.1 Spill Excavation 15
4.3.2 Placement in the Landfarm 15
4.4 Contaminated Snow 15
4.5 Remediation 15
4.5.1 Absorbent Materials 16
4.5.2 Aeration 16
4.5.3 Soil Moisture 16
4.5.4 Nutrient Amendment 16
4.6 Removal of Soil from the Landfarm 17
4.6.1 Remediation Guidelines 17
4.6.2 Sampling and Analysis 18
4.6.3 Soil Removal 18

4.7 Water and Snow Management 19
4.7.1 Snow Management 19
4.7.2 Water Management 19
4.8 Landfarm Abandonment 19
4.9 Summary of Activities 20
5 Contingency Options 22
5.1 Large Spill Event 22
5.2 Alternate Treatment Options 22
5.2.1 Soil Amendment 22
5.2.2 Tier 2 – Modified Criteria Approach 22
5.2.3 Thermal Desorption 23
5.2.4 Direct Placement in the TSF or PRSF 23
6 Plan Review and Continual Improvement 24

LIST OF TABLES

Table 1 - Summary of relevant Government of Nunavut Tier 1 soil remediation criteria for surface soil for industrial land uses. 18
Table 2 - Summary of landfarm activities and records to be kept. 21

LIST OF FIGURES

Figure 1. General location of Landfarm 1 and Landfarm 2. 9
Figure 2. Landfarm 1 as-built design 10
Figure 3. Landfarm 2 as-built design 11

1 INTRODUCTION

1.1 Background

In 2008 the Landfarm Design and Management Plan was developed by Agnico Eagle in accordance with Water License 2AM- MEA0815 to describe the handling and remediation of petroleum hydrocarbon (PHC)-contaminated soil at the Meadowbank site. During construction and initial operations (2008-2011, prior to construction of the landfarm facility), soil potentially contaminated with PHCs, as a result of spills was deposited in two quarries (Q5 and Q22) along the All Weather Access Road (AWAR). The majority of this soil was from a transport tanker spill in 2010 and from the contractor camp used for roadway construction in 2007 and 2008. In 2012 the transport of this soil back to the minesite for treatment/storage at the onsite landfarm began. Subsequent landfarm design and management plan modifications (Version 2 and 3) focused on minimizing the waste footprint onsite, and maximizing remediation potential through implementation of a pilot bioremediation project, as well as spill prevention and contingency planning. The current version (Version 4) has been updated to describe construction of an extension to the original landfarm, and construction of a new landfarm facility in 2016.

1.2 Objectives

Onsite storage and remediation has been established as the preferred method for treatment of petroleum hydrocarbon-contaminated soil that may be generated on the Meadowbank site, Exploration Camp and Amaruq Road. Specifically, remediation through landfarming has been identified as the primary treatment option and, as such, is the focus of this contaminated soil management plan. A pilot project to enhance rates of bioremediation through addition of a nutrient source is also described. Alternate contingency options in the event that landfarming is not successful or as efficient as planned are also discussed.

This plan is a component of the Meadowbank Environmental Management System. The objectives of this plan are:

- To provide an overview of contaminated soil management at Meadowbank
- To describe the physical setting, location and design criteria of the landfarm
- To define acceptable types of contaminated soils to be placed in the landfarm and conditions for removal of treated soil
- To define operating procedures and monitoring requirements for the landfarm, including the pilot bioremediation project
- To describe contingency options for alternate treatment/storage of PHC contaminated soil

2 SPILL PREVENTION

2.1 Spill Management Documentation

Spill prevention is the first stage in contaminated soil management at the Meadowbank site. Three documents describe spill prevention, management and response at this facility: the Spill Contingency Plan, the Emergency Response Plan, and the Oil Pollution Emergency Plan. Specifically, Section 2.1 of the Spill Contingency Plan describes spill prevention measures and can be referred to for further detail. All are updated regularly. General spill prevention methods include:

- Regular inspections of fuel/chemical storage areas for leaks
- Training in safe handling procedures
- Keep containers sealed
- Use methods of secondary containment
- Keep over pack drums nearby to contain leaking drums
- Keep storage area secure from unauthorized access, and protected from weathering and damage
- Segregate incompatible materials
- Regular meetings with site departments

2.2 Spill Severity

In 2011, spills of landfarmable materials (fuel and hydraulic oil) at Meadowbank totaled 5,338 liters. In 2012, Meadowbank Division Environment Department increased delivery of spill prevention programing. This included more departmental information sessions to maintain awareness about spill prevention methods and reporting procedures. In 2012, spills of fuel and hydraulic oil have been reduced to 3,012 liters. In 2013, the Environment Department incorporated a site wide training session for every employee on site. In addition, the Emergency Response Team as well as Environment and Road Maintenance staff had extensive training in spill response by a consultant specializing in spill training (January, 2013). Training pertains to spill response on the tundra as well as surface water. In addition, Agnico has begun use of a new hydraulic fluid (Hydrex™ Extreme; Petro-Canada) that contains no heavy metals and is 40% biodegradable in 28 days. It is therefore estimated that any soil contaminated with the new fluid will be more rapidly remediated in the landfarm than soil contaminated with the previously used fluid. A significant increase of reported spills was noted in 2016 comparing to previous years. The overall changes are a result of different factors, focus on proper spill reporting, equipment wear and increased mining production. An action plan was initiated to address the increase and identify proper improvement channels.

3 LANDFARM DESIGN

3.1 Background

When spills do occur, onsite storage and remediation is the most practical and efficient method of handling contaminated soil, particularly in an isolated location like Meadowbank. For PHC contamination, bioremediation through landfarming has been identified as a viable remedial technique. This method involves spreading, mechanical mixing, and placing the contaminated soil in windrows within a containment area and promoting conditions favorable for the volatilization and aerobic microbial degradation of hydrocarbons. A number of environmental factors and physical properties of the soil affect microbial growth and rates of biodegradation, including temperature, soil moisture, nutrient content, salinity and soil particle size.

Previously, a landfarm options analysis prepared for Agnico by Golder (2007a) identified some of these factors, and presented the following information from the literature on landfarming in the north. Although rates of biodegradation decline with temperature, landfarming is still a feasible technique in arctic climates (Reimer et al. 2005). Microbial activity stops between 0 – -5°C (although volatilization continues at this temperature), so degradation in the north is typically restricted to the months of June – September. Nevertheless, degradation was reported at 70% after one year in a study in Alert, NU (Greer et al. 2007), and 90% over two summers on Resolution Island (Paudyn et al. 2005).

3.2 Location

The overall site plan for the Meadowbank Gold Project and the location of the landfarm facilities are shown in Figure 1. This central location was chosen to minimize the waste footprint on site and the transport distance of contaminated material from spill locations. All of the waste generated at Meadowbank in the form of tailings, wasterock and the site landfill is in close proximity. The location of the original landfarm facility (Landfarm 1) is directly north of the South Cell Tailings Facility. In 2016, Landfarm 1 was extended due to operational work required at the buttress of the Stormwater Dike. The Landfarm 1 extension as-built drawing is presented in Figure 2.

In 2016, a second landfarm facility (Landfarm 2) was constructed in the same general location within the South Cell Tailings impoundment, since the Landfarm 1 facility is planned to be flooded by reclaim water in mid-2017. Landfarm 2 is located on the north east side of the South Tailing Cell, north of the Central Dike. Specifications of the Landfarm 2 design are presented in the as-built drawing, Figure 3. As with the original landfarm, the Landfarm 2 facility is designed with one soil remediation/storage cell.

Landfarm 1 may continue to be used until mid-2017. At that point, any un-remediated soil will be moved to Landfarm 2 as necessary.

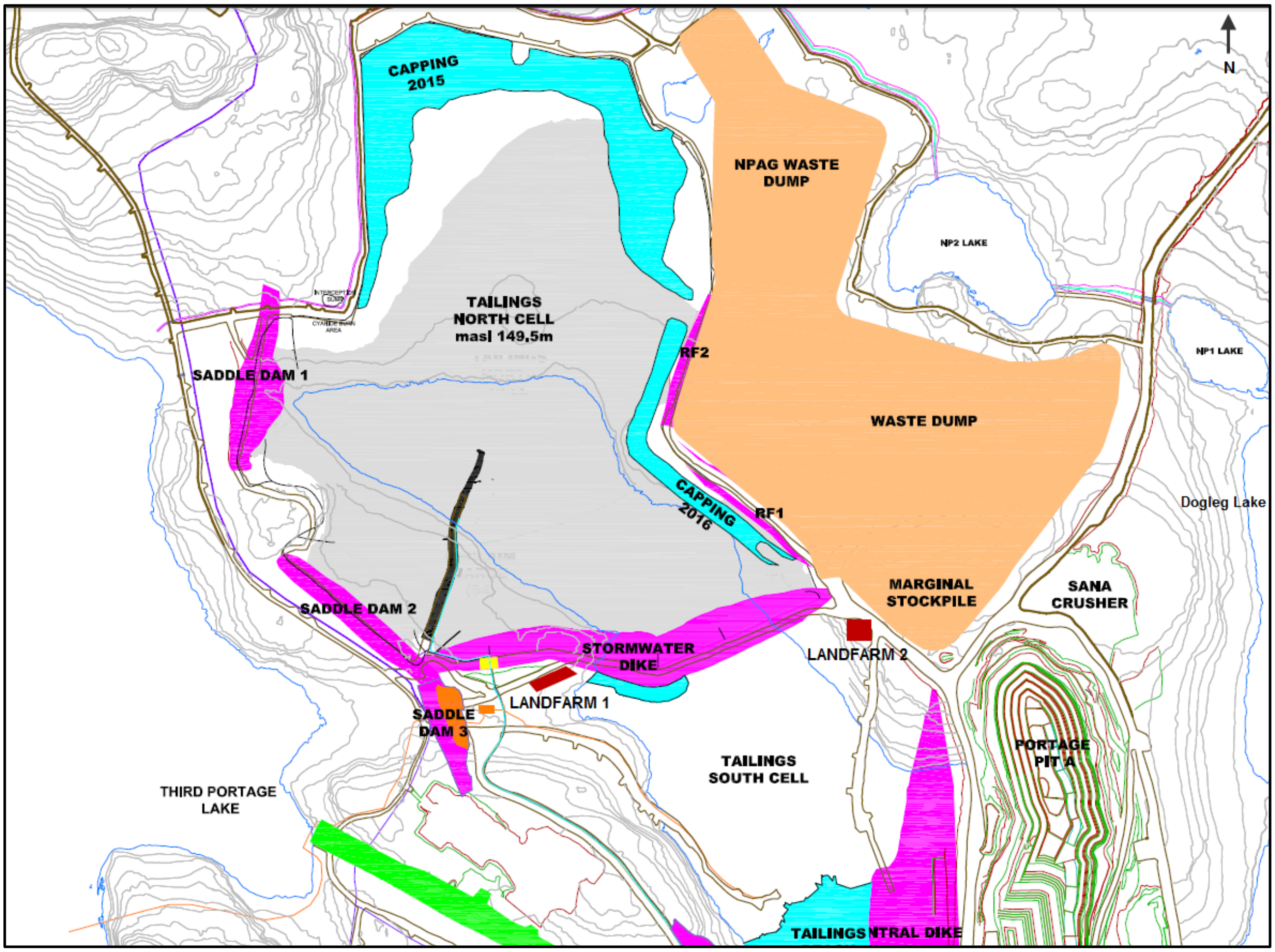


Figure 1. General location of Landfarm 1 and Landfarm 2.

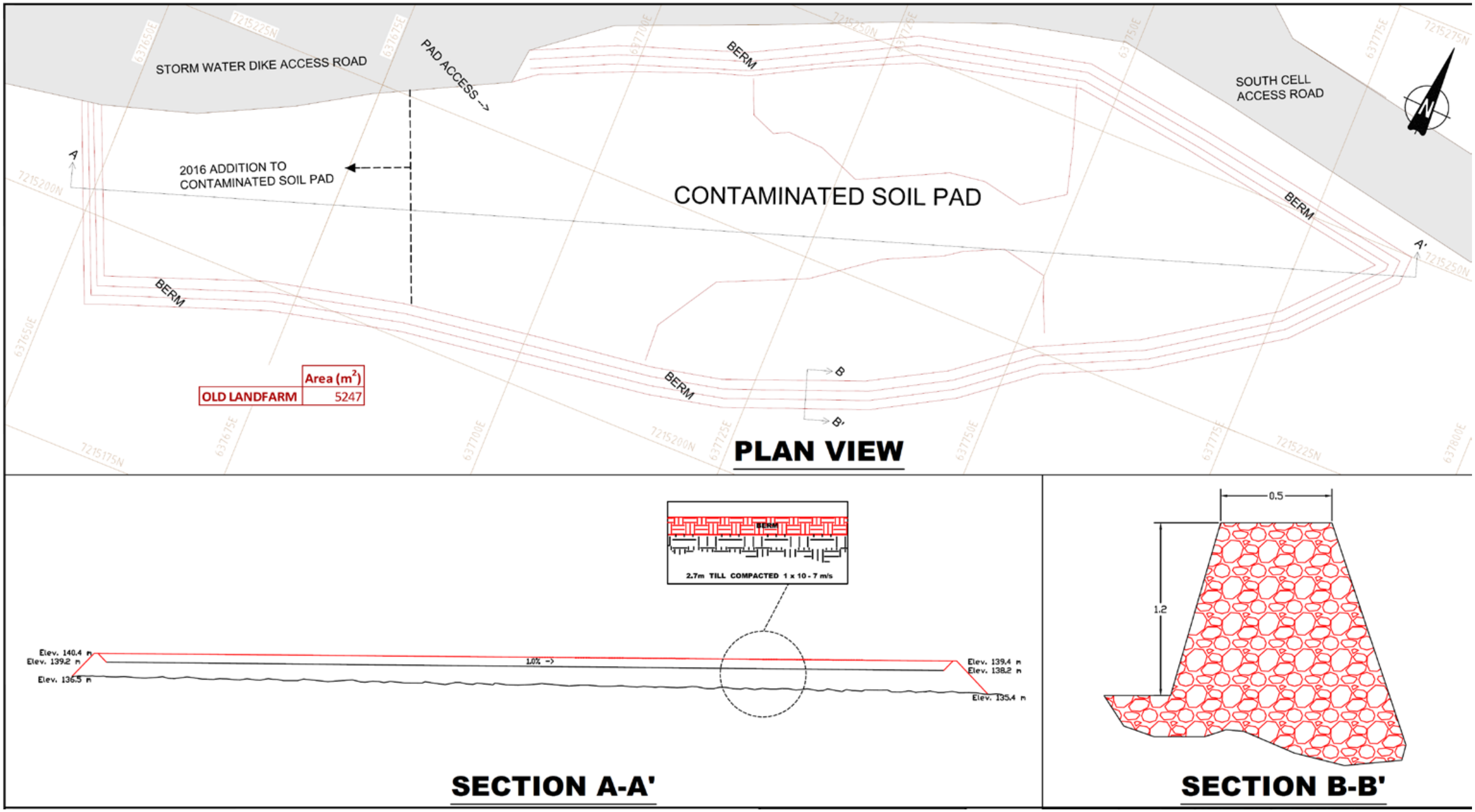


Figure 2. Landfarm 1 as-built design

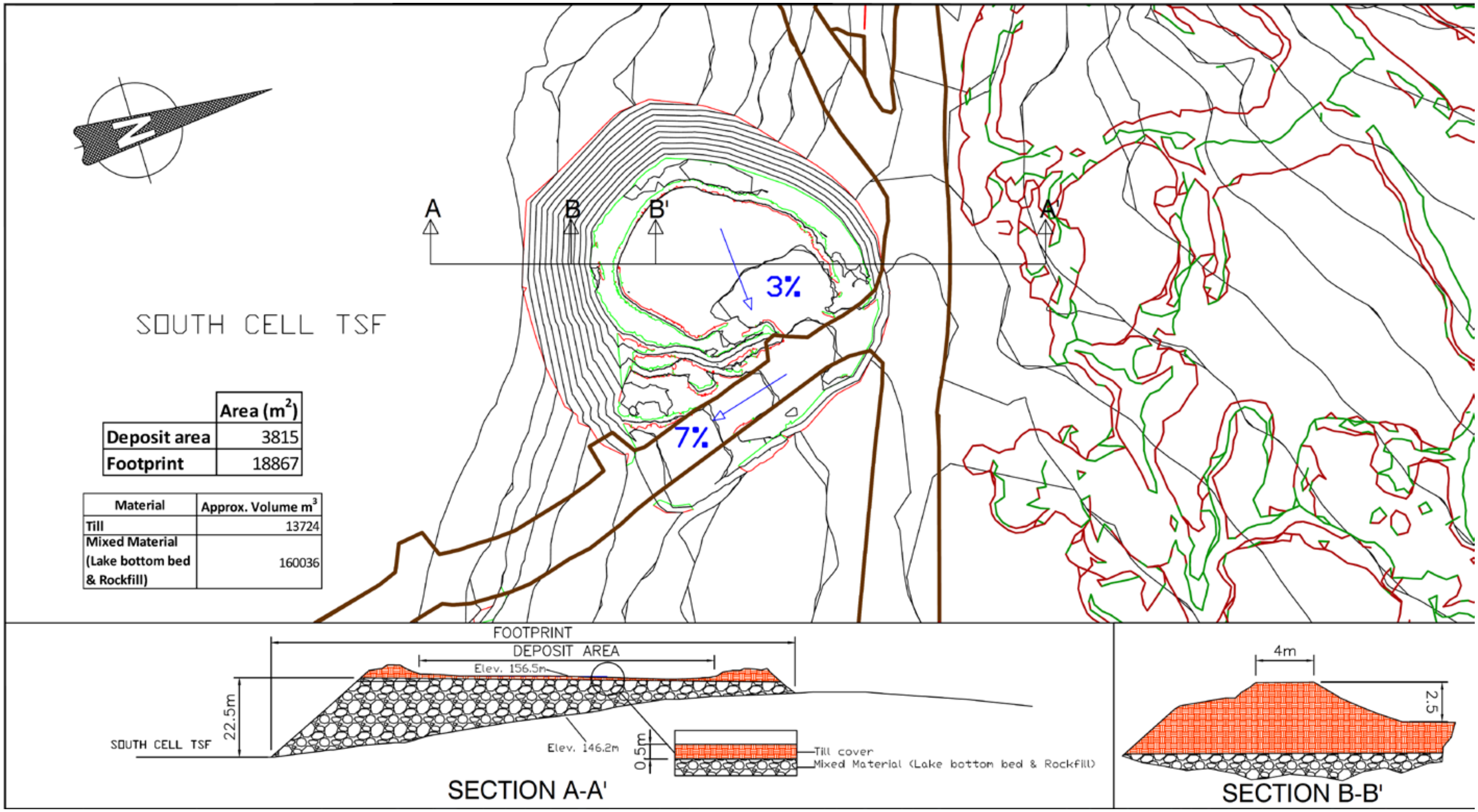


Figure 3. Landfarm 2 as-built design

3.2.1 Proximity of Surface Water

Landfarm 1 is located 300 m from the nearest water body, Third Portage Lake (TPL) and immediately adjacent to the North Cell Tailings Storage Facility (TSF). Surface drainage in this area is easterly, towards the TSF and away from TPL.

Landfarm 2 is 900 m west of the nearest water body (Dogleg Lake). Surface drainage in the area of Landfarm 2 is westerly, towards the South Tailings Cell and away from surface watercourses.

3.2.2 Proximity of Groundwater

In the Meadowbank area, the shallow groundwater is estimated to be 1.5 m below surface (active layer July – October), at the average depth of thaw. In order to prevent movement of contaminants from the landfarm facility into groundwater, Environment Canada (SAIC, 2006) recommends implementation of a barrier with 10^{-7} m/s hydraulic conductivity at a thickness of 0.6 m. The Meadowbank Landfarm 1 facility pad is constructed of 2.7 m of compacted till with a hydraulic conductivity of 10^{-7} m/s. The Landfarm 2 cell is constructed with a 0.5 m thick layer of compacted till base with hydraulic conductivity estimated of 10^{-7} m/s, over a constructed pad which varies between 6 m and 22.5 m in thickness. Therefore, no impacts to groundwater are anticipated.

3.3 Design

The landfarm facilities are designed with one soil remediation/storage cell. The design volumes of the cells are based on allowances for the materials to be treated. This calculation is described in the following section.

3.3.1 Soil Volume Requirements Landfarm 2

In September 2016, Landfarm 1 held a total of 1,258 m^3 of contaminated soil, based on survey results. Currently production will continue through 2018 for an expected additional required landfarm capacity of 692 m^3 (2 years x 346 m^3/year; average yearly amount of contaminated soil, from LDMP (Agnico, 2013)). With an additional 30% for contingency, and conservatively assuming that no soil will be remediated in Landfarm 1 in 2017 and before closure, the total estimated required capacity for landfarm 2 is 2,535 m^3.

3.3.2 Design Specifications

Specifications of the landfarm designs are shown in Figure 2 and 3. Landfarm 1 is constructed with a 1.5 m high berm and a 2.7 m deep compacted till base with hydraulic conductivity of 1×10^{-7} m/s. The slope of the base is 1.5%.

Landfarm 2 is constructed with a 2.5 m high berm and a 0.5 m thick compacted till base with hydraulic conductivity estimated of 10^{-7} m/s. The slope of the base is 3% towards the east side, and 7% towards the South Tailings Cell. The pad under the till layer on top of the tundra varies from 6 – 22.5 m thick.

For Landfarm 1, the useful landfarm area is 5,247 m^2, with the extension. The area of Landfarm 2 is 3,815 m^2. Based on landfarm specifications of other northern mines (Ekati Diamond Mine – in Golder, 2007a), contaminated material can be stockpiled up to 4 m high. Accounting for a 25% loss of area due to sloping at that windrow height, the landfarm area will allow for the storage of a maximum of 11,445 m^3. This will readily accommodate the estimated total of 2,535 m^3 of contaminated soil, should all of it need to be stored until closure. In addition, ample room will be available to accommodate a designated area for spreading of contaminated coarse-grained material that cannot be bioremediated (see Section 4.2.2).

Based on the available area, maximum windrow size will be 15 m wide at base x 4 m high x 50 m long, but smaller piles will be used as space allows maximizing rates of biodegradation and volatilization.

4 LANDFARM OPERATION AND MAINTENANCE

The following presents the operational procedures that apply to each landfarm facility.

4.1 Management Responsibility

Agnico Eagle will be responsible for managing and implementing the operation plan. Operation and monitoring of the facility will come under the responsibility of the Environment Superintendent. Designation of training requirements is the responsibility of Meadowbank Environment Department.

4.2 Acceptable Materials

4.2.1 Contaminants

The landfarm facility will only treat and/or store petroleum hydrocarbon contaminated soils that have been generated through mine-related activities at the Meadowbank Gold, Project Meadowbank exploration camp and the Amaruq Road. Material from other sites will not be accepted without approval from the Nunavut Water Board, AANDC Water Resources Officers and the Kivalliq Inuit Association.

The following products may be treated in the landfarm if used onsite and spilled on soil:

- Diesel fuel
- Gasoline
- Aviation fuel (Jet A)
- Hydraulic oil
- Other light oil e.g. engine oil, lubricating oil

In the event that the contaminant source is unknown, soil samples will be analyzed for petroleum hydrocarbons and possibly additional contaminants prior to placement in the landfarm. These additional parameters could include total metals, oil and grease, and volatile organic compounds. Analysis for additional compounds will be determined by the Environment Department on a case-by-case basis. Concentrations of contaminants will be compared to the site background values (for metals) and/or criteria in the GN Guidelines for Contaminated Site Remediation (March, 2009). If this analysis indicates soil contamination above background or GN guidelines with any substances not described in Section 4.2.1 (i.e. non-PHC contaminants), it will not be placed in the landfarm facility. This is to ensure PHC contaminated soil is not contaminated with other products.

Spills of > 100 L of non-PHC material (e.g. solvents, glycol) will be placed in drums and stored in the site Hazmat area for shipment south to approved facilities during barge season. Spills of non-PHC material < 100 L will be placed in the TSF.

4.2.2 Grain Size

While very coarse-grained larger soil material does not readily retain moisture and nutrients, inhibiting bioremediation, volatilization will occur more rapidly (SAIC, 2006). It has been noted that this material likely contains lower concentrations of contaminants due to a lower volume:surface area ratio, and can typically be screened out prior to landfarming (SAIC, 2006). A 2010 study at Meadowbank (Qikiqtaaluk Environmental, 2010) indicated increasing concentrations of PHC with decreasing grain size in one group of samples with soil fractions of 0.5, 0.5-1 and >1" (two other groups sampled were below detection at all grain sizes) (see Section 4.3.1).

4.3 Contaminated Soil Additions

4.3.1 Spill Excavation

Soil contaminated with the above-described petroleum hydrocarbon materials will be excavated from the source and transported to the landfarm facility in dump trucks or by roll- off containers. Care will be exercised to ensure that the entire spill is excavated (verified by visual assessment, by using a PID meter or sampling if necessary) and that none of the contaminated material is lost during transport.

4.3.2 Placement in the Landfarm

All material collected (coarse and fine) from spill locations will be deposited at the landfarm to be remediated.

A mechanical screener, used to separate coarse and fine material, will be operated to segregate material once in landfarm when conditions permit it.

4.4 Contaminated Snow

For spills < 100 L, PHC-contaminated snow will be placed in a designated area of the landfarm and treated as contact water after snowmelt.

For spills > 100 L, PHC-contaminated snow will be excavated and stored in labeled drums. After snow melt, the contaminated water will be pumped through the site's oil-water separator (carbon filter) to remove PHC residue. The treated water will be sampled per Part F, Item 7 of the Water License, and discharged to the Stormwater Management Pond if criteria are met. If criteria are not met, water will be treated as hazardous material and shipped south. Also, after snowmelt, visible product will be cleaned up with absorbent pads or booms.

4.5 Remediation

Remediation of fine-grained PHC-contaminated soil in landfarms occurs naturally through volatilization and aerobic microbial degradation. Soil aeration and nutrient amendment are recognized as methods of improving rates of remediation. To this end, remedial operations at the Meadowbank site include soil mixing (aeration) and a pilot project utilizing onsite nutrient additions. While it is recognized that pH, salinity, moisture content and microbial population density also contribute to rates of degradation, these factors will not be explicitly investigated or managed unless remediation rates are too slow to meet the site closure time period (see Section 5.2).

4.5.1 Absorbent Materials

Coarse-grained soils are not readily bio-remediated, but concentrations of PHC contaminants may still be reduced through volatilization. Oil absorbent pads will be used to help remove visible product from coarse-grained material. Used absorbent materials will be incinerated.

4.5.2 Aeration

In order to promote aerobic conditions throughout the windrows, soil will be mixed mechanically with earth-moving equipment. This turnover of soil piles will occur at least once per year, during the summer months. The presence of coarse material also helps creating gaps within the piles which will increase aeration and help degradation of PHC.

4.5.3 Soil Moisture

Prior to turning, site personnel will ensure that soil is not so dry as to generate significant dust, nor overly saturated. If soil is dry, water from within the landfarm containment area will be used as a moisture source and sprayed on the piles. If no accumulated water is available, a freshwater supply will be used. If the windrows are saturated, aeration will be conducted at a later date.

4.5.4 Nutrient Amendment

A number of studies have indicated that amendment with nutrients may increase rates of biodegradation in PHC contaminated soils, but the effectiveness of this practice is not well defined in northern climates. For example, in a Resolution Island study by Paudyn et al. (2008), aeration alone reduced concentrations of diesel fuel by 80% over three summers, almost entirely due to volatilization (not biodegradation). One-time amendment with nutrients (C:N:P of 100:7.5:0.5) in combination with aeration resulted in 90% reduction of TPH concentrations over this time, with significant (but undefined) contributions from microbial degradation.

In 2012, three pilot piles in the landfarm facility were treated with 400 gallons of sewage sludge as a nutrient source. Sewage sludge was mixed into the pilot piles on October 8th 2012. Each pile consisted of approximately 140 m^3 of soil. Samples of the nutrient-treated piles were taken in July 2013 (CSP-STP-1, 2, 3) in attempts to determine if this method of nutrient amendment significantly affects rates of PHC degradation

Representative composite samples of two non-treated piles (CSP-WDP-1, 2) were taken from two locations (0.5 m depth) in October 2012 and again in July 2013 to assess degradation of TPH over this time period without sewage sludge amendment. Samples were sent to an accredited analytical laboratory and analyzed for humidity, BTEX and F1-F4 hydrocarbons. Attempts to sample all piles again in the fall of 2013 were unsuccessful because of frozen ground.

Overall, rates of PHC degradation were found to be sufficiently rapid to warrant continued use of the landfarm as a viable treatment for spills of the designated materials. Nutrient treatment appeared to generally increase degradation rates, particularly for the F3 fraction. Use of the landfarm with application of sewage sludge as a nutrient treatment will be continued. Based on these results, the pilot project (comparison of treated and untreated piles) was completed and the addition of sewage sludge as a nutrient source to enhance bioremediation was implemented as an operational practice in 2014. Sewage sludge was incorporated into all contaminated soil since 2014.

The use of sewage sludge as a nutrient amendment has precedent in the north. This method has been used at Diavik Diamond Mine, as reported in the BSc thesis of Brenda Lee Bailey, Carleton University (in Golder, 2007). It was found in this study that with sewage sludge amendment (12.6 gallons on a 6 m^3 soil pile), aeration by perforated pipe and clear polyethylene covers to retain heat and moisture, TPH concentrations declined from 15,000 mg/kg to less than 2,000 mg/kg in 88 days. Sewage sludge as a nutrient source has also been proposed for the Milne Inlet Mary River Project (EBA, 2010). This material not only provides the benefit of nutrients, but adds organic matter to help retain moisture, and is a source of microorganisms. Furthermore, the re-use of this material produced onsite helps to reduce the waste footprint of the mine by re-directing this material from disposal facilities and avoiding the import of chemical fertilizer.

4.6 Removal of Soil from the Landfarm

When PHC vapors are no longer detected, coarse-grained material will be removed to the site waste rock disposal area and disposed of as potentially acid generating (PAG) material. PAG will be covered with a minimum of 2 m of non-potentially acid generating (NPAG) material to closure, such that freeze-back occurs and any potentially remaining contaminants are not mobile in the environment.

Prior to removal of the finer grained soil from the landfarm, soil samples will be analyzed to ensure they meet Government of Nunavut guidelines, as described below.

4.6.1 Remediation Guidelines

In assessing the remediation success of PHC contaminated soils being treated in the landfarm facility, Agnico Eagle will use the Government of Nunavut (GN) Department of Environment, Environmental Guidelines for Site Remediation (March, 2009) to determine if the soil has been suitably treated.

The following parameters will be measured and compared with the GN industrial remediation criteria in order to determine whether PHC contaminated soil has been adequately remediated:

- Benzene, toluene, ethylbenzene and xylene (BTEX)
- Petroleum hydrocarbon fractions 1 - 4

GN remediation criteria are characterized for agricultural/wildland, residential/parkland, commercial and industrial land uses. At the Meadowbank site, remediation to agricultural/wildland criteria is targeted. However, if these criteria cannot be met efficiently, industrial criteria will be followed and soil disposed of accordingly (see Section 4.6.3). Remediation criteria for coarse-grained (>75 um) soils will be applied. Table 1 presents the applicable Tier 1 criteria for coarse-grained soil, assuming agricultural/wildland or industrial land uses. For contaminated sites, a Tier 1 analysis involves the most conservative criteria, and may be applied when the proponent does not wish to establish site-specific criteria.

Table 1 - Summary of relevant Government of Nunavut Tier 1 soil remediation criteria for surface soil for industrial land uses.

Parameter	Criteria (mg/kg)
Benzene	0.03
Toluene	0.37
Ethylbenzene	0.082
Xylene	11
PHC Fraction 1	320
PHC Fraction 2	260
PHC Fraction 3	1700
PHC Fraction 4	3300

4.6.2 Sampling and Analysis

Landfarm windrows will be sampled annually to determine if remediation objectives have been met. Representative composite samples will be taken of each windrow to estimate remaining PHC concentrations. For each 10 m of windrow length, one composite sample will be collected, each consisting of three surface sub-samples and three sub-samples at 1 m depth. Sub-samples will be taken approximately 3.3 m apart, and will be taken from both sides of the windrow.

Degradation rates are assessed regularly to estimate the total remediation time required for PHC-contaminated soil under these conditions. If remediation to GN guidelines is feasible within the timeframe, landfarm operations will continue, with aeration and nutrient amendments as described above. If rates of TPH degradation are not sufficient through this method, alternate options will be further investigated (see Section 5).

4.6.3 Soil Removal

Coarse-grained material will be assessed after segregation from mechanical screening has been started, by Environment Department technicians for PHC product and odors. A PID monitor may be employed to assist in petroleum-hydrocarbon based vapor detection. When PHC vapors are no longer detected, this material will be removed to the Portage Rock Storage Facility (PRSF) and disposed of as PAG material.

When sample analysis of fine-grained material indicates that concentrations of contaminants are below Government of Nunavut guidelines, a soil pile or the appropriate section of a pile will be deemed acceptable for removal from the facility. Interim monitoring may be conducted through measurements of head-space with a portable instrument (e.g. flame ionization detector), but samples will be confirmed by an accredited laboratory prior to soil removal.

Soil remediated to agricultural/wildland criteria will be appropriately delineated by Environment Department staff, and stockpiled outside the landfarm for use in site works or reclamation activities.

Soil remediated to industrial-use criteria will be removed from the landfarm and placed in the (PRSF) as PAG material. This material will be capped with a minimum of 2 m of NPAG at closure, allowing freeze-back and permanent encapsulation to occur.

4.7 Water and Snow Management

Since the landfarm facility is uncovered to facilitate natural weathering, water accumulating inside the bermed area may come into contact with contaminated material. The management plan for handling this potentially contaminated water is described below.

4.7.1 Snow Management

Snow will be removed as much as possible during winter to minimize the quantity of spring melt water inside the berm. Care will be taken to ensure contaminated snow/soil is not disturbed by leaving a base layer of snow (no less than 10 cm) in place. After snowmelt any contaminated product left from winter spill clean-up operations will be padded up. The base soil in these areas will be excavated and added to existing remediation windrows as soon as possible after snow melt to minimize migration into the facility substrate.

4.7.2 Water Management

Monitoring will be conducted for seepage of contact water through the perimeter berm, or accumulation of water within the containment berm through visual inspection by the Environment Department. This will be conducted on a weekly basis, after freshet, from July through October when water is likely to be present. In the event of water accumulation or seepage, the ponded water will be analyzed for Group 4 monitoring parameters, as described in Table 2 – Monitoring programs of the Water License prior to discharge to the adjacent Tailings Storage Facility (monitoring stations ST-14 and ST-14b). Alternatively, ponded water will be sprayed on the windrows to increase moisture content, as required. Water accumulating in the landfarm will not be discharged to the environment as per Part F, Item 18 of the water license.

4.8 Landfarm Abandonment

After removal of all remediated soil and prior to abandonment/closure of the landfarm, the berm and base will be sampled on a 10 m grid, including at a depth of 1 m in representative locations, to determine if these soils are free from PHC contamination. Results of this analysis will be compared to GN criteria. Since this area will form part of the TSF at closure, no excavation is necessary if industrial criteria are not met. Agnico Eagle's Closure Plan notes that the tailings facilities will be capped with at least 2 m of NPAG to ensure freeze-back encapsulation. Monitoring of tailings freeze-back is ongoing at the site, and to date the results indicate that tailings are already freezing as planned.

4.9 Summary of Activities

A summary of landfarm activities including monitoring of the physical condition and potential environmental impacts of the landfarm facility is provided in Table 2. A report will be prepared annually, indicating the volume of material added to the facility, amount of material removed and disposal or reuse location, all analysis results, volume and type of nutrient addition, visual inspection results and volume of contact water pumped. This information will be appended to Agnico Eagle's Annual Report to the NWB.

Table 2 - Summary of landfarm activities and records to be kept.

Activity	Analysis	Frequency	Record
Excavation of spill and transport of contaminated material	If unsure of full excavation - F1-F4, BTEX	As needed	Date and time of excavation; estimated quantity of excavated soil; storage/disposal location of excavated soil, if applicable; any evidence of remaining product
Contaminated soil additions to landfarm	If contaminant source unknown, F1-F4, BTEX, metals, oil and grease, VOCs (at discretion of Environment Department)	Prior to soil addition at facility	Date and time; quantity of soil; original location; landfarm location; spill/excavation record # or storage container label
Soil aeration	N/A	Min. once during summer	Date and time; location; soil condition (moisture, odour, etc.)
Soil treatment with sewage sludge as nutrient supplement	Visual inspection to ensure proper incorporation	At least once during summer on selected windrows	Date and time; location in landfarm
Ponded contact water	BTEX, oil and grease, lead – as per Part F, Item 6 of Water License	Prior to any dewatering; if re-used in landfarm, no sampling necessary	Date and time, location, laboratory report, Annual Report
Sampling for progress of remediation	Hydrocarbon vapour in headspace (by PID); F1-F4, BTEX (laboratory)	Vapour – as needed; Laboratory - annually	Date and time; location; odour; laboratory report;
Soil removal from landfarm	Removal subject to meeting GN criteria	N/A	Date and time; location; quantity of soil removed; final location
Identification of maintenance requirements	Visual inspection of facility	Twice annually during summer	Inspected areas; condition of berm and base; previously unidentified safety concerns

5 CONTINGENCY OPTIONS

The following sections describe the contaminated soil management plan, should a large spill event occur, and if landfarm treatment is not successful.

5.1 Large Spill Event

Considering that the landfarm is built to hold nearly 5x as much contaminated soil as is expected to be produced, a large spill event producing a quantity of soil that cannot be contained in the landfarm is unlikely. Nevertheless, in this event, soils will be placed in a temporary storage area. A temporary stockpile area would be set up in the PRSF or at another location as approved by the NWB and AANDC. The soil would then be placed in the landfarm as soon as practical. Through extensive spill prevention measures discussed earlier in this Plan Agnico Eagle is minimizing the probability of this scenario occurring.

5.2 Alternate Treatment Options

Should landfarm treatment not perform as anticipated and it is evident that rates of degradation are not sufficient to meet GN Tier 1 criteria within the life-of-mine and the anticipated closure period (to 2025) the following alternative treatment options will be considered. Implementation will be after development of a more detailed protocol and approval of a revised plan by the NWB.

5.2.1 Soil Amendment

Since pH, salinity, moisture content and microbial population density all affect rates of biodegradation by microbes, these factors may be monitored and adjusted through soil amendments if they are not found to be optimal (see SAIC, 2006). In addition, the height of soil windrows could be reduced to maximize air exposure if space in the facility allows.

5.2.2 Tier 2 – Modified Criteria Approach

According to the Government of Nunavut Environmental Guideline for Contaminated Site Remediation (Appendix A), in cases where site conditions, land uses, receptors or exposure pathways are different from those assumed in the development of the Tier 1 criteria, modified criteria may be permitted. This process requires the collection of site-specific information on exposure and risk estimates, and is subject to GN approval. In the case of the Meadowbank site, landfarmed soils are to be encapsulated in the PRSF rather than used in surface applications, as assumed in Tier 1, reducing the likelihood of exposure to any remaining contamination. Therefore, the Tier 2 approach could be warranted if Tier 1 criteria cannot be met. Any consideration for this approach would be based on soil sampling results and science based information.

5.2.3 Thermal Desorption

In the thermal desorption process, excavated soils are heated in a chamber to rapidly volatilize PHCs. Gases produced are consumed in an oxidation unit, and particulate matter removed (baghouse). Soil, free of any contamination, can then be replaced, or used in site reclamation or construction processes. The other advantage of this approach is that this equipment is mobile and could be brought to any spill site for remediation activities (e.g. spills along the AWAR). This method is described by Environment Canada (2002). The purchase or rental of a portable thermal desorber unit is under consideration by Agnico Eagle as a contingency option.

5.2.4 Direct Placement in the TSF or PRSF

Another option for management of contaminated soil would be the direct placement of this material in the Tailings Storage Facility or Waste Rock Storage Facility, if bioremediation is not effective or for operational reasons. Although the consumption of space in these storage areas is not optimal, the quantity of PHC-contaminated soil created onsite is small in comparison to the quantity of tailings or waste rock. While this method would not result in the treatment of soil, it is a viable contingency option because it would allow for the safe disposal of the contaminated material. The final cover with NPAG will be a minimum of 2 m deep (current closure plan is 4 m of NPAG cover). Total encapsulation and freeze-back would occur, eliminating any movement of contaminants. Over time, this material would undergo natural degradation. Consideration of this option would also include a suitable monitoring program for PHCs, which would be incorporated into the Meadowbank Closure Plan.

6 PLAN REVIEW AND CONTINUAL IMPROVEMENT

The Landfarm Design and Management Plan will be reviewed regularly by the Meadowbank Environmental Superintendent, and updated, when needed.

REFERENCES

EBA. 2010. Hydrocarbon Impacted Soils Storage and Landfarm Facility Operations, Maintenance and Monitoring Plan, Milne Inlet, Mary River Project, Nunavut. Prepared for: Baffinland Iron Mines Corporation. Issued for Review. December 2010.

Environment Canada. 2002. Technical Assistance Bulletin 13: Soil Remediation: Low Temperature Thermal Desorption Available at: http://www.on.ec.gc.ca/pollution/ecnpd/tabs/tab13-e.html

Environment Canada. 2007. Part 4 screening for Land Farm, Hamlet of Pond Inlet – NIRB 07UN061. Technical advice. Available at: http://ftp.nirb.ca/01-SCREENINGS/COMPLETED%20SCREENINGS/2007/07UN061-GN-CGS%20-%20Pond%20Inlet%20Quarry/02-DISTRIBUTION/COMMENTS/070829-07UN061-EC%20Comment-IEAE.pdf

Golder (Golder Associates Ltd). 2007a. Technical Memorandum: Landfarm Option Analysis, Meadowbank Gold Project, Nunavut. Prepared for: Agnico-Eagle Mines Ltd. August 23, 2007.

Golder (Golder Associates Ltd.), 2007b. Final Report on Pit Slope Design Criteria for Portage and Goose Island Deposits, Meadowbank Gold Project Nunavut, Project 06-1413-089/5000, Doc. No. 449, Revision 0, submitted to Meadowbank Mining Corporation, dated April 5, 2007.

MMC (Meadowbank Mining Corporation), 2007. Meadowbank Gold Project Mine Waste and Water Management. August 2007.

SAIC (Science Applications International Corporation), 2006. Federal Guidelines for Landfarming Petroleum Hydrocarbon Contaminated Soils. Final report presented to: Contaminated Sites Division and Emergencies Engineering Technologies Office (EETO), Environmental Technology Centre, Environment Canada. SAIC Canada Project #: 11953.B.S08. CM #:

MEADOWBANK GOLD PROJECT

Operation & Maintenance Manual
Sewage Treatment Plant

In Accordance with Water License 2AM-MEA1525 & 8BC-TEH0809

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

Version 6
March 2017

EXECUTIVE SUMMARY

The Nunavut Water Board (NWB) has issued Type A Water License 2AM-MEA0815 to Agnico Eagle Mines Limited (Agnico) for the Meadowbank Gold Project site authorizing the use of water and the disposal of waste required by mining and milling and associated uses. In September 2015, Agnico received the renewed Type A Water License 2AM-MEA1525.

Agnico has prepared the following document which summarizes the operational and maintenance procedures to be followed at the sewage treatment plant.

This report documents the stand alone Operation & Maintenance Manual – Sewage Treatment Plant, as specified under Water License 2AM-MEA0815 Part D, Item 19 and includes the following requirements:

- The manual was prepared in accordance with the "Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories, 1996", and adapted for the use of a mechanical sewage treatment facility;
- The manual includes contingency measures in the event of a plant malfunction;
- The manual includes sludge management procedures; and
- The manual incorporates the Operation and Maintenance Manual requirements of 8BC-TEH0809, Part D, Item 10.

IMPLEMENTATION SCHEDULE

As required by Water License 2AM-MEA1525, Part B, Item 16, the proposed implementation schedule for this Plan is outlined below.

This Plan will be immediately implemented (September 2015) subject to any modifications proposed by the NWB as a result of the review and approval process.

DISTRIBUTION LIST

Agnico Internal:

- Site Services Superintendent
- Site Services General Foreman
- Environmental Superintendent
- Environmental Coordinator
- STP Operator

DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
1	08/11/07			Operation and Maintenance manual
2	July 2012			Complete review of Operation and Maintenance Manual
3	February 2013			Complete review of Operation and Maintenance Manual
4	April 2013			Change in sampling frequency and parameters of analysis
5	September 2015	3.4	13	Remove option of incinerating food and kitchen grease
6	March 2017			Complete review of Operation and Maintenance Manual

Version 6

Prepared By: ______________________
Environmental Department

Approved by: ______________________
Erika Voyer
Environment General Supervisor

TABLE OF CONTENTS

1 INTRODUCTION 7

1.1 Purpose 7
1.2 Brief Description of the Project 7
1.3 Contact Information 7

2 BACKGROUND AND DESCRIPTION 8

2.1 History of Sewage Treatment at Meadowbank 8
2.2 Description of Treatment Plant 8
2.3 Sewage Generation and Composition 10

3 OPERATION AND MAINTENANCE 12

3.1 Wastewater Collection 12
3.2 Sludge Management 12
3.3 Stormwater Management Pond 12
3.4 Normal Operational and Maintenance Procedures 13
3.4.1 Chemicals used in the Treatment Process 13
3.4.2 General Operation & Maintenance and Sampling Procedures and Frequency 13
3.5 Record Keeping 14
3.6 Safety Procedures For Operators 15
3.7 Controlling Access to STP 15

4 EMERGENCY RESPONSE 16

4.1 Fire 16
4.2 Spill 16
4.3 Plant Malfunction 16

LIST OF FIGURES

Figure 1 – Flow Diagram 10

LIST OF APPENDICES

Appendix A: Seprotech RBC Operations Manual

Appendix B: Nordikeau RBC Operations Manual

Appendix C: Sample Daily/Monthly Record Sheets

Appendix D: Site Services Protocols and Procedures

1 INTRODUCTION

1.1 PURPOSE

This sewage treatment plant (STP) operation and maintenance (O&M) manual for the Meadowbank Gold Project has been prepared in accordance with the Nunavut Water Board Type A Water License 2AM-MEA1525 and is based on the "*Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories, 1996, prepared by the Department of Municipal and Community Affairs, NWT*". The manual has been adapted for the use of a mechanical sewage treatment facility.

This manual is a component of the Meadowbank Environmental Management System. The objectives of this plan are summarized as follows:

1. To define the location, design and operating procedures to be used in the treatment of sewage generated at the Meadowbank Mine; and
2. To provide monitoring requirements for the STP.

1.2 BRIEF DESCRIPTION OF THE PROJECT

The Meadowbank Gold Project, operated by Agnico Eagle Mines Ltd. (Agnico), is located approximately 70 kilometres north of the Hamlet of Baker Lake, in the Kivalliq Region of Nunavut. The center of operations is situated at 65^{o} 01' 9.12''N latitude and 96^{o} 04' 1.91''W longitude on NTS map sheet 66H/1. The site has been actively mining since March 2010.

Gold will be extracted using traditional open pit mining methods during the roughly two year remaining mine life (2018 Q3). Access to the site is via an airstrip at Meadowbank and via an all-weather access road from the Hamlet of Baker Lake. On-site facilities will include a mill, power plant, maintenance facilities, tank farm for fuel storage, water treatment plant, sewage treatment plant, and accommodation and kitchen facilities for 550 people.

1.3 CONTACT INFORMATION

The individuals responsible for the operation of the sewage treatment plant for the Meadowbank Gold Project are the following:

Site services Superintendent	819-759-3555 ext 6803
STP Operator	819-759-3555 ext 6758
Environmental coordinator	819-759-3555 ext 6747/6744

2 BACKGROUND AND DESCRIPTION

2.1 HISTORY OF SEWAGE TREATMENT AT MEADOWBANK

The sewage treatment plant (STP) at Meadowbank first went into operation on May 15, 2008. It is located on the northern end of the mine site in a prefabricated structure adjacent to the accommodations camp. The proximity of the system to the camp optimizes the wastewater inputs. The treated wastewater is discharged into a small attenuation pond (formerly known as Teardrop Lake – now as the Stormwater Management Pond). It is less than 2m deep, and fishless. This water body is located between the plant site and Portage Pit, within the mine footprint, and is also used as a storm water management pond for the Meadowbank site. This wastewater is pumped periodically (when near capacity of the pond) with mill tailings or directly to the Tailings Storage Facility (TSF). There is no discharge of treatment effluent to the natural environment.

2.2 DESCRIPTION OF TREATMENT PLANT

A Rotary Biological Contactor (RBC) sewage treatment system has been installed at Meadowbank. Four RBC units are installed at site; the Seprotech L333 Rotordisk model, and three Biodisk LJ100 units. These units are designed to remove solids, organic material a limited amount of nutrients from the wastewater (sewage and grey water).

The main unit, the Seprotech L333, and two (plus one backup) Biodisk LJ100 units, run in a parallel series. An 80 m^3 capacity equalization tank is utilized prior to the treatment units and serves as an equalization tank to manage peak flows of influent (morning and evenings). The treated effluent from both systems passes through a U.V. disinfection system and flows to a common lift station (station 3) prior to discharge.

The operation of the RBC system is based on a continuous flow of wastewater through a series of stages. As wastewater flows through the RBC system, each successive RBC stage receives influent with lower contaminant concentrations than the previous. In general, treatment of wastewater by an RBC system includes the following processes:

- Aeration and mixing via rotating disks;
- Biological reactions on disk surfaces; and
- Sloughing of solids from rotating disks.

Prior to entering the RBC, untreated wastewater, as a pretreatment, passes through a screen system to provide for course solids removal prior to primary clarification. Wastewater can then flow into the RBC units, where it comes in contact with disks attached to a rotating shaft. The disks can be configured and corrugated in various patterns to provide increased surface area and enhanced structural stability as they rotate through the wastewater. Aeration and mixing occurs as the shaft and associated disks rotate through the wastewater. The disks provide surfaces on which microorganisms can react with ambient air and wastewater to convert ammonia to nitrate (termed nitrification) and reduce the Biological Oxygen Demand (BOD). As wastewater flows through the disks, sloughing of solids accumulated on the disks occurs by displacement and gravity. After the treatment process within the RBC is complete, the resulting wastewater is directed to settling tanks. These tanks are necessary for secondary clarification. The settled solids remaining after secondary clarification is termed sewage sludge.

The Meadowbank RBC units are housed within an insulated tank with an insulated cover and are equipped with immersion heaters to ensure efficient operation under Northern adverse weather conditions. See below for Photographs of the system and Figure 1 for a flow diagram of the system.

Photo 1 – RBC units

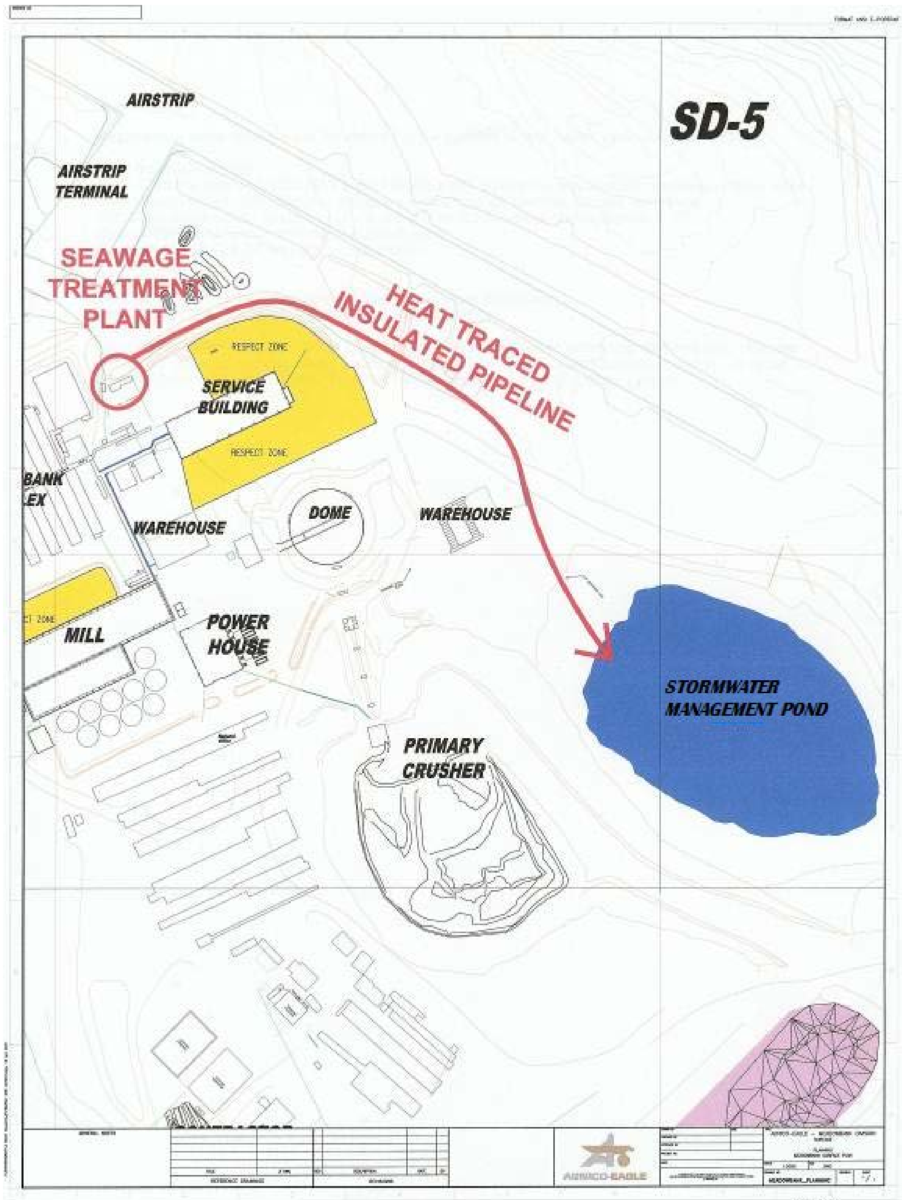


Figure 1 – Flow Diagram

2.3 SEWAGE GENERATION AND COMPOSITION

The STP at Meadowbank is capable of handling 188 m^3 per day. With a biological oxygen demand (BOD) of approximately 350 mg/L, the L333 has a capacity up to 105 m^3, and the two Biodisks, operating in a series, another 27.5 m^3 each. These units provide primary and secondary treatment.

On average between 100 m^3 and 120 m^3 of sewage and grey water is generated at site each day. Daily records are maintained of the amount of sewage and grey water generated.

The composition of the sewage and grey water entering the plant and the composition water exiting the units are monitored monthly (to determine plant efficiencies). Initially, STP Operations and Maintenance Manual stated that samples were taken weekly to make sure the units are operating correctly. In February 2013, Agnico reduced sampling frequency to once every two weeks and to once per month in May 2013. The reasons for this sampling frequency reduction are;

- Sampling data from the last three years certainly indicates that units are operating as designed and show little variability in the results;
- Raw sewage stream basically doesn't change;
- Operators do daily operational inspection and perform weekly maintenance and repairs, if necessary. The daily operational inspections identify problems efficiently and quickly and have proven to be as effective as sampling;
- If there is major problem or failure in the RBC it would be most likely due to changes in the influent (raw sewage) i.e. high strength sewage (BOD high) killing bacteria in the RBC. In this case, there would be visible effluent problems (part of daily operational checks), low dissolved Oxygen (part of daily operational checks) and increased odours that the operator would note. If this occurs, a sample will be taken to try to determine the source of the problem;
- RBC effluent is not discharged to the environment; and
- Sampling weekly or bi-weekly at this point is not necessarily and does not provide any more useful data than a monthly sampling and the daily operational checks provide.

Average results for 2012 are presented in Table 1 to provide an example of the characteristics of the raw sewage (influent) and the effluent discharged from the RBC treatment units. Sludge generated as a result of the treatment process is collected and disposed of with mill tailings in the TSF. All monitoring results are contained in Agrico's Annual Reports submitted to the Nunavut Impact Review Board and the Nunavut Water Board.

Table 1: Untreated and treated Water Quality from the STP (Influent and Effluent) – average for 2012

Parameter	Units	STP-IN (Influent)	STP-LJMIX (Effluent from combined LJ)	STP-SEP (Effluent from Seprotech)
BOD-5	mg/L	230	18	11
COD	mg/L	500	80	71
TSS	mg/L	161	27	21
Nitrate	mg N/L	0.02	24.17	22.12
Nitrite	mg N/L	0.01	1.29	0.45
pH		7.72	5.65	5.07
Total Phosphorus	mg/L	11.6	10.6	10.8
Ammonia	mg N/L	93	13.9	8.2
NTK	mg N/L	112	19.36	12.16
Fecal Coliforms	cfu/100 ml	4 846 666	721	84
Total Coliforms	cfu/100 ml	15 875 000	2458	1236

3 OPERATION AND MAINTENANCE

3.1 WASTEWATER COLLECTION

All sewage and grey water generated at Meadowbank is drained by gravity pipelines to a specific lifting station, then pumped through a heat traced insulated pipeline to the STP equalization tank. The number of lifting stations, and the building they service, is provided below.

- Lifting station 1 services the grey water generated from the kitchen grease trap, laundry room; this is strictly a grey water line that connects to lifting station 3;
- Lifting station 2 services the dormitory accommodations in trailer units # 1 to 11; this is the main sewage line;
- Lifting station 3 services the discharge line to the storm water management pond;
- Lifting station 4 services the service building; this line connects to the main line;
- Lifting station 5 services the mine operation office; this line connects to the main line;
- Lifting station 6 services the power plant; this line connects to the main line;
- Lifting station 7 services the mill; this line connects to the main line;
- Lifting station 8 services the assay laboratory; this line connects to the main line;
- Lifting station 9 services the dormitory accommodation in trailer unit # 12 and Site services building; this line connects to the main line;
- Lifting station 10 services the nova camp sewage;
- Lifting station 11 services the nova camp grey water; and
- Lifting station 12 services the gym and construction/training area.

In addition to the sewage generated from the buildings above, a sewage holding truck picks up sewage three times per week from storage tanks at the Exploration Camp, the Emulsion Plant, the old Nahanni lunch room, the north gate washroom, the primary crusher washroom, and the airport washroom. This material is deposited into Lift Station # 2 which flows to the treatment plant.

3.2 SLUDGE MANAGEMENT

Sludge from the STP treatment units is pumped and transferred to the TSF as required. Sludge and other settled solids is also removed from Lifting Station # 2 and deposited at the TSF as required.

3.3 STORMWATER MANAGEMENT POND

Agnico has built up the depth of this pond through construction of low permeability roadways around the perimeter of the pond. These roadways operate as dikes to increase capacity of the pond to better manage storm water and STP discharge flows. The treated sewage from the STP is pumped through a heat traced insulated pipeline to lifting station # 3 and then into the storm water management pond. The Stormwater pond is pumped to the TSF during the summer period.

3.4 NORMAL OPERATIONAL AND MAINTENANCE PROCEDURES

The sections below outline the general operational and maintenance procedures at the plant; further details are available in the manufacturers' operating manuals in Appendix A (Seprotech), Appendix B (Biodisk) and in the Site Services protocols and Procedures - Appendix D.

Agnico recognizes that in order to keep a properly functioning STP, certain material must be kept out of the influent raw sewage. These items are:

- Food and other kitchen grease are removed from the sewage in the kitchen via a grease trap. The grease trap is manually cleaned to keep this material out of the sewage treatment plant influent and the recovered grease is co-disposed with the mill tailings in the TSF.
- Camp rules and purchasing practices prohibit anti-bacterial soap products from being used on site to protect the biological activity in the RBC units.

3.4.1 Chemicals used in the Treatment Process

The dry bacteria product, BEC105, is used in the treatment process to stimulate biological activity when needed.

3.4.2 General Operation & Maintenance and Sampling Procedures and Frequency

The STP at Meadowbank went into operation in May 2008. The following are the general Operation & Maintenance and sampling procedures that have been employed since the plant's start up. Further details of Operation & Maintenance procedures are provided in the equipment operating manuals and in Site Services Protocols and Procedures (Appendix A, B, and D).

<u>Daily</u>

A daily inspection of the sewage collection system, heat traced pipelines, and treatment plant is conducted to ensure there are no spills or incidents to report.

Inspection and sampling sheets are completed every second day for each of the RBC units; these forms include:

- Daily weather observations;
- Discharge volumes;
- Turbidity;
- Dissolved Oxygen and pH measurements in the final discharge of the treatment units; and
- Visual observations of the final discharge.

Example daily/monthly record sheets are provided in Appendix C.

<u>Weekly</u>

Maintenance inspections and repairs, if necessary, of bearings, pumps and hoses in the STP are conducted weekly.

Monthly

Influent (sewage and grey water) and effluent sampling of the final discharge from the Seprotech and Biodisk RBC units is conducted monthly. Parameters include:

- Ammonia
- Ammonia-nitrogen
- Total Kjeldahl Nitrogen
- Biological Oxygen Demand (BOD_5)
- COD
- Nitrate
- Nitrite
- Faecal Coliforms
- Total Coliforms
- pH
- Total Suspended Solids
- Total Phosphorus

Sample monitoring for Phosphorus in the treated effluent has been discontinued because the units do not have Phosphorus removal capability. Agnico will continue to monitor Phosphorus in the influent sewage.

Every 6 Months

An inspection of the chain linkage in the RBC units will be conducted every 6 months and the gear oil is changed.

Annually

On an annual basis, each of the tanks will be pumped out for maintenance and cleaning purposes. Depending on the accumulation of sludge in the tanks it may be done more often or as required.

3.5 RECORD KEEPING

Records of the operational and maintenance and sampling procedures are kept daily in order to assist in the evaluation of the effectiveness of the sewage treatment plant.

The following is recorded on a daily basis:

- Volume of any effluent discharged to the Stormwater Pond;
- Sewage volume collected; and
- Details of any maintenance undertaken at site.

The record sheets are kept in the Sewage Treatment Plant office.

3.6 SAFETY PROCEDURES FOR OPERATORS

Employees working in the STP facility must be trained prior to commencement of work so that they are aware of the health and safety risks as well as the operational procedures associated with the STP. The following are two very important safety rules:

- No person shall drink the water in the plant or the water that is discharged from it;
- Working with sewage requires adequate protection for operators. This includes wearing steel toed boots, hard hat, safety vest, protective glasses and protective gloves; and
- All authorized personnel working in the STP must have received Hepatitis A and B vaccine.

Eye and hand wash are located in the plant for use in the event of accidental contact with unprotected hands or face due to splashing or other causes.

3.7 CONTROLLING ACCESS TO STP

Access to the STP at Meadowbank is restricted to authorized personnel only. All doors to the plant are locked, with only authorized persons having keys. Signs are posted on the STP entrance doors notifying all people that the entrance to the STP is for authorized personnel only.

No fencing is used to control access to the STP. Due to the remote nature of Meadowbank, there is no concern of non-mine personnel attempting to access the site.

4 EMERGENCY RESPONSE

4.1 FIRE

In case of fire at the STP, the on-site emergency response team would be notified as per Agnico protocol. Instructions from the on-site emergency response team would be followed by all personnel at the STP. Further details of fire response are provided in the "*Emergency Response Plan*".

4.2 SPILL

In the event of a spill at the STP, the on-site emergency response team would be notified as per Agnico protocol. Instructions from the on-site emergency response team would be followed by all personnel at the STP. Further details of spill response are provided in the "*Spill Contingency Plan*".

4.3 PLANT MALFUNCTION

In the event of a failure of one of the three operating RBC's (i.e. Seprotech and 2 LJ100's) there is a backup LJ100 unit available at all times.

The following other contingent measures can be applied by Agnico in the event of an RBC malfunction at the Meadowbank Sewage Treatment Plant for more than 24 hours:

- Cut back on allowable camp water until the malfunction is corrected and use the equalization tank to retard the peak flow to the remaining RBC unit;
- Shut down the malfunctioning RBC unit until the malfunction is repaired and use only one of the two parallel units until repairs are completed;
- Shut down all water use in the camp until the repairs are complete; and
- Bypassing untreated STP influent around the malfunctioning RBC unit and holding this untreated influent in a holding tank or lined pond on site until the repairs are complete is another contingent measure that could be applied. The untreated sewage would then be pumped back to the STP when the unit is repaired. This will require the coincidental restriction of water use to minimize the volume of untreated influent being bypassed.

Appendix A: Seprotech Operation and Maintenance Manual

Seprotech
Water Pure and Simple

Seprotech Systems Incorporated
2378 Holly Lane, K1V 7P1
Ottawa, Ontario, Canada
Telephone (613) 523-1641
Fax (613) 731-0851

INSTALLATION, OPERATION AND MAINTENANCE

MANUAL

TABLE OF CONTENTS

1.0 SITE INSTALLATION OF ROTORDISK® SEWAGE TREATMENT PLANTS: ... 4
1.1 – CONCRETE TANKAGE FOR ROTORDISK® ... 4
1.2 - DIRECTION OF SHAFT ROTATION ... 6
1.3 - RECYCLE for ROTORDISK® ... 7
1.4 - SUMMARY OF OPERATION ... 8

2.0 - ROUTINE VISUAL CHECKS ON PHYSICAL AND BIOLOGICAL FUNCTIONING OF ROTORDISK® & DESCRIPTION OF TREATMENT PROCESS ... 9
2.1 - PRIMARY SETTLING TANK (PST OR PRIMARY "CLARIFIER") ... 9
2.2 - ROTORZONE ... 10
2.3 - 'BATHTUB RING' ... 10
2.4 - FINAL SETTLING TANK (FST OR FINAL "CLARIFIER") ... 10
2.5 - MONITORING OF DISCHARGE FLOW RATE ... 10
2.6 - OPERATING PARAMETERS ADJUSTABLE ON THE CONTROL PANEL ... 11
2.7 - FREQUENCY OF INSPECTION ... 11

3.0 - STANDARD RECOMMENDATIONS AND PROCEDURES FOR SLUDGE REMOVAL ... 11
3.1 - STORAGE CAPACITIES ... 11
3.2 - DETERMINATION OF ACCUMULATED SLUDGE VOLUMES ... 11
3.3 - SLUDGE REMOVAL ... 12
3.4 - POTENTIAL CONSEQUENCES OF OPERATING ROTORDISK® UNITS PAST DESIGNATED MAXIMUM SLUDGE STORAGE LEVELS ... 12
3.5 - FRONT VIEW SCHEMATIC OF ROTORDISK® ... 14
3.6 - PUMPOUT PROCEDURES FOR ROTORDISK® TREATMENT SYSTEMS (summary) ... 15
3.7 - START-UP PROCEDURES OF ROTORDISK® ... 16

4.0 - STORAGE OF ROTORDISK® SEWAGE TREATMENT EQUIPMENT ... 18

5.0 - ASSEMBLY PROCEDURE OF ROTORDISK® COMPONENTS SUPPLIED BY SEPROTECH SYSTEMS INCORPORATED ... 18

6.0 - ROUTINE MECHANICAL MAINTENANCE OF ROTORDISK® SEWAGE TREATMENT PLANTS ... 22
6.1 - MOTOR: ... 22
6.2 - REDUCER: ... 22
6.3 - BEARINGS: ... 22
6.4 - SPROCKETS AND CHAIN: ... 22
6.5 - COUPLING: ... 22

7.0 - TROUBLE SHOOTING ... 23
7.1 - MECHANICAL HARDWARE ... 23
7.2 - ROTORDISK® PROCESS ... 24

8.0 - MAINTENANCE PROGRAM – Do's and Don'ts ... 27
8.1 - DO'S ... 27
8.2 - DON'Ts ... 28

9.0 - INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS FOR VARIOUS MECHANICAL PARTS OF THE ROTORDISK® AND OTHER EQUIPMENT SUPPLIED ... 29
9.1 - INSTALLATION & MAINTENANCE DETAILS FOR ROLLER CHAIN DRIVES ... 29
9.2 - PROCEDURE FOR ASSEMBLING BEARINGS AND PILLOW BLOCKS ... 32
9.3 - GREASE CLASSIFICATION ... 34

10 - LIMITED WARRANTY ... 35

IMPORTANT: READ THIS INSTALLATION PROCEDURE PRIOR TO START-UP.

1.0 SITE INSTALLATION OF ROTORDISK® SEWAGE TREATMENT PLANTS:

IMPORTANT: READ THIS INSTALLATION PROCEDURE PRIOR TO START-UP.

1.1 - Concrete Tankage for ROTORDISK®

If the ROTORDISK® unit supplied is to be encased in concrete tankage, the site preparation is as follows:

The unit is lowered into the concrete tankage, the pipe at the end of the unit is placed into the opening of the intermediate wall between the primary and final settlement chambers and lowered onto the anchor bolts (contractors supply).

Unit is to be lifted only at lifting points by use of hooks and spreader bars.

All anchor bolts (contractors supply) should be correctly located in concrete in a vertical position. In addition, all bolts should include a levelling nut.

All anchoring and levelling of ROTORDISK® unit on site is to be done by customer/contractor. When the unit is set onto the anchor bolts in the concrete tank, it must be levelled to a slope of no more than 3/4" in 20' along the length. The unit is then centred in the tank and completely bolted down.

After the unit has been bolted down, check alignment of shaft and sprockets and clearances of couplings where applicable prior to start-up, failure to do so may void manufacturer's warranty. Refer to this ROTORDISK® manual for details. If required, the contractor must perform levelling.

All hydraulic piping, to and from the unit, is to be supplied and installed by customer/contractor.

All input electric and hydro hook-ups to be done by customer/contractor to local governing regulations and a signed approval sent to SEPROTECH SYSTEMS INCORPORATED. Under no circumstances must electrical connections, junction boxes or equipment pertaining to the electrical function of the unit be installed in the ROTORDISK® tank.

SEPROTECH SYSTEMS INCORPORATED will supply a man on-site to assist customer/contractor at a specified rate and at customer/contractor discretion.

If unit is not shipped completely assembled assembly instructions and drawings will be supplied. (As shown)

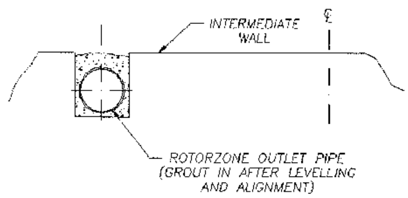


Figure a - **ROTORDISK®** tank outlet through intermediate wall between settlement tank chambers.

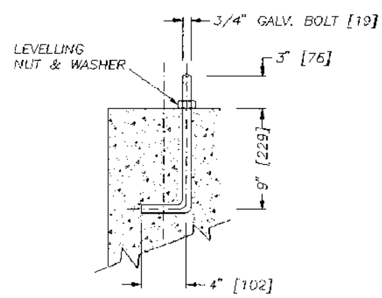
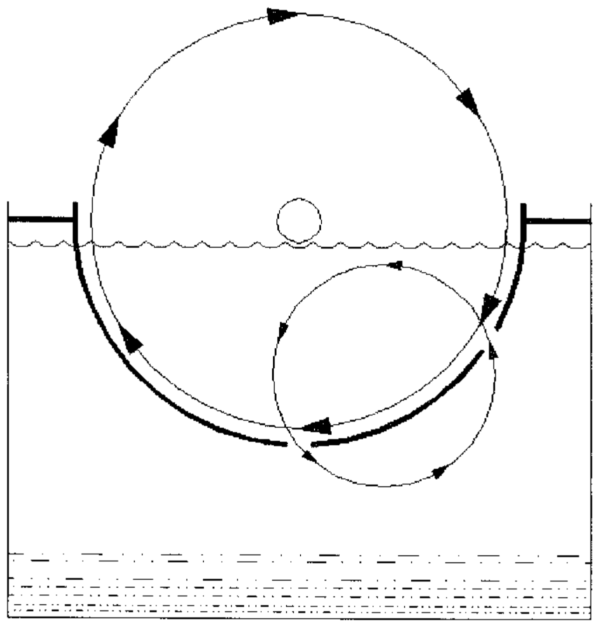


Figure b - anchor bolt detail for **ROTORDISK®** tank.

1.2 - DIRECTION OF SHAFT ROTATION



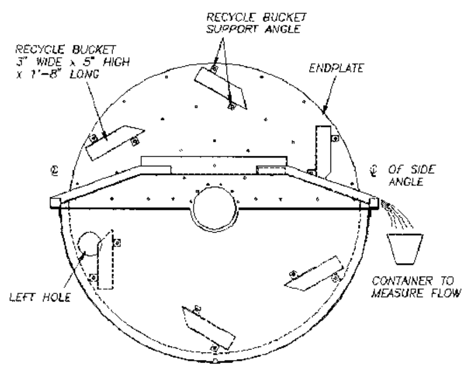
The direction of shaft rotation should be such that disks mounted on shaft will enter water on the side where inlet to "Rotorzone" is located. The electric motor driving the shaft should be wired accordingly.

1.3 - RECYCLE for ROTORDISK®

1.4.1 Recycle buckets are mounted on the last stage of the ROTORDISK®. These buckets rotate at the same speed as the disks. See the attached elevation view of the recycle buckets and trough on the Rotorzone tank.

1.4.2 As the disks rotate, the buckets scoop-up treated wastewater. As this wastewater falls into the recycle trough, it is exposed to the atmosphere, where it absorbs fresh oxygen. The wastewater then cascades on one side of the trough through a narrow steel channel and mixes back with the contents of the Primary Clarifier, thereby introducing fresh dissolved oxygen in the Primary Clarifier. See the section of diskbank assembly showing buckets and recycle trough.

1.4.3 The set-up described above is comprised of the recycle buckets and recycle trough, is what we term as our D.O. re-circulation device. This is especially advantageous to preventing septic conditions from occurring in the Primary Clarifier in small flow or low flow situations.



***SECTION OF DISKBANK ASSEMBLY
SHOWING 6 BUCKETS
AND RECYCLE TROUGH***

1.4 - SUMMARY OF OPERATION

(ROTORDISK® systems designed for BOD/SS/Ammonia/Nitrate removal)

The sewage plant (as supplied by SEPROTECH SYSTEMS INCORPORATED) is comprised of three (3) main components: the primary settling tank, the RBC tank, and the secondary settling tank.

Raw sewage is pumped and/or gravity flows into the primary settling tank (PST). When the sewage is pumped into the plant, pumping must simulate conditions encountered in gravity fed systems. Indeed, over a 24-hour period, the plant is designed to handle a flow rate corresponding to the Average Daily Flow (ADF) and can accommodate for two Peak Daily Flow (PDF) periods of two (2) hours per day. Each PDF event can be at a maximum of three times ADF.

In the PST, sedimentation separates heavy solids from the bulk of the liquid and the supernatant enters the aerobic section through the inlet slot located at the front section of the RBC tank.

The aerobic section is made up of four stages. The 1st stage is mounted on one common shaft. This 1st stage is comprised of one (1) to three (3) disk banks. The normal colour of the bacteria in the 1st stage is dark brown. This is the stage where most of the BOD removal by biological oxidation occurs. The succeeding 2nd, 3rd, and 4th stages are mounted on the rest of the shaft or another common shaft. Each stage has one (1) to three (3) disk banks. It is in the 2nd stage that further BOD is removed, and if the BOD is removed to approximately 30 mg/l, nitrification will follow. As such, in the 3rd stage, nitrifying bacteria (those which convert ammonia (NH_3) in the form of ammonium ions (NH_4^+) into nitrite (NO_2^-) and, ultimately, nitrate (NO_3^-) predominate in the 3rd and 4th stages. The 4th and last aerobic stage has recycle buckets that introduce both fresh dissolved oxygen into the primary settling tank and nitrifying bacteria present in the recycled water.

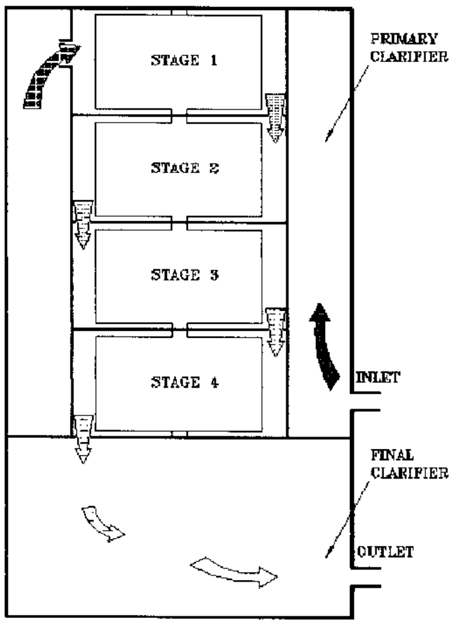
The rotation of the disks in and out of the water provides a mean of air and heat transfer from the ambient air to the water. The transfer of air to the water is important for aerobic bacteria to remove BOD and ammonia. The transfer of heat to the water is important to maintain the water at an optimum temperature of 15 °C and above such that BOD and ammonia removal rates by the bacteria are maximized (removal rates are a function of the water temperature). Because maintaining a temperature that provides acceptable removal rates is important to the process, RBC's are installed indoors and ambient air is maintained at 15 °C and above.

In the secondary settling tank, remaining suspended solids as well as sloughed off biomass from the disks settles and is pumped to the primary settling tank via sludge return pumps.

Chemical dosing of alum facilitates the coagulation and flocculation of aluminium phosphate resulting in the removal of phosphorus. Sodium bicarbonate can be used to maintain the pH balance throughout the process.

2.0 - ROUTINE VISUAL CHECKS ON PHYSICAL AND BIOLOGICAL FUNCTIONING OF ROTORDISK® & DESCRIPTION OF TREATMENT PROCESS

ROTORDISK® sewage treatment plants have three major steps in the purification process. In the primary settling tank, gross solids separate from the flow by either sinking or floating. In the Rotorzone, dissolved pollutants are broken down to simple, non-pollutant compounds by the bacteria ("biomass"), which grows on the rotating disks. The final settling tank permits gravity separation of spent biological growth, which continually sloughs off the disks in the Rotorzone preceding it.



2.1 - PRIMARY SETTLING TANK (PST OR PRIMARY "CLARIFIER")

The accumulation of floating scum on the surface of the primary clarifier is normal. It is proportional to the accumulation of settleable solids at the bottom of the tank. Periodic (9-12 months) removal of sludge at the bottom of the tank is required for proper operation of the Unit.

If no sludge, measuring device is available; the accumulation of 9"-12" depth of scum on the surface is a good indication that it is time to remove the accumulated deposits of sludge from the bottom of the tank(s).

2.2 - ROTORZONE

The Rotorzone is subdivided into four sections, with disk banks in each. The wastewater first enters the Rotorzone in the section marked "1" in the sketch (furthest away from the inlet to the plant). The flow then proceeds through sections 2, 3, and 4 before entering the final settling tank.

The accumulation of biological growth will be greatest in section 1, and gradually decrease through subsequent sections. Generally, the growth will be thick, and often filamentous ("stringy"), in section 1, becoming thinner and more compact through sections 2-4.

The colour of the growth will typically be dark brown to black in Section 1. Some grey growth may also be noticed, depending on the relative load and type of wastewater being treated. Growth in sections 2-4 will typically vary from medium brown to a light brown or tan growth in section 4.

In a well-functioning unit with the appropriate feed of wastewater, there will be an earthy, humus-like ("musty") smell inside the unit. A substantial sour, "sewage" smell may be an indication of sub-optimal conditions in the treatment process.

2.3 - 'BATHTUB RING'

The wastewater flows by gravity within a ROTORDISK® Plant thus the water level is relatively constant. Changes in water level of 1" to 2" are not unusual due to surge flows entering the unit. The evidence of this is a 'bathtub ring' 1" - 2" above the normal level. A 'bathtub ring' higher than this, suggests partial or complete flooding of the unit has occurred since the last check. If so, the (gravity or pump) discharge system should be checked for blockages or mechanical malfunction. Another condition, which can lead to the level of water rising to levels greater than 1" – 2"; is if the plant is fed by pumps, which exceed, the design limits of the plant (i.e., ADF over a period of 24 hours including a maximum of two (2) PDF events no longer than 2 hours each).

2.4 - FINAL SETTLING TANK (FST OR FINAL "CLARIFIER")

The effluent near the outlet at the backside of the final clarifier should be relatively clear and colourless and relatively free of suspended matter. Clarity can best be judged by scooping a small volume of the final effluent into a clear glass container. This is particularly true of larger units where the depth and dark colour of the tank walls may make clarity hard to determine. (Note: Although the risk of infection is very small, the wearing of rubber gloves is a rational safety precaution when hand-scooping the effluent for a clarity check. This is particularly true if there are open cuts on the hands.)

Although the final effluent itself should be relatively clear, some floating matter may accumulate on the surface of the final clarifier. This is normal, and will typically be much less than the accumulation of floating scum in the primary clarifier.

2.5 - MONITORING OF DISCHARGE FLOW RATE

The plant is equipped with a flow meter located on the influent pipe. This instrument is equipped with a counter that allows tracking of the total volume of clean effluent discharged by the plant.

2.6 - OPERATING PARAMETERS ADJUSTABLE ON THE CONTROL PANEL

Sludge pumps should be set to operate for 15s every 3h. Making changes and adjustments to the default plant's operating parameters requires a good understanding of the wastewater treatment process and should therefore only be performed by qualified and trained staff. Please contact SEPROTECH SYSTEMS INCORPORATED if assistance is needed to optimise the operation of the plant.

2.7 - FREQUENCY OF INSPECTION

Visual checks every week should be sufficient. However, for better preventative maintenance of the wastewater treatment plant and thus the capital investment, a daily walk through is often the preferred frequency of visit. Many owners prefer the visual and audible (look and listen) walk through. A standard operator checklist should be prepared and used by the person responsible for periodic maintenance of the plant at every visit. SEPROTECH SYSTEMS INCORPORATED can assist in preparing such checklist upon request.

3.0 - STANDARD RECOMMENDATIONS AND PROCEDURES FOR SLUDGE REMOVAL

3.1 - STORAGE CAPACITIES

A design feature of ROTORDISK®, which contributes greatly to overall simplicity of the process, is the sizing of clarifiers to accommodate static internal sludge storage for extended periods. Depending on such factors as raw wastewater solids concentrations, and design organic loading in a given application, maximum sludge storage levels will typically be reached in 6-9 months of operation.

This period is based on calculated rates of initial decomposition of raw and biological solids, and, upon operating experience, indicating the degree of auto-digestion/compacting, which proceeds during the storage period. The 6-9 month period will be shortened to the extent that design hydraulic and waste loads are exceeded. It will be lengthened to the extent that flows and waste load are less than those designed for.

3.2 - DETERMINATION OF ACCUMULATED SLUDGE VOLUMES

The accumulation of maximum storage capacities can be indirectly monitored through visual observation of the thickness of the scum blanket on the surface of the primary clarifier. When the scum blanket has matured to a height of approximately 7"-10", this is a good indication that sludge accumulations at the bottom of both clarifiers are at or near maximum levels, and that sludge withdrawal is indicated.

A more accurate procedure of determining sludge levels is to directly measure actual accumulations, and compare these to the maximum storage capacities listed on the "Details" section of the general arrangement drawing for the ROTORDISK® model in question.

A variety of sludge measuring devices is commercially available. The two most common are the weighted hollow tube type, and, the (electronic) turbidity-change detector type. The former is less costly, relatively easy to use, and more appropriate because of the low frequency with which measurements need to be made in a ROTORDISK® unit.

Whatever means of measuring the sludge may be selected; it must be kept in mind that the sludge is not a firm solids substance. Domestic wastewater sludge is mostly trapped water and other liquids. Only to determine sludge levels by "feeling" for a solid layer with a stick or pole. The settled sludge is far more liquid than the surface scum, which is perhaps 30-40% solids, by volume.

Irrespective of the type of device used, sludge levels should be measured at several locations in each settlement tank to ensure a reasonably accurate calculation of accumulated volumes. This is required since sludge accumulation levels are not uniform; being highest at the inlet ends of both clarifiers, and, below the slot at the bottom of the first section of the Rotorzone trough.

Once an average sludge height has been determined, multiply by the surface area of the clarifier in question to determine the existing volume of stored sludge. Compare to maximum design capacity listed on the general arrangement drawing. If the accumulated levels equal or exceed design values, it is time to remove the sludge from the unit.

3.3 - SLUDGE REMOVAL

A pump-out truck of the same type that pumps out septic tanks normally does the sludge removal. For smaller ROTORDISK® units, the entire liquid contents of the treatment plant can be withdrawn. For larger installations, the haulage contractor should be instructed to get the suction hose directly to the bottom of the tanks and withdraw the sludge only, while taking as little of the supernatant as possible. Once the primary sludge is withdrawn from the primary settlement tank, the supernatant of the secondary clarifier can be transferred to the primary settlement tank to expose the secondary sludge. The suction hose should be placed down at a multiple number of points to help ensure complete removal of accumulated sludge deposits. Floating surface scum should also be removed. Haulage contractors should be given a brief description of the unit and its operation if they are not already familiar with it. A particular point to emphasise is that the biological growth on the disks should not be washed off, but should be left in place. The exception to this is if the disks have accumulated excess biomass due to sludge pump out being delayed past the indicated intervals.

Sludge removed from the unit is normally hauled away by the pumping truck and disposed of at municipal facilities, or, by controlled spreading on farmland. On-site disposal in shallow trenches and/or some form of on-site volume reduction (prior to export) may be feasible or desirable depending on the specific opportunities and limitations afforded by the site of a given installation.

3.4 - POTENTIAL CONSEQUENCES OF OPERATING ROTORDISK® UNITS PAST DESIGNATED MAXIMUM SLUDGE STORAGE LEVELS

Sludge accumulations should be removed once they reach indicated maximum storage levels, because failure to do so could result in lowered treatment efficiency, and possibly cause serious damage to the structure of the Rotating Assembly and drive unit. The potential for problems is as described below and depicted in the attached sketches.

Figure (c) shows a unit operating with sludge build-ups at or near maximum storage levels. This will cause no problem since the storage heights are designated so that flows through the primary clarifier will not disturb the sludge layer. Characteristics of wastewater reaching the Rotorzone at this time (and since start-up) will be in the range of 180-200 mg BOD/l and 50-250 mg SS/l. The supporting structure of the rotating assembly is over designed for the amount of biological build-up which will occur on the disks under this operating condition, and the shear force of the rotation through the trough water will limit the thickness of growth.

However, if sludge is allowed to accumulate past designated storage heights, flow through the primary clarifier will begin to disturb the sludge blanket, and thus carry loads of solids and dissolved organic matter into the Rotorzone which are not anticipated in the design of the unit (Figure d). The pollutant load reaching the biomass on the first stage of disks will overload that biomass (in terms of F:M ratio), and force a change in its activity and growth. The biomass becomes more gelatinous, and does not shear off as well with disk rotation. Additionally, the biomass will readily adsorb and entrap the extra solids with the sum effect being an increase in weight on the rotating assembly that considerably exceeds that which its design is based on.

This tendency reaches its extreme if sludge is allowed to accumulate to the point where it will be disturbed by-, and caught up in -, the re-circulation pattern created by the two slots in the trough on the first section of the Rotorzone (see Figure e).

The sludge will have characteristics in the order of 20,000 mg TSS/l and 10,000 mg BOD/l, so it is obvious that even a minor amount of this material caught up in the re-circulation flow will significantly increase the concentration of the waste stream entering the Rotorzone. If, for example, the sludge was caught up in the recycle flow at a ratio of as little as 1:10 or 1:15, the resulting concentration would be sufficient to produce a considerable first-stage overload on an amount of disk area selected based on normal concentrations.

The resulting build-up of poorly-shearing gelatinous biomass and trapped solids would pose a serious potential for strain on the drive unit, and for structural damage to disk bank assemblies and shaft, in spite of them being considerably over designed for loads anticipated in normal operation.

Clearly, these potential problems should be avoided by the removal of sludge once it reaches the level specified as maximum for the ROTORDISK® unit in question.

3.5 - FRONT VIEW SCHEMATIC OF ROTORDISK®

UNIT OPERATING AT-, AND ABOVE-,
RECOMMENDED MAXIMUM SLUDGE STORAGE LEVELS

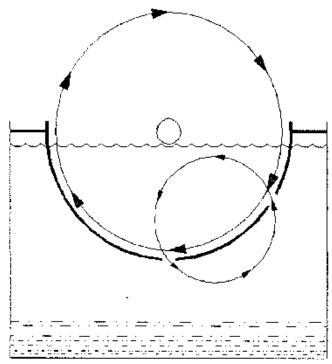


Figure c-unit operating at maximum sludge storage levels. Neither influent flows, nor re-circulating flows, disturb sludge blanket.

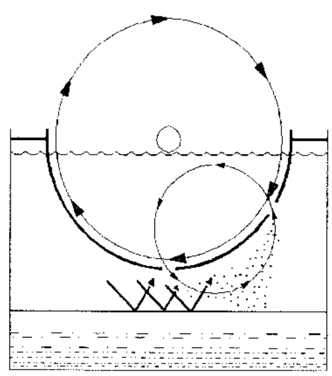


Figure d- unit operating with excess accumulations. Influent flows may disturb sludge blanket and increase BOD and solids loads to Rotorzone to levels above treatment design.

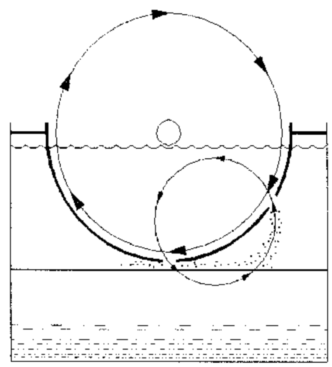


Figure e-Unit operating with excess sludge accumulated to base of Rotorzone. Both influent flows and re-circulation flows will disturb and carry sludge solids. Increase in BOD and solids loads entering Rotorzone will be substantially above design treatment levels, increase accumulated masses on rotating assembly, produce potential for damage to structure and drive unit.

3.6 - PUMPOUT PROCEDURES FOR ROTORDISK® TREATMENT SYSTEMS (summary)

Using suction hose, floating or surface scum should be removed first. Place the suction hose directly to the bottom of the tank and withdraw sludge only, while taking as little as possible of the volume of waste liquid above the sludge blanket (supernatant).

Move the hose at a multiple number of points along the bottom of the settlement tanks. Do not wash off biological growth (biomass) on the disks. The exception to this is excess accumulated biomass on the disks due to an overdue sludge pump-out. Excess accumulated biomass is when a disk bank is 100% fully covered with biomass and the colour is grey with a slight odour.

Keep a record of all pump-outs to arrive at an actual normal operating interval for sludge pump-outs. For systems with several flow meters, it is also beneficial to note the total flow generated between pump-outs.

3.7 - START-UP PROCEDURES OF ROTORDISK®

WARNING: A VALVE LOCATED AT THE BOTTOM OF THE DENITRIFICATION TANK AND EQUIPPED WITH A REMOTE ACTUATION MECHANISM WAS PROVIDED WITH YOUR UNIT. THIS VALVE:

- Needs to be OPEN: when the plant is first filled with water, during draining if the plant ever requires such operation and during subsequent refilling operations. FAILURE TO OPEN THIS VALVE DURING FILLING AND DRAINING WILL RESULT IN SERIOUS DAMAGE TO THE PLANT. This is because, during a filling operation, the water rising in the PST would push the denitrification tank upwards while it is empty (this tank wouldn't have had a chance to fill with water until the water level reaches the inlet slot between the PST and the aerobic ROTORDISK®. Th open valves provide a mean of filling the PST and the through (denitrification tank included) at the same time.

- Needs to be CLOSED: during normal operation of the plant. Indeed, the denitrification section contains water already partly treatment thus this water and that contained in the PST shouldn't mix. FAILURE TO CLOSING THIS VALVE DURING NORMAL OPERATION OF THE PLANT WILL RESULT IN A POOR QUALITY EFFLUENT.

The ROTORDISK® sewage treatment plant is based on a fixed film treatment process referred to as the Rotating Biological Contactor (RBC). In this process, micro-organisms or bugs are attached and grown on the surface of a media, the quantity of bugs being directly proportional to the amount of food in the wastewater. When starting up a new system, it will normally take about two weeks to get organic removal from the wastewater and three to four weeks to establish the nitrification process at normal domestic sewage temperatures. The method of and effluent discharge during system start-up should be discussed and thoroughly communicated with the environmental authority. The primary sedimentation tank and RBC of the system should, preferably, be filled with fresh water before admitting wastewater to the system. A flow less than design is not a problem. The biomass will develop themselves on the media. If there is a small flow only a portion of the disk will have biomass. As the flow increases the amount of biomass will increase.

Seeding a ROTORDISK® with activated sludge, although not required, can be accomplished. The activated sludge should be at the same temperature as the influent. Sudden changes in wastewater temperature cause biomass sloughing. In most cases, the use of domestic waste as a seed culture has provided the required biomass for continuous operation. When seeding the ROTORDISK® with activated sludge is decided, the primary sedimentation tank and RBC of the system should first be filled with fresh water (preferably) and the activated sludge added to the RBC. The RBC should be rotating at all times. The wastewater introduced to the tank needs to have only 20% of the disks covered with waste. This can already provide the needed wetting and still provide some time to reach normal operating levels when source flow is introduced. The final clarifier does not need to be filled with anything.

Alternately, seeding can be accomplished using dry bacteria and a source of organic carbon such as raw molasses or sugar. This can be done, for example, in situations where wastewater or activated sludge are not available and the plant needs to be ready to treat wastewater very shortly after it begins receiving it. By simulating the conditions encountered in wastewater (where large amounts of organic carbon and bacteria are present), biomass will establish on the ROTORDISK® and the plant can thus be prepared to work under actual conditions before these are actually encountered. SEPROTECH SYSTEMS INCORPORATED can help find appropriate supplies of both dry bacteria and raw molasses.

The preferred start up is the introduction of source wastewater at design or less than design loading. The disks need to be rotating at all times. When the disks are rotating and wastewater is introduced the biomass will develop and the pollutants will be removed.

The practice of starting up a sewage plant with a charge of septage or activated sludge may be appropriate for suspended growth systems where sludge return is an essential and necessary part of the process. However, start-up with septage is <u>not</u> an appropriate practice for fixed film systems such as the Rotating Biological Contactor process and is <u>not</u> recommended. This is especially true of the ROTORDISK® process and its static, internal storage of sludge.

Studies have shown that the natural start-up time for a ROTORDISK® is 2 1/2 – 3 weeks (normal temperatures and BOD reduction only), and that it has already developed sufficient biomass for 50% removals in only 1 week. These are time frames significantly shorter than respective ones for suspended growth systems. Thus there is little rationale for "pre-starting" a ROTORDISK® unit with septage.

Further, septage contains solids that are already well digested, and therefore not subject to further digestion-compaction in the storage zones. This contrasts to the fresh solids, which will undergo considerable digestion-compaction in the 6 – 9 months after initial settlement. Therefore, a charge of septage would contribute disproportionately to the accumulation of sludge levels, and necessitate a shorter interval to the first pump-out of the unit.

The ROTORDISK® concept of static sludge storage contributes greatly to its overall operation and maintenance simplicity. Following the above guidelines and recommendations will help ensure that the trouble-free simplicity of ROTORDISK® is maintained.

4.0 - STORAGE OF ROTORDISK® SEWAGE TREATMENT EQUIPMENT

If the unit is not to be operated for an extended period, then the motor-reducer assembly (drive unit) should be removed from its mound and stored at room temperature in a reasonably dry area (unless the whole unit is being stored in such an area).

Additionally:

1. Reducer: The input shaft should be given several turns once a month to re-lubricate the upper bearings.

NOTE: Some reducers are shipped to site filled with synthetic lubrication. Otherwise, fill the reducer with the lubricant (see reducer section of installation & maintenance instructions).

2. Motor: The motor has a tendency to take on moisture when not in operation. It requires no attention during storage, but before it goes into operation the insulation should be measured using a Meger. It should be at least 1.0 mega-ohm. If below 1.0 mega-ohm, it has taken on excessive condensation, and must be dried out before being operated. (Note: any electrical contractor or repair shop commonly understands these terms and procedures).

3. Support bearings on main ROTORDISK® shaft(s) should be re-lubricated prior to start-up.

4. The system should not be installed and operated in water. In the absence of sewage inputs and normal biological activity, freezing and consequent mechanical damage would be a distinct possibility. Water level in the primary settlement tank to be dropped to below the bottom of the Rotorzone tank level, if freezing of the tank contents is possible.

5.0 - ASSEMBLY PROCEDURE OF ROTORDISK® COMPONENTS SUPPLIED BY SEPROTECH SYSTEMS INCORPORATED

1. Upon receipt of mechanical components:

   a. Check packing list for any missing items on delivery.

   b. Motor/Reducer is shipped loose, for assembly on the reducer flange. The reducer is shipped completely filled with synthetic lubricant.

   c. Bearing components are shipped as a set. Open only when ready for assembly to avoid moisture contamination.

   d. Chain and sprockets are shipped as a set. Check for the following:

      -Large sprocket bushing (O.D.) fits into the large sprocket bore.
      -Large sprocket bushing bore (I.D.) fits the Rotordisk® shaft drive end.
      -Small sprocket bore (I.D.) fits on the reducer output shaft.
      -Cottered chain fits or matches the teeth on the sprockets.

   e. Coupling (applicable only to split-shaft ROTORDISK® is shipped as a set. Check the coupling hubs to ensure they fit the center stub ends of the ROTORDISK®shafts.

f. Disk banks are shipped pre-assembled on the shaft by SEPROTECH SYSTEMS INCORPORATED and are shipped on A-frames. Handle with care, as the Fiberglass of the disk banks is brittle.

g. Hardware (bolts, nuts, washers) for mounting the following items are provided:

-Bearings
-Reducer
-Recycle trough

2. If, for any reason, the diskbanks must be removed from the shaft, the procedure for remounting them is as follows:

If disk banks are 5 ft. in diameter or larger (supplied in semicircular sections)

Mount them on shaft(s) as shown on Dwg.# GL-28D, with 1/2-20NFX1-1/2 Bolts. Connect two half sections with two connecting plates (see sketch of typical mounting details) Remove outer nuts on required tie rods, fit connecting plate on tie rods over the end plates, then fasten them together with nuts and washers.

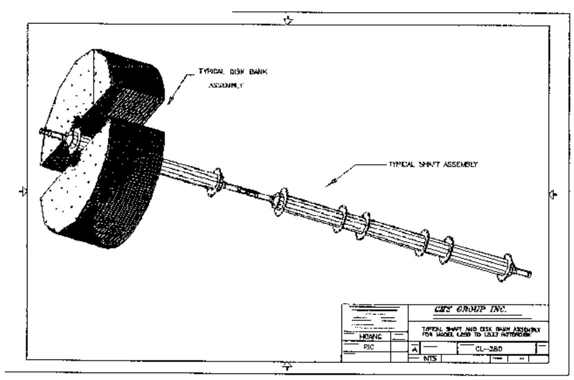


Figure f - typical mounting of disk banks on the shaft(s).

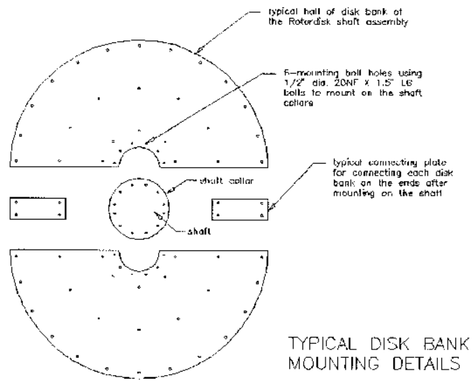


Figure g - exploded view of disk bank mounting parts.

3. Mount Bearings on Shaft(s).

   a) Bearing should be mounted at the centre of stub end. Follow bearing manufacturer's installation instructions.
   b) Use of the bearing fixing rings: one bearing of each pair is "fixed", the other "floating". Install the fixed bearing on the drive end of the shaft and the floating bearing on the non-drive end.

NOTE: All bearings mounted on tapered sleeves have to be driven up the taper to the tolerances given in the manual, using a bearing locking tool or equal. See installation, operation and maintenance instructions section of this manual regarding bearings.

4. Mount coupling hubs on their respective shafts (if applicable) so that hub face is flush with the end of its shaft (for direct drive and 'L' models). See installation, operation and maintenance instructions section of this manual regarding couplings.

5. Install shaft(s) in ROTORDISK® tank.

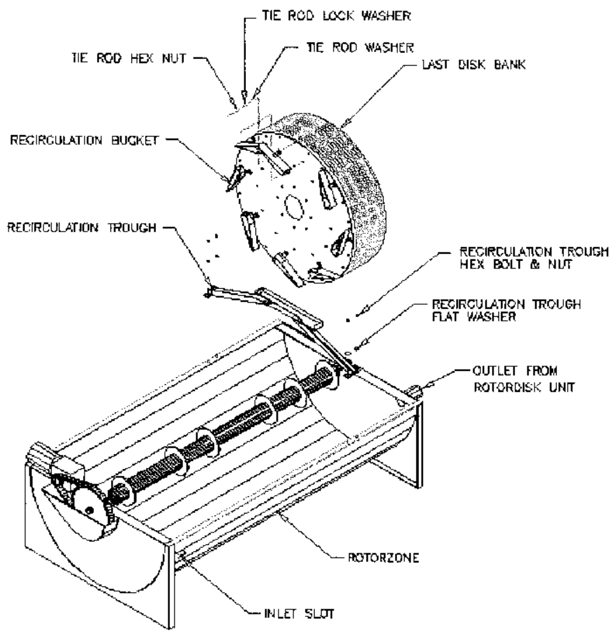
6. Mount small sprocket/coupling hubs on reducer output shaft (whichever is applicable).

7. Install Reducer-Motor Assembly in place. The reducer comes completely filled with synthetic lubricant. Ensure that the breather plug (mounted on top of one of the reducer oil intake ports) is installed on the reducer, after it is mounted on the ROTORDISK®. It is recommended that the motor be mounted into the reducer prior to assembly into the ROTORDISK® tank. Allow for some play in the reducer mounting bolt tightness so the chain tightness can be adjusted later.

8. Connect sprockets with chain. Check the axial alignment of the sprockets while tightening the chain. Tighten the previously loosened reducer mounting bolts after the sprockets are aligned and set in place. See installation, operation and maintenance instructions section of this manual regarding roller chain drives.

9. Connect two coupling hubs, grease, and fit coupling cover (if applicable). Before mounting, check bore on both hubs to match the shaft diameter. See installation, operation and maintenance instructions section of this manual regarding couplings.

10. Mount the stainless steel recycle trough on the ROTORDISK® tank with the bucket opening points to the proper rotation of the shaft.



NOTES:

1. Follow manufacturers instructions in the "Installation, Operation & Maintenance Manuals" included by SEPROTECH SYSTEMS INCORPORATED for mounting bearings, couplings (if applicable), reducer, sprockets and chain (if applicable).

2. Make sure all setscrews on sprockets and coupling hubs; bolts on reducer and bearings, are all well tightened before machine goes into operation.

6.0 - ROUTINE MECHANICAL MAINTENANCE OF ROTORDISK® SEWAGE TREATMENT PLANTS

6.1 - MOTOR:

If motor is equipped with grease fittings and relief plugs, it should be re-lubricated using a low-pressure gun once a year with Shell Alvcnia R2" grease (DO NOT OVER-LUBRICATE). There is no lubrication required for motors without grease fittings and relief plugs

6.2 - REDUCER:

Reduction gear on ROTORDISK® units is filled with synthetic long life lubricant. No inspection or maintenance outside of periodic visual inspection is normally required. If there are no evidence of oil leaks on the seals, the synthetic lubricant must be changed every five (5) years for ROTORDISK® units running 24 hours a day.

Reduction Gear on medium and large ROTORDISK® size units are filled with Shell Tivela 75 oil and does not require oil changes (permanent lubrication). Periodic visual inspection is required. Check oil level and top up to required level with same oil, if necessary.

6.3 - BEARINGS:

Lubricant will deteriorate in time and rate of deterioration is a function of the operating conditions encountered. Lubrication cycle can be determined by analysing the samples taken near the bearing. See bearing manufacturer's maintenance instructions.

6.4 - SPROCKETS AND CHAIN:

(Applicable to non-direct drive ROTORDISK® units)

Chain drive should be inspected every six- (6) months for following points:
- If Chain is covered with grit or chips, it should be cleaned in kerosene and re-lubricated.
- Inspect oil for contamination, such as chips, dirt or grit. Replace oil if necessary (Oil with viscosity of SAE30 at ambient temperature 40° to 100° F is recommended).
- Milky white colour of the oil is indicative of flooding. Replace oil and determine the cause of the flood.
- Check Chain tension and adjust if required.

6.5 - COUPLING:

(Applicable for direct drive ROTORDISK®)

Coupling should be checked for lubricant level. Lubricant is to be added if required. Re-lubrication with NLGI#2 or LTG Grease once a year is usually adequate.

7.0 - TROUBLE SHOOTING

7.1 - MECHANICAL HARDWARE

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Noisy chain	1. Loose chain 2. Faulty lubrication 3. Misalignment 4. Worn Parts 5. Moving parts rubbing stationary parts	1. Tighten chain 2. Lubricate properly 3. Correct sprocket alignment 4. Replace worn chain 5. Align & tighten chain to clear oil bath
Rapid wear on chain	1. Faulty lubrication 2. Loose or misalign parts	1. Lubricate properly 2. Align & tighten entire drive
Chain climbing sprockets	1. Worn out chain and sprockets 2. Loose chain	1. Replace worn out parts 2. Tighten chain
Stiff chain	1. Misalignment 2. Worn out chain or sprockets 3. Faulty lubrication 4. Rust corrosion	1. Correct alignment 2. Replace worn out parts 3. Lubricate properly 4. Clean and lubricate
Noisy Bearing	Rollers or bearings damaged	Replace bearing cartridge
Bearing grease discoloured or mixed with water	Insufficient grease in the bearings	Purge bearing with grease and increase lubrication interval
Hot bearing	1. Improper lubrication 2. Rollers or bearing race damaged	1. Purge bearing with grease and decrease lubrication interval 2. Replace bearing cartridge
Reducer temperature rises above 200 degrees Fahrenheit.	Oil level too high or too low	Maintain proper oil level
Oil leakage from reducer	1. Oil seals need to be replaced 2. Ventilators/breather plugged causing pressure build-up inside the reducer. 3. Oil level too high	1. Replace oil seals 2. Clean Ventilators 3. Correct oil level
Noisy reducer	1. Bearing failure 2. Misalignment in worm gear inside 3. Coupling between motor and reducer worn out and misalign	1. Check bearings and replace if necessary 2. Align worm gear shafts. 3. Replace coupling between motor and reducer. Align coupling hub vertically
Noisy Motor	Bearing damage	Replace damaged bearings
Motor overheating	1. Reducer overheating 2. Cooling fins on motor are clogged 3. Overload 4. Rotor rubbing on stator 5. Over greasing or lubrication	1. Check reducer 2. Clean fins 3. Check for excess friction or imbalance 4. Replace bearings 5. Avoid packing grease too tightly
Motor won't start	1. Power trouble 2. Single phasing at station 3. Fuse blown	1. Check source of power supply 2. Do not try to make it go and "fry" motor. Check starter windings 3. Replace fuse
Knocking/rumbling on motor bearings	1. Bearing worn due to lack of lubrication or excessive mechanical overload 2. Bearings slack in housing	1. Replace bearing and put new grease of recommended grade. 2. Fir new end shields
Rotordisk® shaft doesn't turn	1. Power failure 2. Motor failure 3. Reducer failure 4. Chain drive failure	1. Check power supply 2. Check and replace motor and bearings. 3. Check teeth worn gears and bearings. Replace necessary parts 4. Replace chain

7.2 - ROTORDISK® PROCESS

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
1. Slime on media appears shaggy with a brown colour	PROPER OPERATION	NO PROBLEM. NORMAL CONDITION
2. Black slime growing on disks	Solids and/or BOD overloading	a. Pre-aerate RBC influent b. For severe organic overloads, increase recycle rate c. De-sludge unit d. Place another RBC unit in parallel
3. Rotten egg or other obnoxious odors	Solids or BOD overloading	See Problem 2, solutions a, b, c and d, above
4. Development of odors and white biomass over most of the media surface	1. Septic influent wastewater or high hydrogen sulfide or sulfate concentration	a. Determine the cause of the problem and correct it at source. For example, aerate equalization tank b. Pre-aerate influent wastewater c. Determine the cause of the problem, possibly with the addition of chlorine or hydrogen peroxide; potassium permanganate has also been used
	2. Overload first stage	a. Check dissolved oxygen levels to confirm overload problem b. Increase number of recycle buckets
5. White slime	1. Bacteria that feed on sulfur compounds. Also, industrial discharges containing sulfur compounds may cause an overload	▪ See Problem 2, solutions a and b above
	2. Grease on the disks	a. Remove grease at source b. Install grease traps
6. Sloughing or loss of slime (biomass)	1. Toxic or inhibitory substances in influent, including abrupt pH changes	a. Eliminate source of toxic or inhibitory substances b. Reduce peaks of toxic or inhibitory substances by carefully regulating inflow to plant c. Dilute influent using plant effluent or any other source of water d. See Problem 7.4
	2. Variation in flow or organic loading	a. During low flow or loading periods, pump from secondary clarifier or 4th stage RBC unit effluent to recycle water with food and dissolved oxygen through the RBC unit b. During high flow or loading conditions, attempt to throttle plant inflow during peak periods c. For severe organic under loads, add a cheap source of soluble carbon in the PST such as molasses

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
7. Decrease in process efficiency	1. Reduced wastewater temperature	a. Decrease air opening in RBC building b. Heat air inside RBC unit cover or building
	2. Unusual variations in flow or organic loading	▪ See Problem 6, cause 2, solutions a and b above
	3. Sustained flows or loads above design levels	▪ Install additional treatment units
	4. High or low pH values	▪ Adjust pH to near neutral
	5. Improper rotation of media	▪ Inspect chain tension and adjust
8. Accumulation of solids and clogging in the RBC system	Solids removal in pre-treatment steps is not adequate	a. Improve pre-treatment efficiencies b. Provide supplemental aeration to help prevent solids from settling c. De-sludge primary tank
9. Floating or rising sludge in the secondary clarifier	Removal of sludge from the clarifier is inadequate	a. Increase the duration of pumping sludge from the clarifier b. Remove sludge from the clarifier more often
10. Excess shaft weight or biomass thickness	1. Organic loading too high	▪ Decrease organic loading
	2. Stage loading too high	a. Increase number of recycle buckets
	3. Inorganic solids accumulation because of inadequate pre-treatment	▪ Check primary treatment and grit removal equipment for proper operation
	4. Accumulation of minerals	▪ Use chemical pre-treatment to eliminate minerals
	5. Digester supernatant adding excessive BOD or sulfides	▪ Modify supernatant pumping frequency
11. Shaft rotation non-uniform or "jerky"	1. Normal variations in balance	▪ Time rotation by quarters. A difference of less than 3 seconds in quarter rotation time is normal
	2. Uneven biomass weight due to power outage	a. If severe, shut unit down and wash down disks b. Turn off the unit temporarily and rotate manually to uniformly wet biomass growth before restarting c. Decrease or stop flow of wastewater to affected units d. Contact manufacturer for assistance

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
12. Effluent quality apparently below requirements	1. Organic loading too high	a. Add additional operating RBC's b. Identify cause of additional loading and eliminate at source c. Add supplemental air to RBC trough
	2. Sampling or testing procedures inaccurate	a. If nitrification is occurring, analyze for carbon BOD only by using nitrification inhibitor b. Check for contaminated dilution water, sampler lines, or improper sampling storage
	3. Inadequate secondary clarifier operation	a. Clean and de-sludge clarifier b. Modify sludge removal procedures to eliminate BOD kickback c. Install filters after clarifier d. Increase alum dose to enhance flocculation
	4. Anaerobic solids in the RBC tanks producing BOD kickback	▪ Flush or drain tanks
13. Snails or other nuisance organisms in RBC tanks	Nutritional and conducive environment for reproduction of hard-bodied shell snails ($^{1}/_{8}$" - $^{1}/_{2}$" in size)	a. Addition of controlled dosages of chlorine. Physical removal may be required with taking units out of service temporarily b. Contact manufacturer

Contact SEPROTECH SYSTEMS INCORPORATED for advice on how to resolve problems related to the process before making changes to the process or equipment.

Adapted from Water Pollution Control Federation "Manual of Practice OM-10", 1988.

8.0 - MAINTENANCE PROGRAM – Do's and Don'ts

8.1 - DO'S

1. Do use biodegradable soap if at all possible. The system will, however, handle a certain amount of normal soap. When laundering clothes, please follow manufacturer's instructions regarding quantity of detergent. Excessive use of detergent can cause odour in the system.

2. Do put large amounts of grease in a container and dump in garbage. The system will handle a certain amount of fat and grease. If a tile bed is used and if fats and grease get into it, they may plug the pores of the soil and seal up the bed. Never put large amounts of grease (i.e. old grease from deep fryer) into the sewer lines.

3. Have your system pumped out a minimum of once a year to remove sludge and scum to maintain top operating treatment in your system and filter bed.

4. For small systems equipped with a service hatch, keep the service hatch above the ground. Do not let run-off water enter system, as this will cause hydraulic overload.

5. If a tile bed is used, do keep traffic such as cars, snowmobiles, etc., away from the system bed areas as they will break pipes and seal the soil over the bed.

6. If a tile bed is used, do leave the raised filter in place without disturbing it. The filter is specifically designed to provide maximum dispersal of the water. Altering it by adding fill, covering it up or changing in any way may destroy its water dispersal characteristics and result in bed failure.

7. If a tile bed is used, do encourage a growth of ground cover over the filter bed as it helps disperse water by evaporation and transpiration.

8.2 - DON'Ts

1. Do not put non-biodegradable materials downs the drain, put them in the garbage, these include any plastics, rubber, disposable diapers, sanitary napkins, rubber goods, cigarettes, children's toys, cellophane, etc. They will plug the system, and a pump out will be needed.

2. Do not put harsh chemicals down the drain. They will kill the bacteria necessary for efficient treatment. These include acid or caustic cleaners, gasoline, oil, turpentine, photographic chemicals, etc. Disinfectant and chlorine bleaches should be kept to domestic uses.

3. Do not leave taps running or faulty toilets. The excess water may overload the system and, if used, tile field causing breakout and poor treatment.

4. If you do not have access to workers with appropriate training, do not attempt to fix the mechanical parts yourself. Your dealer is trained to repair your plant and work safely with electrical and mechanical components. Call him if you have a problem or concerns.

5. Do not connect any other electrical load to the fuse or breaker feeding the plant as it will cause damage to the controls.

6. Never put large amounts of grease (i.e. old grease from deep fryer) into the sewer lines.

YOUR CO-OPERATION WITH RESPECT TO THE ABOVE POINTS SHOULD ENSURE TROUBLE-FREE OPERATION OF YOUR TREATMENT PLANT AND WILL BE GREATLY APPRECIATED.

9.0 - INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS FOR VARIOUS MECHANICAL PARTS OF THE ROTORDISK® AND OTHER EQUIPMENT SUPPLIED

9.1 - INSTALLATION & MAINTENANCE DETAILS FOR ROLLER CHAIN DRIVES

CHAIN TENSIONING:
The proper fit of a chain may be obtained by adjusting the sprocket centres. When a chain is correctly tensioned, the total mid-span movement (double amplitude) in the slack span should be 4-6% of the span length for normal drives.

Where there is no adjustment means, adjustment may be made by removing links to compensate for elongation due to wear (Drives with fixed centres). Proper lubrication and proper drive maintenance may minimize chain wear.

LUBRICATION:
Although many slow-speed drives operate successfully with little or no lubrication beyond the initial factory lubrication, proper lubrication will greatly extend the useful life of every chain drive.

A good grade of clean petroleum oil without additives, free from flowing at the prevailing temperatures should be used.

Chain drives should be protected from abrasive and corrosive conditions, and the oil supply kept free of contamination. Periodic oil change is desirable. The lubricant viscosity recommended for ambient temperature 40° - 100°F is SAE 30.

OIL BATH:
With bath lubrication, the lower strand of chain runs through a sump of oil in the drive housing. The oil level should reach the pitch line of the chain at its lowest point while operating. Only a short length of chain should run through oil.

INSTALLATION RECOMMENDATIONS:
Shafting, bearings and foundations should be supported rigidly to maintain the initial alignment. Roller chain should be free of grit and dirt. Wash the chain in kerosene when required. Re-lubricate!

Misalignment results in uneven loading across the width of the chain and may cause roller link-plate and sprocket tooth wear. Drive alignment involves two things:

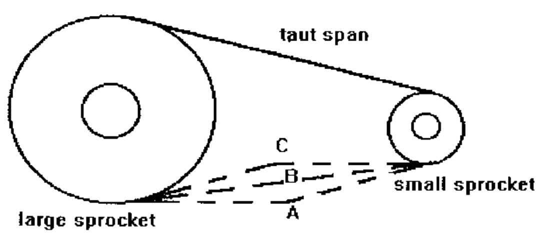
a) Parallel shaft alignment: Shafts should be parallel and level.
b) Axial sprocket alignment: Sprocket axial alignment can be checked with a straight edge, which will extend across the finished sides of the two sprockets.

Normally, it is good practice to align sprockets as close to the shaft bearings as possible.

Installing the Chain: Recheck all preceding adjustments for alignment and make sure all setscrews, bolts and nuts are tight. Fit chain around both sprockets and bring free ends together around one sprocket for connection.

Chain Tension: Check chain tension to be sure that the slack span has 4-6% mid-span movement in horizontal drives.

Recommended Possible Mid-Span Movement AC									
Drive	Tangent Length Between Sprockets								
Center-Line									
	5"	10"	15"	20"	30"	40"	60"	80"	100"
Horizontal to 45	.25"	.5"	.75"	1"	1.5"	2"	3"	4"	5"
Vertical to 45	.12"	.25"	.38"	.5"	.75"	1"	1.5"	2"	2.5"



AC = Total Possible Mid-Span Movement
Depth of Free Sag = .866 AB, approximately

MAINTENANCE RECOMMENDATIONS:

Regular maintenance schedules should be followed for all chain drives. Each drive should be inspected every six months. At each inspection period the following points should be checked:

a) Check Lubrication: If chain is covered with grit or chips, it should be cleaned in kerosene and re-lubricated before reinstalling. With bath lubrication, oil should be maintained at the proper level, as shown in lubrication instructions. Add oil if necessary. At each inspection, oil should be checked for contamination, such as chips, dirt or grit.

b) Check sprocket alignment: If the chain is properly aligned, no wear will show on the inner surfaces of the chain roller link-plates. If wear is apparent, this is evidence that sprockets are misalign and should be realigned as outlined in the installation instructions to prevent further chain and sprocket wear.

c) Check sprocket tooth wear: If sprocket shows evidence of wear high on the sprocket teeth, this is evidence of excessive wear in the chain and the chain should be replaced. If the sprocket teeth are severely worn, the sprocket should be replaced. Do not run new chain on worn sprockets.

d) Check chain tension: At each inspection period, the chain tension should be adjusted. If excessive slack has accumulated which cannot be removed by available shaft centre adjustment (i.e. by moving reducer away from large sprocket using chain tensioning bolts), two or more pitches of chain should be removed and chain reconnected.

9.2 - PROCEDURE FOR ASSEMBLING BEARINGS AND PILLOW BLOCKS

Shaft Preparation
Clean shaft and remove any burrs or sharp edges. Check the shaft diameter to given specifications.

Seal Installation
Place seal, which consists of: Double lip 'G' type seal

9.2.1 - MOUNTING OF BEARING ON SHAFT

Adapter Sleeve Mounting
Position adapter sleeve on the shaft to correct location with respect to required bearing centerline. A smear of lubricating oil (SAE 10 or 20) applied to the sleeve outside diameter surface results in easier bearing mounting and removal. (For pillow blocks mounted close to a pulley hub or similar obstruction, mount the adapter sleeve with threads inboard for easy removal. Remember to slide lock-nut, lock-washer and bearing onto the shaft before positioning the sleeve.)

NOTE: All bearings mounted on tapered sleeves have to be driven up the taper to the tolerances given in SKF tables, to ensure correct fits. Spherical roller bearings can be measured between the unloaded rollers and the outer ring sphere surface.

Un-mounted Clearance, Spherical Roller Bearings
Measure the un-mounted internal clearance in the bearing by inserting and sliding progressively larger feeler blades the full length of the roller between the most vertical unloaded rollers and the outer ring sphere. Never run the rollers over the feeler blade, as the wrong value will be obtained. Record the measurement of the largest size blade that will slide through. This is the un-mounted internal clearance.

Bearing
Mount the bearing hand tight on the adapter sleeve. Be sure the large end of the bore of the inner ring matches the taper of the adapter. To avoid damage to the bearing it is most important during this and subsequent operation that the shaft is blocked up so the bearing is unloaded. Do not apply lock-washer. Drive up procedure may damage it.

Bearing Drive Up, Spherical Roller Bearings
Lubricate the face and thread of the lock nut and apply to sleeve with chamfered face toward the bearing. Tighten the lock nut. Do not attempt to tighten the lock nut with a hammer and drift (use proper wrenches), the lock nut can be damaged and chips can enter the bearing. Further tighten the lock nut and measure the internal clearance until the internal clearance is less than the un-mounted clearance figure by the amount shown in the attached table (see last page). Finally, remove lock nut, position lock washer with outer tangs facing away from the bearing, and inner tang properly seated in the slot provided in the adapter. Replace lock nut and tighten until firmly seated.

9.2.2 - PREPARATION OF PILLOW BLOCK HOUSING
Check to be sure all pillow block parts are free of burrs and are completely clean. Internal surfaces should be removed. Apply a thin coat of grease to the bearing seat in the base. Fit the bearing and seal inserts into the pillow block base, being careful not to damage to O-rings. For assembling larger sizes where hoists must be used, it may be convenient to seat both bearings into their housing bases simultaneously.

FIXING RINGS
On each shaft one bearing is generally "Held" and other bearings are "Free", to permit shaft expansion. For "Held" bearing housings, use two fixing rings. Place one on each side of bearing.

CAPPING THE PILLOW BLOCK
Place the cap on the base so that the dowel pins in the base align with the holes in the cap, being careful not to damage the O-rings. Caps and bases are not manufactured for interchangeable assembly. They must be kept together. Install cap-bolts with lock washers and tighten securely.

GREASE LUBRICATED BLOCKS
Lubrication Notes
Grease Lubrication
If grease is used as a lubricant, it should be smeared between the rolling elements and worked in. The lower half of the housing should be packaged $^1/_2$ to $^3/_4$ full.

9.2.3 - PROCEDURE FOR APPLYING LUBRICANT TO BEARINGS AND PILLOW BLOCKS
Pack each bearing as completely full of the specified grease as possible by swiveling the outer ring open and rotating it as necessary to inject the grease. Then, swivel the outer ring closed being careful not to use force in the event a roller end catch the corner of the outer ring sphere.

B) Before assembling the pillow block cap to the base, and after completing bearing and base assembly, fill $^1/_2$ to $^3/_4$ of the pillow block base with the same lubricant that was used to pack the bearing.

9.2.3.1 - LUBRICATION PROCEDURE TO BE USED AT START-UP
A) All pillow block assemblies that have not been prepared for stage are ready for use, assuming the installation procedures have been correctly followed.

B) While shaft is rotating, lubricate each seal through the outside lubricant fittings until grease is seen emerging from the labyrinth areas. Make sure the outside of the lubricant fitting is clean before applying grease.

9.2.3.2 - RE LUBRICATION
Lubricants deteriorate in time, and the rate of deterioration is a function of the lubricant used at the operating conditions encountered. Determining the re-lubrication cycle depends on sampling the grease and analysis of the samples. Provisions must be made to adequately evaluate the contamination by solids. Samples for grease evaluation should be taken from near the bearing, and evaluation of the samples should dictate the re-lubrication cycle.

Remove caps once a-year and re-apply new grease.

Each seal assembly should be lubricated once a month, while the bearing is rotating, with the same grease that is used in the bearing.

9.3 - GREASE CLASSIFICATION

		Oil Viscosity Saybolt Second (approx. SSU)		
Class	Type of Base (1)	@ 100 F	@ 210 F	NLGI (2) Grade
A	Lithium or Equal	200 - 500	48 – 55	0
B	Lithium or Equal	400 - 600	58 – 68	1
C	Lithium or Equal	800 - 1,000	75 – 82	1
D	Lithium only	800 - 1,000	75 – 82	2

	Grease requirement from above			
Operating temperature of bearing (4)	Low (5)	Medium	High	Suggested Re-lube cycle
0 – 70	A or B			6 – 12 months
70 – 120	B or C			6 – 12 months
120 – 160	B or C	C or D (6)	D (7)	2 - 3 weeks
160 – 200	C	C or D (6)	D (7)	1 - 4 weeks

1) Calcium Complex Greases NOT recommended for spherical roller bearings.

2) National Lubricating Grease Institute Consistency Code.

3) Definition of speed categories:
Low: up to 1/4 of catalog speed limit for static oil lubrication.
Medium: 1/4 to 1/2 catalog speed limit for static oil lubrication.
High: 1/2 to full catalog speed limit for static oil lubrication.

4) Consult SKF Engineering if temperature is below 0° or above 200°F.

5) Extremely slow speed will require special consideration if loads are high.

* Under all conditions, application should be checked using the SKF lubricant film parameter found in the Engineer Data Catalog.

6) Use type "C" where load is heavy, 15,000 hours-rating life or less and/or speed are less than RPM.

7) Consult SKF Engineering - Grease lube not normally recommended under this combination of operating conditions.

8) Dry clean applications only. For moderate conditions of dirt and/or moisture, use cycle of 1 to 2 months. For extreme conditions of dirt and/or moisture, use cycle of 1 week. Vertical applications normally require shorter than normal re-lube cycle.

9) Never mix greases with unlike bases.

10) Remove old grease at least once a year.

10 - LIMITED WARRANTY

SEPROTECH SYSTEMS INCORPORATED warrants the parts in each treatment plant to be free from defects in material and workmanship; for a period of 15 months from shipment or 12 months from start-up, whichever occurs first, in the treatment of domestic wastewater. Sole obligation under this warranty is as follows:

SEPROTECH SYSTEMS INCORPORATED shall fulfil this warranty by repairing or exchanging any component part, F.O.B. our factory, that in SEPROTECH SYSTEMS' judgement, shows evidence of defects, provided said component part has been paid for and is returned through an authorized dealer, transportation prepaid. The warranty must also specify the nature of the defect to the manufacturer. New placed parts are under warranty for one year.

The warranty does not cover treatment plants that have been flooded, by external means, or that have been disassembled by unauthorized persons, improperly installed, subjected to external damage or damage due to altered or improper wiring or overload protection.

This warranty applies only to the treatment plant and does not include any other electrical wiring, plumbing, drainage, or disposal system. SEPROTECH SYSTEMS INCORPORATED is not responsible for any delay or damages caused by defective components or material, or for loss incurred because of interruption of service, or for any other special or consequential damages or incidental expenses arising from the manufacture, sale, or use of this plant.

SEPROTECH SYSTEMS INCORPORATED reserves the right to revise, change, or modify the construction and design of the treatment plant for domestic wastewater or any component part or parts thereof without incurring any obligation to make such changes for modifications in previously sold equipment. SEPROTECH SYSTEMS INCORPORATED also reserves the right, in making replacements of component parts under this warranty, to furnish a component part, which, in its judgement is equivalent to the Company part replaced.

Under no circumstance will SEPROTECH SYSTEMS INCORPORATED, be responsible to the warrantee for any other direct or consequential damages. Including but not limited to; lost profits, lost income, labour charges, delays in production, and/or idle production, which damages are caused by a defect in material and/or workmanship in its parts.

This warranty is expressly in lieu of any other expressed or implied warranty, excluding any warranty of merchantability or fitness, and of any other obligation on the part of SEPROTECH SYSTEMS INCORPORATED.

Appendix B: NORDIKeau Technical Support Manual

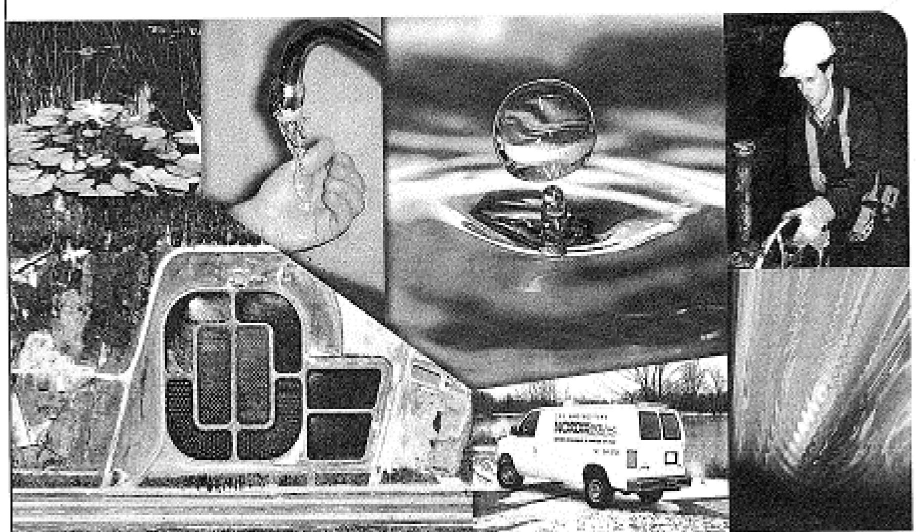
ORIGINAL

AEM

Agnico-Eagle Mines

TECHNICAL SUPPORT

SECTION 2



NORDIKeau INC.

EXPERTS TECHNIQUES EN GESTION DE L'EAU

HEAD OFFICE
603, Base-de-Roc Blvd
Joliette (Québec) J6E 5P3
Tel: (450) 756-6227
Fax: (450) 756-8313
nordikeau@bellnet.ca
www.nordikeau.com

30255 / JUNE 2010

ORIGINAL

AEM

Agnico-Eagle Mines

TECHNICAL SUPPORT

SECTION 2

NORDIKeau INC.

EXPERTS TECHNIQUES EN GESTION DE L'EAU

HEAD OFFICE
603, Base-de-Roc Blvd
Joliette (Québec) J6E 5P3
Tel: (450) 756-6227
Fax: (450) 756-8313
nordikeau@bellnet.ca
www.nordikeau.com

50255 / JUNE 2010

AGNICO EAGLE

TECHNICAL SUPPORT
SECTION 2

Written by :

Yves Payette
Yves Payette, T.A.E. Sr

Approved by :

Frédéric Rubin-Delanchy
Frédéric Rubin-Delanchy, assistant general manager

NORDIKeau INC.
EXPERTS TECHNIQUES EN GESTION DE L'EAU
603, Base-de-Roc Blvd
Joliette (Quebec) J6E 5P3

June 30th, 2010
(N/Réf. : 50255)

NORDIKeau INC.
EXPERTS TECHNIQUES EN GESTION DE L'EAU

TABLE OF CONTENTS

1. INTRODUCTION 1

2. PROCESS DESCRIPTION & DESIGN CHARACTERISTICS 2

2.1 Process description 2
2.2 Design characteristics 3
2.3 Effluent characteristics and performance guarantee 5

3. DESCRIPTION AND OPERATION OF THE SEWAGE TREATMENT 6

3.1 Basic description of the sewage treatment plant 6
3.2 Operation procedure 9
3.2.1 Lifting station n° 1 9
3.2.2 Lifting station n° 2 9
3.2.3 Equalization tank 10
3.2.4 Rotating biological contactors (RBC) 13
3.2.5 U.V. Disinfection system 24
3.2.6 Lifting station n° 3 33

4. PROCESS CONTROL 34

4.1 Summary 34
4.2 Sampling procedures 35
4.3 Sampling points location 36
4.4 Analysis results interpretation 37
4.4.1 Independent laboratory analysis results 37
4.4.2 On site analysis results 40
4.5 Other process interpretations 42
4.5.1 Observing the media 42
4.5.2 Smell 44
4.5.3 Observing the clarifiers and final effluent 44
4.5.4 Determination of the sludge blanket 45
4.6 Process parameters 45
4.6.1 Percent Removal Calculations 45
4.6.2 Organic loading 46
4.7 Process troubleshooting guide 47

5. TROUBLESHOOTING GUIDES 55

NORDIKeau INC.
EXPERTS TECHNIQUES EN GESTION DE L'EAU

5.1 MOTOR AND GEARBOX – BIODISK L333 55
5.2 TROJAN UV 3000 – BIODISK L333 55
5.3 PYROTENAX INDUSTRIAL HEAT TRACING – BIODISK LJ-100 55
5.4 SEVERN TRENT ULTRADYNAMIC UV SYSTEM – BIODISK LJ-100 55
5.5 GREY LINE FLOWMETER DFM 4.0 - EQT 55
5.6 YSI ENVIRONMENTAL – YSI 550A DISSOLVED OXYGEN METER 55
5.7 HACH – SENSION 6 DISSOLVED OXYGEN METER 55

6. RECORD KEEPING 56

APPENDIX

Appendix A MOTOR AND GEARBOX – BIODISK L333
Appendix B TROJAN UV 3000 – BIODISK L333
Appendix C PYROTENAX INDUSTRIAL HEAT TRACING – BIODISK LJ-100
Appendix D SEVERN TRENT ULTRADYNAMIC UV SYSTEM – BIODISK LJ-100
Appendix E GREY LINE FLOWMETER DFM 4.0 - EQT
Appendix F YSI ENVIRONMENTAL – YSI 550A DISSOLVED OXYGEN METER
Appendix G HACH – SENSION 6 DISSOLVED OXYGEN METER

1. INTRODUCTION

The operations manual is a practical guide for the operation and maintenance of the wastewater treatment system, Rotating Biological Contactors type, installed on the Meadowbank mine site to treat domestic effluents from the Main Camp and Nova Camp.

This manual is intended both to the operator and technical supervisor. It aims to collect and condense specific data of works in place. Whenever possible, information available on previous works has also been collected and grouped together to present the most coherent overall.

Typically the operations manual contains the main works components, and described its function, its characteristics and its operation. The equipments mechanical maintenance is briefly discussed, most often in reference with documents provided by the supplier. Finally, it also includes a method and tools to follow and document the works' functioning, including information that must appear in the Daily Operation Logbook.

The operations manual has been prepared assuming that the staff assigned to the building installations has a basic knowledge in wastewater treatment and possesses the necessary qualities and skills to plan and carry out all operating tasks, process control, and maintenance grouped in this manual.

The operator plays a key role and represents a factor in:

- The quality of treated water, in connection with the disposal requirements to be met, among others;
- the optimization of the operation that can significantly reduce costs (electricity, chemicals);
- the quality of equipment maintenance which, in turn, directly affects both short-term costs (repairs) and the medium and long term (parts or equipment replacement).

2. PROCESS DESCRIPTION & DESIGN CHARACTERISTICS

2.1 Process description

Rotating biological contactors (RBC) were originally developed in Europe and recently accepted by America and Asia. The process system is primarily a fixed-film biological reactor consisting of a synthetic medium mounted on a horizontal shaft and place in a contour-bottomed tank. The general concept of rotating biological contactors is to let wastewater flow through the tank, and to rotate the medium in the wastewater to be treated, alternatively exposing the medium (and the attached biological growth) to air and the wastewater. The slowly rotated media are 40% immersed in the wastewater for aerobic removal of organic waste by the biological film developing on the media. The lattice-structured medium, and to a lesser extent the disc structure, is fragile and should be protected from direct exposure to wind, sun, and weather fluctuation. Therefore, the media are usually enclosed in a superstructure or individual shaft covers.

Media rotation can be provided by either mechanical drives or air-motivated rotation. Rotation not only results in exposure of the film to the atmosphere as a means of aeration, but also provides rotational shear forces for stripping off the excess biomass on the medium. The stripped biological solids are maintained in suspension by the mechanical mixing action of the rotation medium or by supplemental diffused air, depending on the driving force of rotation. The air-driven system, in rotating the media by diffused air generated near the thank bottom, alleviates the development of undesirable anaerobic conditions, and also reduces the oxygen limitation, which often is the limiting factor in biological oxidation.

The most important factor affecting performance of the rotating biological contactors is the biological slime of those microorganisms that grow on a series of thin media, such as disc, mounted side by side on a shaft. When the process is first started, the microorganisms in the wastewater begin to stick to the medium surfaces and grow there until all the media are covered with a 1/16 to 1/8 in layer of biological slime. The attached biomass is similar to the biofilm in a trickling filter, except that the microorganisms are passed through the wastewater rather than the wastewater being passed over the microorganisms. As with all biological units, alkalinity, pH, nutrients, temperature, oxygen, biomass population balance, concentrations of pollutants, and so on, must be acceptable for efficient operation.

Most organisms cannot tolerate pH levels above 9.5 or below 4.0. In general, the optimum pH for biological growth lies between 6.5 and 7.8 for carbonaceous oxidation, between 8.2 and 8.6 for nitrification (12), and between 7.2 and 7.8 for denitrification. An alkalinity deficit can result from nitrification; thus a supplemental alkalinity source may be required. The inorganic nutrients normally present in domestic wastewater are sufficient to assure maximum biological growth, provided that all other environmental conditions are optimum. The nutrient needs should be checked when there is a significant industrial waste contribution. A suggested ratio of BOD_5:N:P is 100:5:1. Wastewater temperatures between 13 and 32 °C have no significant effect on process performance. The treatment efficiency, however, decreases with decreasing wastewater temperature below 13 °C. For year-round operation in warm climates, a simple sun roof is sufficient protection; whereas for year-round operation in cold climates, rotating biological contactor plants should be weatherproofed.

To achieve high treatment efficiency, the wastewater should be maintained under aerobic conditions throughout the entire treatment system for carbonaceous and nitrification. It is suggested that a minimum of 1 to 2 mg/L of dissolved residual oxygen be maintained in the tank to prevent oxygen deficiencies from limiting the substrate removal rate.

Each shaft of medium operates as completely mixed, fixed-film reactor, I which the biological growth rate and the excess biomass stripping rate are at dynamic equilibrium. As the treated wastewater and the stripped biomass pass from stage to stage, the wastewater undergoes a progressively increased degree of treatment by the specific biomass found in each stage, which in turn adapt to the changing wastewater. Microorganisms in the initial stages of a medium, which receive the highest concentration of organic wastes, are mainly ordinary bacteria responsible for carbonaceous oxidation. Higher life forms, such as nitrifying bacteria, protozoa, rotifers, and other predators, begin to appear in subsequent stages, where the concentration of organic substances gradually decreases form stage to stage.

2.2 Design characteristics

The sewage treatment plant (STP) has been designed to meet environmental requirements and site conditions.

The STP design includes two (2) parallel biodisks units and has been based on the following characteristics:

NORDIKeau INC.
EXPERTS TECHNIQUES EN GESTION DE L'EAU

DESCRIPTION	L 333	LJ 100	Total
Number of unit	1	3	4
Average Daily Flow	105 m^3/d	3 x 27,5 m^3/d	188 m^3/d
Peak Hour Flow	4 x design	4 x design	4 x design
Influent BOD_5			250 mg/L
Total Suspended Solids (TSS)			250 mg/L
Total Ammonia			35 mg/L
Outdoor temperature			-40 to +40 °C
Indoor temperature			10 to 25 °C
Operating			24 hr / 365 day

Process details

Hydraulic loading	105 m^3/d	3 x 22,62 m^3/d	173 m^3/d
Bio support media area	3390 m^2	3 x 487 m^2	4851 m^2
Bio support media diameter	2,44 m	1,63 m	
Primary clarifier capacity	73,09 m^3	3 x 6,82 m^3	93,55 m^3
Final clarifier capacity	24,72 m^3	3 x 3,88 m^3	36,36 m^3
Biozone capacity	18,12 m^3	3 x 3,43 m^3	28,41 m^3

2.3 Effluent characteristics and performance guarantee

The STP has been designed to meet the effluent characteristics shown in table 2.1 below.

Prior to the construction of the Tailing Storage Facility, the License shall direct the effluent from Stormwater Management Pound to the monitoring station ST-35, to the northwest arm of Second Portage Lake and not exceed the government quality limits shown in table 2.1.

TABLE 2.1 EFFLUENT CHARACTERISTICS AND PERFORMANCE GUARANTEE

PARAMETER	STP Design	Government effluent quality limits	
	Monthly average	Monthly average	Grab sample
BOD_5	15 mg/L	25 mg/L	50 mg/L
TSS	15 mg/L	25 mg/L	50 mg/L
Fecal Coliforms	200 / 100 mL	1000 / 100 mL	2000 / 100 mL
Temperature	10 °C		
pH		6,0 to 9,5	6,0 to 9,5

3. DESCRIPTION AND OPERATION OF THE SEWAGE TREATMENT

3.1 Basic description of the sewage treatment plant

The sewage treatment plant has been designed to treat domestic wastewaters coming from the Main Camp and Nova Camp. As shown in Figure 1, treatment works include the following components:

- **Lifting station n° 1**

  Pumping station n° 1 is adjacent to the Main Camp. It receives grey waters coming from the kitchens and the laundry. A screen basket is installed in front of the inlet pipe to hold the unrefined wastes. These waters are currently pumped downstream to the STP, directly in pumping station n° 3 (LS-3), which insures the pumping of all effluent (treated or not) toward the Tailing Storage Facility.

- **Lifting station n° 2**

  Pumping station no 2 (LS-2) is adjacent to the STP. It receives sanitary wastewaters (washbasins, toilets, showers) coming from dormitories of Main Camp and, still to confirm, Nova Camp. These waters are pumped in the Equalization Tank (EQT) to be processed.

- **Equalization tank**

  The equalization tank (EQT) allows lopping flow peaks of the day. Wastewaters accumulated in this tank are pumped in constant flow towards the rotating biological contactors (RBC). The EQT is currently equipped with four (4) pumps. Pumps P-1 and P-2 send wastewaters towards LJ-1 and LJ-2 RBC, while pumps n° 5 and n° 6 are pumping wastewaters toward RBC L333.

- **Rotating biological contactors (RBC)**

  The RBC secondary treatment system is a fixed culture treatment process. The biological contactor (Rotorzone) is made of several thin plastic disks assembled around a horizontal axis. Microorganisms responsible for the degradation are naturally fixed to the disks and form a biofilm of about 1 to 4 mm of thickness. Approximately 40% of the disks surface is immersed. The disks' rotary movement around the axis alternately exposes the biomass to the atmosphere and the wastewaters, allowing the aeration and wastewaters mixing. The shearing forces created by the rotary movement limit the biofilm's thickness and lead to a detachment of the excess biomass, which is then separated from the effluent with the help of a secondary settling tank (*final clarifier*).

A primary treatment system composed of a settling tank (*Primary tank*) is located under the biological contactor to hold fibrous solids, greases, scum, and other unwanted waste subjected to hang on to the disks.

The treatment system is composed of four (4) biodisks:

- One (1) unit SEPROTECH L333 designed to treat a 105 m^3/d daily flow.
- Three (3) units LJ-100 (one is not started yet) designed to treat an 83 m^3/d daily flow (27, 5 m^3/d per unit).

- **UV disinfection**

The wastewaters disinfection by ultraviolet radiation is the last stage of treatment before the treated waters is discharged towards the Tailing Storage Facility. It consists of sending wastewaters through a reactor composed of mercury vapor lamps emitting UV radiations. The radiations have the characteristic to inactivate the microorganisms.

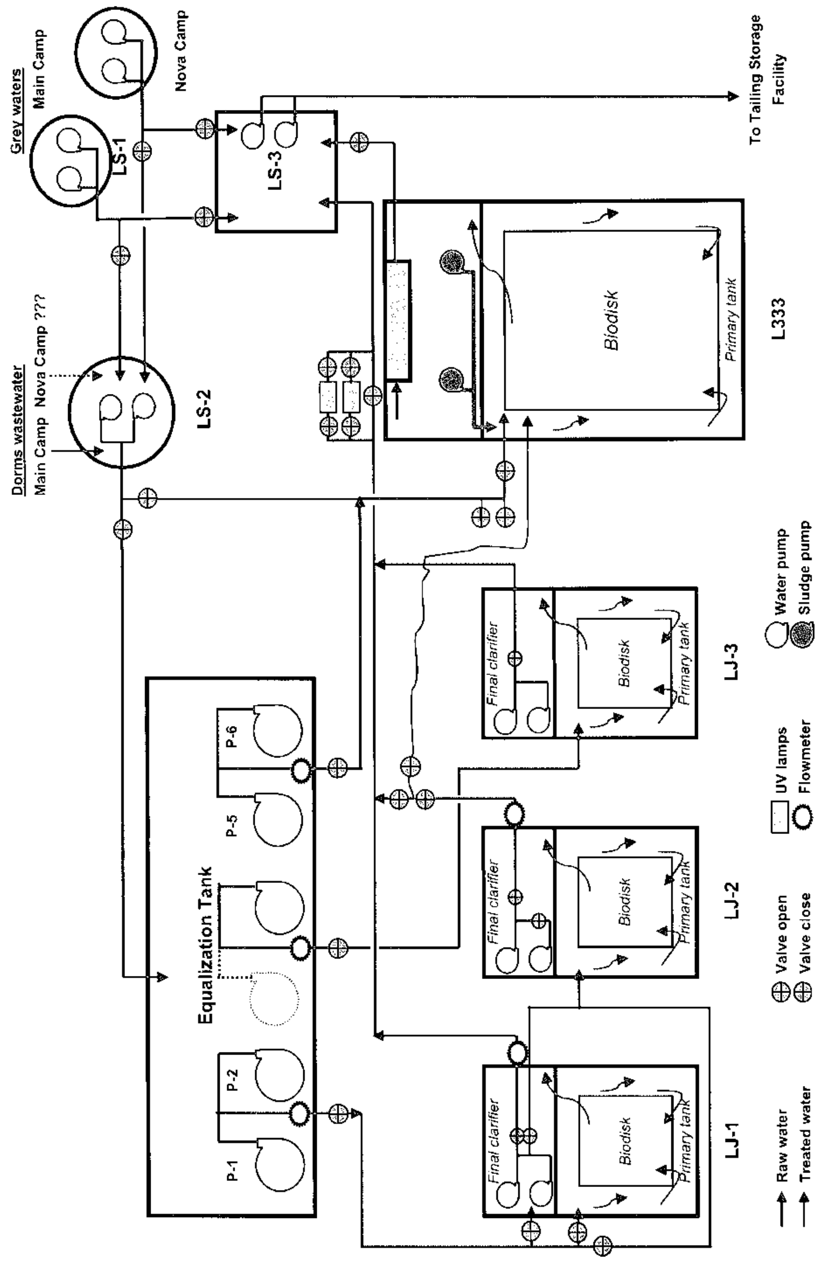
The treatment system is composed of three (3) UV lamps:

- One (1) unit TROJAN, UV3000 PTP model, installed at the exit of biodisk L333
- Two (2) units SEVERN TRENT, ULTRADYNAMICS model, currently installed at the outlet of biodisks LJ-1 and LJ-2. Currently, these units are not in service.

- **Lifting station n° 3**

Pumping station n° 3 is located inside the WTS. It currently receives the final effluent of the STP and untreated grey waters from Main Camp and Nova Camp. Two (2) submersible pumps assure the pumping of these waters towards the Tailing Storage Facility.

FIGURE 3.1: FLOWSHEET



3.2 Operation procedure

3.2.1 Lifting station n° 1

Pumping station n° **1** is adjacent to the Main Camp. It receives grey waters coming from the kitchens and the laundry. A screen basket is installed in front of the inlet pipe to hold the unrefined wastes. These waters are currently pumped downstream to the STP, directly in pumping station n° 3 (LS-3), which insures the pumping of all effluent (treated or not) toward the Tailing Storage Facility.

The lifting station is equipped with two (2) MYERS submersible pumps. There are level floats to control stop, and start cycles of pumps. Each pump has a check valve on their discharge pipe.

Starts and stops levels of the pumps are voluntarily set-up at close intervals to avoid prolonged operations, which could lead to an overflow of pumping station LS-3. It is also for this reason that the ball valve on the pumps' force main (just before LS-3) is maintained partially closed.

The cleaning operation of the screen basket, which requires the presence of two employees, is required approximately once a week.

No overflow pipe is present. In case of defaults of the pumping station, overflowing of the station and sewer system can occur.

3.2.2 Lifting station n° 2

Pumping station LS-2 receives wastewaters (washbasins, showers and toilets), of Main Camp dormitories and, still to confirm, Nova Camp. Pumping station n° 2 (LS-2) is adjacent to the STP. It receives sanitary wastewaters (washbasins, toilets, showers) coming from dormitories of Main Camp and, still to confirm, Nova Camp. These waters are pumped in the equalization tank (EQT).

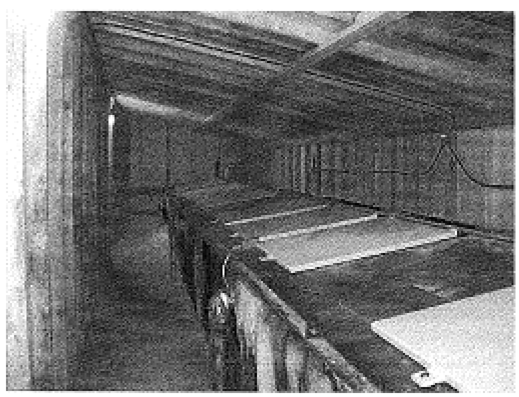
This station is equipped with two (2) MYERS submersible pumps that discharge the wastewater in the EQT. There are level floats to control stop, and start cycles of pumps. Each pump has a check valve on their discharge pipe.

3.2.3 Equalization tank

The equalization tank (EQT) allows lopping flow peaks of the day. Wastewaters accumulated in this tank are pumped in constant flow towards the rotating biological contactors (RBC). The EQT is currently (May 2010) equipped with four (4) pumps, but two (2) more pumps will be installed soon to feed the LJ-3 biodisk:

- Pumps P-1 and P-2 are pumping wastewaters towards LJ-1 and LJ-2;
- Pumps P-3 and P-4 (future) will pump wastewaters towards LJ-3;
- Pumps no. 5 and no. 6 are pumping wastewaters toward L333.

Each pair of pumps are equipped with a Doppler Flowmeter *GREYLINE,* model DFM 4.0. The sensor is fixed to the pipe with coupling material between the sensor face and the pipe. Sensor installation with excessive coupling compound can result in gaps or voids in the coupling and cause errors or signal loss. Insufficient coupling compound will create similar conditions. Over time, temporary coupling compounds (e.g. Petroleum Gel) may gradually sag away from the sensor resulting in reduced signal strength and, finally, complete loss of signal. Warm temperatures, moisture and vibration will accelerate this process. Dow Corning Silicone Compound # 4, as supplied with the DFM 4.0 (and available from Greyline Instruments) is recommended for semi-permanent installations. For more information, refer to the GREYLINE instruction manual.



The equalization tank (EQT) has the following dimensions, approximately: 14,3 m x 2,3m x 2,5 m, for a total volume of 80 m^3. The stabilization of the flow is done with the help of five (5) liquid level floats switches.

Four (4) 10 kW heating elements are installed at the bottom of the EQT to heat wastewater if required. The number of heating elements to put in service must be set to maintain a temperature between 20 and 25 °C. Temperature below 15 °C will probably cause a decrease in microbiological growth on biodisk media and reduce efficiency of the biological process. Temperature over 30 °C increases the nitrification reactions and the anaerobic fermentation which can lead to an important pH and alkalinity decrease and also can, under certain conditions, increase the formation of H_2S gas.

A control unit allow to adjust the running pumps cycles for pumps n° 1 and n° 2 (towards LJ-100), and for pumps n° 5 and n° 6 (towards L333).

The current position of the level floats and pumps on/off cycles' settings ensures an appropriate storage capacity of about 50 m^3.

In automatic mode, the control sequence is currently the following:

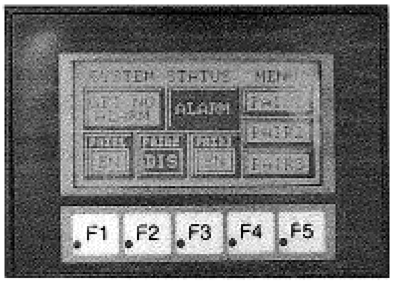
Float 1 (low level):	low level alarm
Float 2 (stop):	stop pumping
Float 3 (start):	Pumps 1 and 2 (54 sec ON, 306 sec OFF) Pumps 5 and 6 (95 sec ON, 265 sec OFF)
Float 4 (high flow):	Pumps 1 and 2 (162 sec ON, 198 sec OFF) Pumps 5 and 6 (285 sec ON, 75 sec OFF)

Float 5 (high level): High level alarm and simultaneous start of the four (4) pumps as long as the float stays in horizontal position.

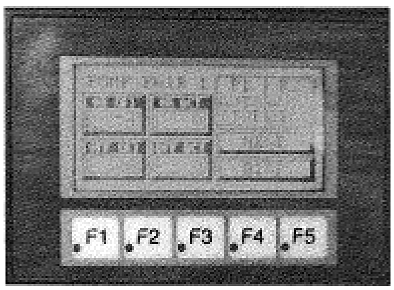
If the water level in the EQT remains low, it indicates that the current controls of the pumps operating time are too high and, consequently, the tank's equalization function is useless.

If the water level in the EQT remains very high, it indicates that the current controls of the pumps operating time are too low and, consequently, the tank's equalization can reach the level 4 «High Flow» which, obviously, would cause overflowing of station LS-3.

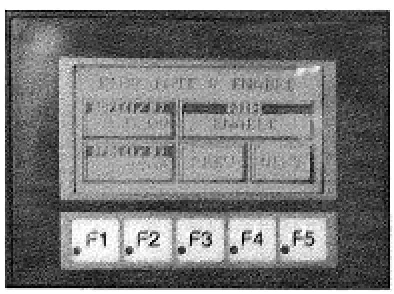
To change the ON/OFF setting cycles of each pair of pumps, you need to follow the step below. The example is for pumps 1 and 2.



Press on **PAIR 1**. A new screen (below) will appear.



Press on **NEXT**. A new screen (below) will appear



Press on **ADF1 (l/s).** Increase or decrease the value in the pop-menu to increase or decrease the running time of the pumps (in seconds) during the 360 seconds ON/OFF cycles.

The five (5) floats level switches must be inspected periodically (once a month). It is very important to keep the floats as clean as possible. Grease can potentially accumulate around the floats and impede operation.

In order to reduce deposits accumulation in the EQT, the level float n° 2 (stop pump) must be kept approximately at mid-level of the motor's pumps.

The depth of solids at the bottom of the EQT must be monitored once a month with the *RAVEN* slude interface detector.

It is possible to bypass the EQT for cleaning, maintenance, or repairs by closing valve V-__ and opening valve V-__. In this situation, Lifting Station n° 2 wastewaters will be all pumped in unit L333. A decreasing of the final effluent quality could be observed.

3.2.4 Rotating biological contactors (RBC)

The treatment system is composed of four (4) biodisks:

- One (1) SEPROTECH L333 UNIT
- Three (3) LJ-100 units

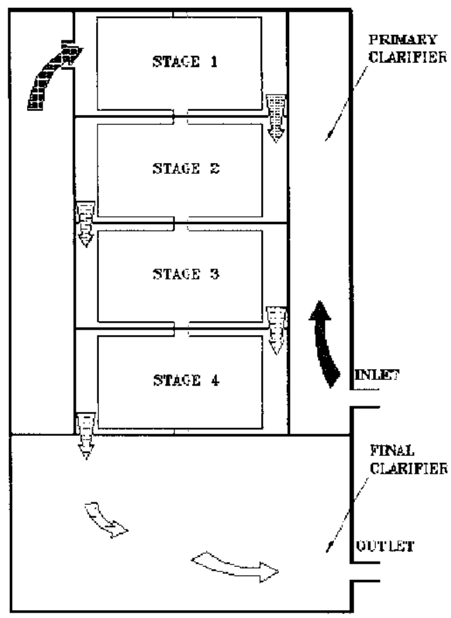
3.2.4.1 Operation summary

Rotating Biological Contactors (RBC) is a secondary treatment plant designed to remove organic material. It is composed of the primary settling tank (PST), the Biozone tank, and the final clarifier.

Raw sewage is pumped into the PST. Fats, oils and greases (FOG) will float to the top of the PST. The Biozone location concentrates the scum in the area along the side walls of the tank. Settling separates the heavy solids. The clarified water enters the Biozone tank section through the inlet slot located at the bottom of the non-drive end section of the Biozone.

This is the first section of four stages in the RBC aeration process. The normal color of the bacteria in the first stage is dark brown. This is the stage where most of the BOD reduction occurs. The succeeding stages are mounted on the same shaft. The fourth disk bank has recycle buckets that introduce both fresh dissolved oxygen into the PST and nitrifying bacteria present in the recycled water.

Partially treated water from the RBC now enters the final clarifier which allows gravity separation of spent biological growth. Spent biomass settles in this chamber. Sludge is pumped to the primary clarifier and the supernatant (final effluent) is evacuated to the Lifting Station n° 3.



3.2.4.2 Biodisk LJ-100

A) Equipment characteristics

Supplier		:	Biodisk Corporation
Capacity (each unit)		:	27 500 L/d at a strength of 250 mg/L BOD Effluent BOD and TSS 20 mg/L
Drive motor and gear		:	Nord Gear Limited SK9043.1-80LH/4 Helical Bevel Gear Motor 208 volts, 1 ph, 60 Hz, 1 HP Rotation speed of the shaft is 4,8 rpm
Bearings	(fixed)	:	SKF SNL22518/3.3/16 TG
	(free)	:	SKF22518/3,3/16 THL Bearings are permanently lubricated

Effluent (2) and sludge (1) pumps	:	MYERS, Model ME50S-53 0,5 HP, 575 V, 3ph, 60 Hz
Flowmeter (LJ-1 and LJ-2 only)	:	ENDRESS & HAUSER, Promag 10W
Recorder (LJ-1, LJ-2 and LJ-3)	:	ENDRESS & HAUSER, Echograph RSG 30

B) Electrical controls

The detailed wiring diagram is provided on the inside of the panel and in the operation manual. All of the electrical power requirements pass through the panel. The panel has been designed for a 600/120v, 60 HZ.

The panel has a 200 watt forced air panel heater.

Breaker protection has been provided for all components.

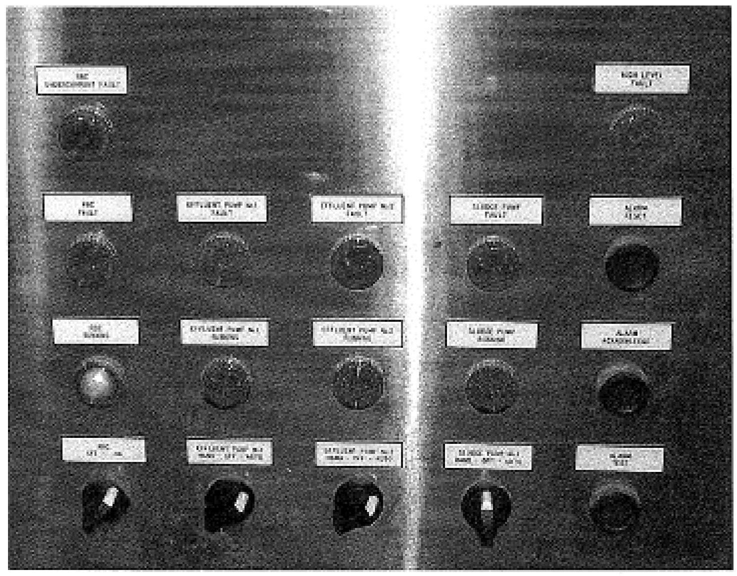
The panel lights will show which equipment is running. Pumps and heaters are normally left in the AUTO position and the RBC runs 24h/365d in the ON position.

Duplex alternating effluent pump controls are provided with HAND-OFF-AUTO switches and high water alarm. The floats in the final clarifier start and stop the pumps. The fourth and highest float allows two pumps to operate at the same time for high flows. This feature will also start the stand by pump when the primary pump failed. The third float is for a high water level alarm.

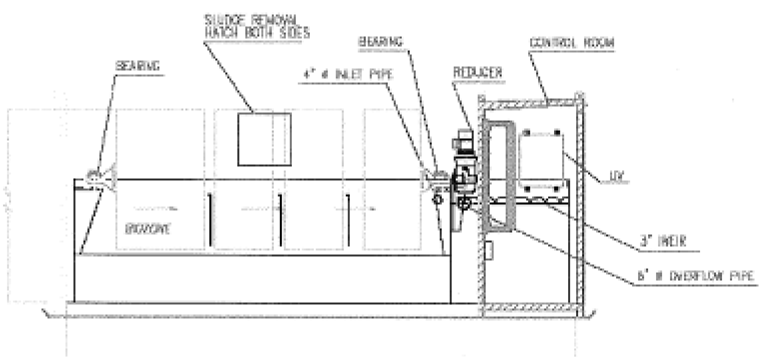
A flashing red light mounted on the top of the control panel is activated by the RBC drive motor when the motor amps are too high or too low, or high water and effluent pump malfunction. The control panel lights will indicate the component that triggered the alarm.

The tank is heat traced. One additional heat tracing contact has been provided.

NORDIKeau INC.
EXPERTS TECHNIQUES EN GESTION DE L'EAU



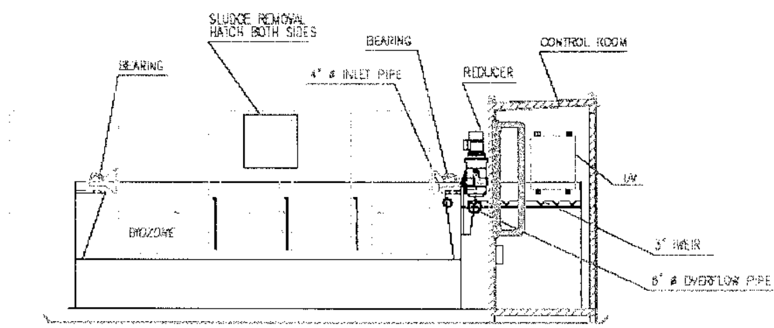
LJ-100 Electrical Panel



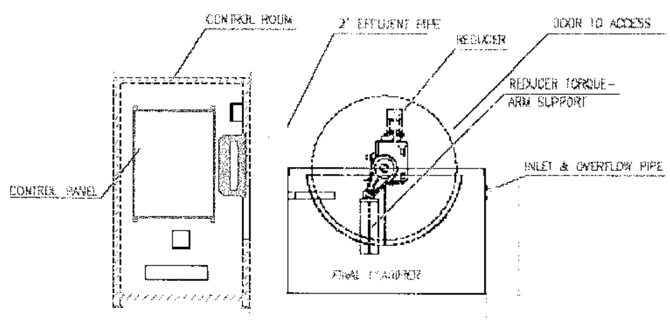
SECTION VIEW

Agnico Eagle Mines - *Technical support Section 2* 16
(N/Réf. : # 50255)

NORDIKeau INC.
EXPERTS TECHNIQUES EN GESTION DE L'EAU



SECTION VIEW

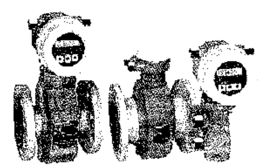


END VIEW

Agnico Eagle Mines• *Technical support Section 2* 17
(N/Réf. : # 50255)

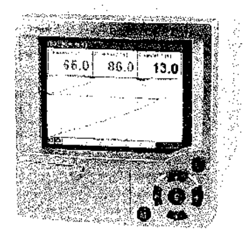
Electromagnetic flow measuring system
PROline promag 10 W

Flow measurement in water or wastewater applications



Ecograph T

Multi Channel Recorder
Display, record, communicate



3.2.4.3 Rotordisk L333

A) <u>Equipment characteristics</u>

Supplier		:	Seprotech Systems inc.
Capacity (each unit)		:	105 000 L/d at a strength of 250 mg/L BOD Effluent BOD and TSS 20 mg/L
Drive motor and gear		:	Nord Gear Limited SK9062185TC Motor TEFC 185 TC Frame 575 volts, 3 ph, 60 Hz, 3 HP
Bearings	(2)	:	SKF SNH22524, 4 $^{3/16}$ inches diameter
	(2)	:	SKF SNH 22526 4 $^{7/16}$ inches diameter
Coupling	(1)	:	
Sludge pumps	(2)	:	MYERS, Model

B) Electrical controls

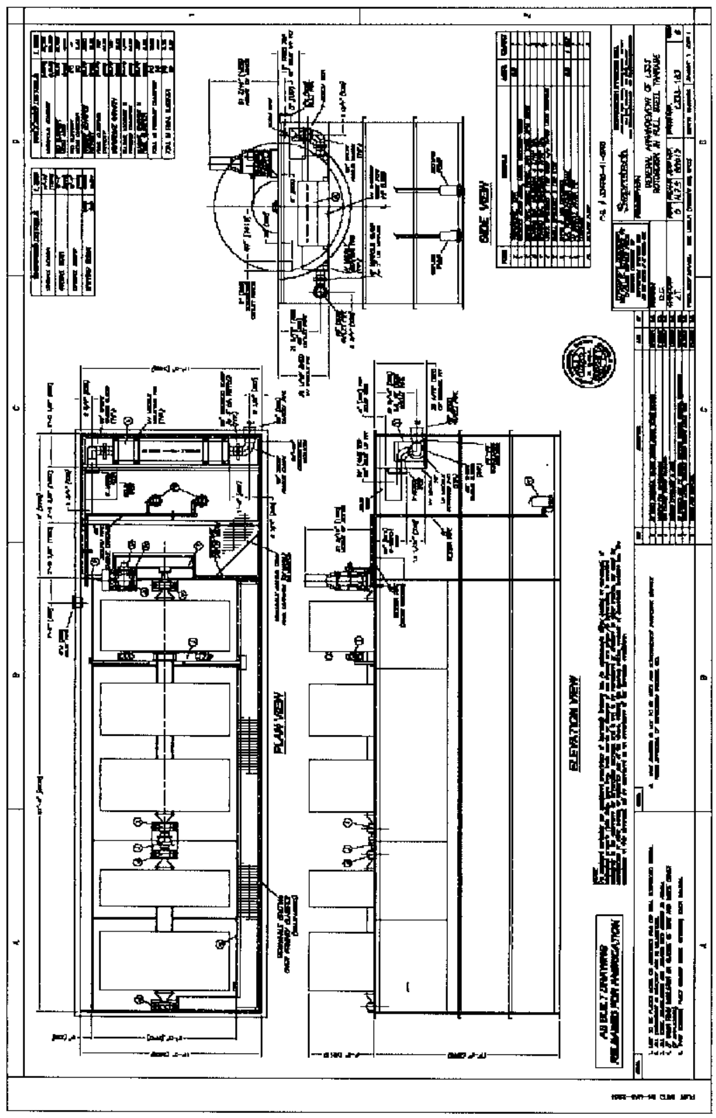
Refer to section 10 of the « *Seprotech L33 Installation, operation and maintenance manual* » for the detailed wiring diagram. All of the electrical power requirements pass through the panel. The panel has been designed for a 600/120v, 60 HZ.

Breaker protection has been provided for all components.

The panel lights will show which equipment is running. Pumps, heaters are normally left in the AUTO position and the RBC runs 24h/365d in the ON position.

Duplex alternating sludge pump controls are provided with HAND-OFF-AUTO switches. In automatic mode, pumps are controlled by an « ON-OFF » timer located inside the panel. Sludge pumps have been initially set to operate for 15 sec every 3 hours.

NORDIKeau INC.
EXPERTS TECHNIQUES EN GESTION DE L'EAU



C) What to check

✓ **Abnormal Noise (1 / day)**

The Biodisk does not have any noisy components. Check valves are the only noisy (clunk) component. The splash of the disk going through the water is as constant as the humming of the motor is. Noises should be at a low level and constant. There are three sources of noise to listen for: the drive, the bearings and the rotating assembly. The drive motor makes a constant humming. High speed noises are generally associated with motor bearings or reducer input bearings. Low speed noises are reducer output noises.

Bearing noises are often cyclical. The rotation speed of the shaft is 4.8 rpm. Bearing can also squeak continuously. This type of noise needs to be investigated.

The rotating assembly consists of the shaft and the disk banks. The disk banks are bolted to the shaft. Lock Tight is used on the disk collar bolts. Movement in the collar bolts will loosen the disk bank and allow it to move. This movement will be evident on every revolution and may be accompanied by a thud. If left unattended, the loose components will eventual break down. Tighten all components that have any movement.

✓ **Visual inspection (1 / day)**

An experienced operator can tell if the Biodisk is working properly by looking at the process. The amount of scum, biomass thickness, coverage, texture, colour, odour, final clarifier scum and time are visual indicators of process efficiency.

Scum will float in the primary clarifier. Scum formation is normal. Fats, oils and grease (FOG) are not beneficial to biological growth and needs to be removed from the wastewater flow before the RBC process. The removal happens in the primary clarifier of the Biodisk. When the scum blanket completely covers the primary tank and has a depth of about 8", the primary tank may need pumping.

The amount of **scum in the final clarifier is an indicator**. A small amount of scum is an indicator that nitrogen gas has being released. Nitrogen gas is liberated in anoxic environments when a carbon source and nitrates are present. This process is called denitrification. When more than 50% of the final clarifier is covered with scum, it is an indicator that the Biodisk may need to have the biosolids and scum removed.

Sludge storage time is directly related to the organic load per day. Lightly loaded systems have long term sludge storage. Scum, biomass thickness, coverage, texture, colour, odour and time are all indicators to tell the sludge's thickness. The removal of biosolids needs to be addressed. A pump-out truck normally does the sludge removal. A particular point to emphasize is that the biological growth (biomass) on the disks should **not** be washed off.

The thickness and distribution of the biomass is an indicator of plant capacity. When the flow is close to or at design, the biomass will be 1/8" in the first stage and progressively less on the following stages. When the treatment is at capacity, biomass will be evident on the last stage. As the flow is reduced, the amount of biomass on the disks will be proportional to the loading. At 50% of design, the organic removal biomass will occupy 50% of the shaft's length. Light brown nitrification bacteria on the last stage are a good sign. Nitrification does not occur in the Biodisk until the BOD is less than 30 mg/L. If the last stage is without obvious biomass, it is a good indicator of complete nitrification.

Biomass colour is a process indicator to the operator. The biomass in the lead stages will be a medium brown colour. In the lag stages, the disks will be lighter brown when the system is lightly loaded and heavier colour shows when designed for nitrification. Colorless or no biomass is a sign of an under loaded system. The appearance of black and grey patches biomass is not good. Black and grey biomass is an indicator of organic overload and or excessive FOG. This will appear first on the lead stage. It may be time to have the system pumped out.

Often, black and grey spots are accompanied by gelatinous material. These unhealthy bacteria hang on the ends of the tie rods. This is also a sign of organic over load, FOG and excessive use of detergents or cleaners.

The **effluent** near the outlet at the backside of the final clarifier should be relatively clear, colourless and relatively free of suspended solids. Clarity can test rapidly by performing turbidity analysis.

The bearing, gear box and motor have been lubricated with long life synthetic lubricants. **Look for oil and grease leaks.**

✓ **Odour (1 / day)**

Odour is evident when dissolved oxygen (DO) levels are low in the RBC. Low DO in the first stage is an indicator of organic overload. If the problem causing the black, grey and gelatinous biomass is not addressed, it will lead to increased odour and process breakdown. The indicators will appear on the first stage and eventually progress down the full shaft.

Odour under the RBC cover is normally not offensive. A healthy biomass smells like rich earth or loam. In some application, the RBC has been used as an odour eater. If the RBC is producing odour, it is an indicator of poor effluent, organic overload or excessive FOG.

✓ **Water sampling and on site analysis (1 / day)**

Dissolved Oxygen (D.O), pH, and temperature analysis must be performed in the first and last stage of the Biodisk.

The same analysis must be performed on the effluent of the final clarifier. Alkalinity analysis must also be performed, if required.

For more information regarding procedures and interpretations analysis, please refer to Section 4 Control Process.

✓ **Monitoring the flow rate (1 / day)**

The plant is equipped with three Doppler (3) flowmeters located on the force main of the EQT pumps. There is also two (2) magnetic flowmeters install on the force main of the effluent pumps of LJ-1 and LJ-2 units.

These instruments are equipped with a counter that allows tracking of the total volume (m^3) and pumps flowrate (m^3/h).

✓ **Determination of accumulated sludge blanket (periodically)**

The sludge blanket in the PST and in the final clarifier must be measure periodically with the « Sludge Interface Detector ». The sludge accumulation must be compare to the maximum storage capacities listed on the "Details" section of the general arrangement drawing for the Biodisk model in question.

Sludge levels should be measured at several locations in each settlement tank to ensure a reasonably accurate calculation of accumulated volumes. This is required since sludge accumulation levels are not uniform; being highest at the inlet ends of both clarifiers, and, below the slot at the bottom of the first section of the Rotorzone. Once an average sludge height has been determined, multiply it by the surface area of the clarifier in question to determine the existing volume of stored sludge. Compare to maximum design capacity listed on the general arrangement drawing. If the accumulated levels equal or exceed design values, it is time to remove the sludge from the unit.

Sludge accumulations in PST should be removed once they reach indicated maximum storage levels, because failure to do so could result in lowered treatment efficiency, and possibly cause serious damage to the structure of the Rotating Assembly and drive unit. If sludge is allowed to accumulate past storage heights, flow through the primary clarifier will begin to disturb the sludge blanket, and thus carry loads of solids and dissolved organic matter into the Rotorzone, which are not anticipated in the design of the unit.

✓ **Sludge removal (periodically)**

L333

A pump-out truck (same type that pumps out septic tanks) normally does the sludge removal. For the L333 primary settling tank, it is preferable to connect the suction hose directly to the three (3) PVC pipes connected to the bottom of the tanks and withdraw the sludge only, while taking as little of the supernatant as possible.

Once the primary sludge is withdrawn from the primary settlement tank, the supernatant of the secondary clarifier can be transferred to the primary settlement tank, to expose the secondary sludge. The suction hose should be placed down at a multiple number of points of the final clarifier (particularly in the corners) to help ensure complete removal of accumulated sludge deposits. Floating surface scum should also be removed.

LJ-100

Before withdrawing the sludge of the LJ-100 primary settling tank, it is recommended to transfer the supernatant at the inlet of other LJ-100 units before connecting the suction hose directly to the bottom of the tanks and withdraw the sludge only.

The same operation is recommended for the LJ-100 final clarifier.

3.2.5 U.V. Disinfection system

3.2.5.1 Summary

Another step in the STP process is to disinfect the wastewater. This ensures that any harmful bacteria are destroyed before wastewater is released from the plant. The most common method for disinfecting treated wastewater for small treatment plants is to use ultraviolet (UV) disinfection. UV disinfection relies on the high energy contained in UV light to destroy the ability of bacteria and other microorganisms to reproduce, thereby, effectively killing them. In wastewater treatment, UV lamps are typically installed in a shallow contact channel, so as the wastewater passes through the channel, UV light is shone through the water. The UV lamps are submerged in the wastewater. When submerged UV lamps are used, they must be encased in quartz tubes to prevent excessive cooling and protected from breakage by a metal grid.

UV disinfection has been proven to be very effective in destroying bacteria in drinking water and some wastewaters. However, because the UV light must reach the bacteria in wastewater in order to be effective, wastewater must be relatively clear and free of turbidity (have few suspended solid particles that give the wastewater a cloudy appearance). In turbid or very cloudy wastewater, the suspended solid particles will reflect and scatter much of the UV light, shielding some bacteria in the wastewater from the light and leaving them unharmed. This will result in inadequate disinfection. For this reason, UV light should not be used as the sole disinfectant on wastewaters with high suspended solids concentrations. It should also be noted that, unlike chlorination, UV disinfection provides no residual disinfection of wastewater. Since wastewater can easily be contaminated again, it should not be stored for a significant length of time before its release back into receiving waters from the treatment facility.

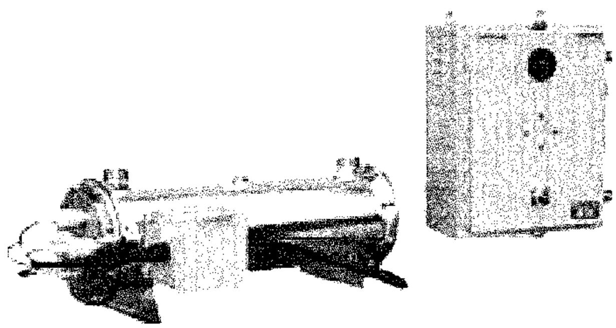
The UV disinfection system must not exceed the following effluent quality limits:

- Fecal Coliforms : 1000 CFU / 100 mL (monthly average)
  2000 CFU / 100 mL (grab sample)

The treatment system is composed of three (3) UV lamps:

- One (1) unit TROJAN, UV3000 PTP model, installed at the outlet of biodisk L333
- Two (2) units SEVERN TRENT, ULTRADYNAMICS model, currently installed at the outlet of LJ-1 and LJ-2 biodisks. Currently, these units are not in service.

3.2.5.2 Ultradynamics UV system



A) Equipment characteristics

Supplier	:	SEVERN TRENT SERVICES
Model – UV Intensity Monitor	:	8102-DM
Model – UV Reaction Chamber	:	8102-HO-60
Number of lamps	:	6
UV lamps rate	:	9000 hours or 1 year
Capacity	:	30 m^3/h (clear wastewater, 65 % T)
Maximum operating pressure	:	150 psi
Power requirements	:	240 V, 1,3 kW, 5,6 amps
Maximum water temperature	:	38° C
Ambient temperature	:	2 to 43° C
Maximum start/stop cycles	:	4 per 24 hours
Minimum flowrate (to avoid heat)	:	0,7 m^3/h (3 us gal/min)

B) Equipment description

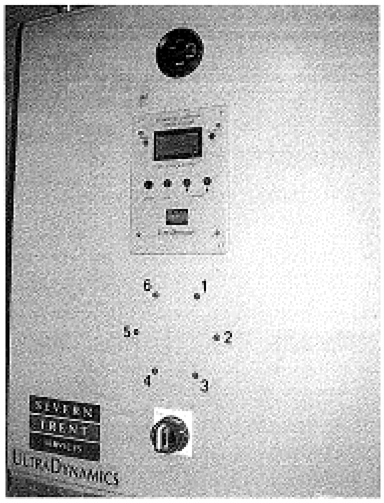
Ultraviolet disinfection performance is monitored with the UV Intensity Monitoring System. The Ultraviolet Intensity Monitoring System includes a monitor with digital display and indicator alarms mounted in a remote cabinet and a sensor assembly located at the lamp source.

Ultraviolet light intensity is monitored with a submersible UV Sensor designed for reliability in a water environment. The sensor transmits an electrical signal proportional to the UV intensity in the channel to the UV intensity monitor. The system is set to accurately indicate relative UV light intensity on a scale of 0 to 100%, with 100% representing the UV intensity in normal process effluent with clean quartz sleeves and new lamps in the UV system. Indicator lights and alarms on the UV intensity monitor keep the operator informed of UV system performance. The sensor is positioned in a UV reactor to measure the relative UV energy. Since the rate of quartz sleeve fouling and the water quality are consistent within the reactor, the readings from the UV intensity monitor are a good indication of performance.

UV Intensity Monitoring Systems measure relative UV intensity, not actual UV intensity. A reading of 100% represents the UV intensity registered with clean quartz sleeves, new lamps and normal water quality. Reductions in UV intensity are due to lamp aging, fouling of quartz sleeves, fouling of the diffuser on the sensor, and/or changes in water quality (suspended solids and percent transmission).

When cleaning the UV system quartz sleeve, it is also necessary to clean the UV sensor probe. Shut off water, relieve the system pressure and/or isolate (valve out) the UV chamber. Remove the monitor by unscrewing the white retaining nut and sliding the probe out of the sensor port. Deposits on the sensor probe are mostly caused by suspended and dissolved solids and minerals naturally occurring in the water. This coating can be easily removed by applying a small amount of lemon juice on a soft dry cloth and gently rubbing the sensor probe until clean, rinsing with hot water.

NORDIKeau INC.
EXPERTS TECHNIQUES EN GESTION DE L'EAU



Ultraviolet lamps must be replaced every 10 to 12 months of continuous use, after every two (2) years of intermittent use, or when the monitor reads 60% of the new lamp output. **DO NOT WAIT** for the monitor to cut-off. Always stock spare lamps.

C) Operation and maintenance

Inspecting the Quartz Jackets:

As water passes through the UV unit, minerals, debris and other matter in the water will settle and deposit onto the quartz jackets. This will impair the ability of the UV rays to penetrate into the water. Therefore, it is necessary to determine a cleaning schedule for the quartz jackets, and the frequency will depend on the specific type of water used at your facility.

If the water has been processed through deionization, reverse osmosis, or distillation, the cleaning frequency can be set at once a year. If clear, fresh water is used, the probable cleaning frequency will be anywhere from once every thirty (30) days to once every six (6) months. You can determine the cleaning frequency by visually inspecting any quartz jacket to see if any debris or film has settled on the outside of the quartz jacket.

Severn Trent Services suggest to initially scheduling your first inspection after thirty (30) days of use and after the first month. If the quartz jacket is noticeably dirty, your cleaning frequency should be shortened; if the jacket is clean, the frequency can be lengthened.

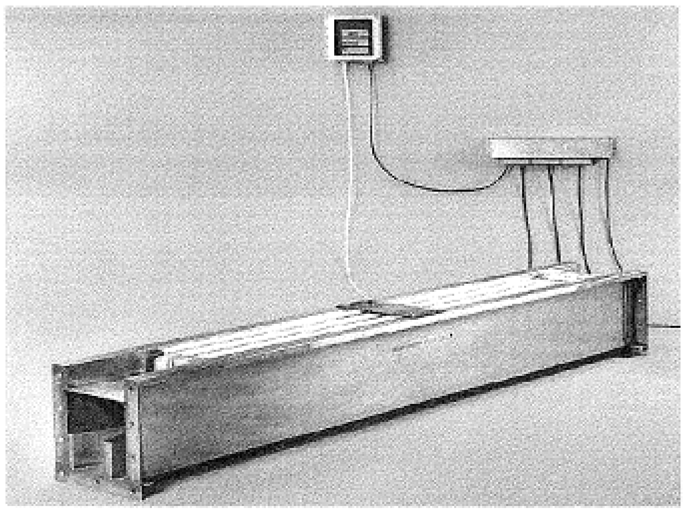
Cleaning the Quartz Jacket:

To clean the quartz jackets, first turn off the water, disconnect the electrical service and drain the UV chamber. Next, remove the UV lamps. Then loosen the compression nut and carefully remove the quartz jackets. The quartz jackets may be washed with a mild soap and hot water and rinsed clean with hot water. Should this be insufficient to clean the quartz jackets, use a mild abrasive cleaning agent. Be careful when cleaning the quartz jacket. It is fragile. Should a quartz jacket be damaged, it must be replaced.

Other Periodic Maintenance :

- ✓ Operate the quartz jacket wiper system regularly on manual models (push/pull stroke). You cannot overclean the quartz jacket(s).
- ✓ The exterior surfaces of the UV unit should be kept clean as part of routine maintenance. Use a soft cloth and water or any commercial stainless steel cleaner.
- ✓ Inspect for overhead piping leaks and correct as necessary to protect UV equipment.
- ✓ Measure the performance of the UV unit at sufficient intervals to ensure the effluent meets your requirements.

3.2.5.3 Trojan UV system



A) Equipment characteristics

Supplier	:	TROJAN TECHNOLOGIES
Model	:	UV3000 PTP
Model – UV Reaction Chamber	:	8102-HO-60
Number of lamps	:	
Number of module	:	
UV lamps rate	:	8 760 hours (1 year)
Capacity	:	
Power requirements	:	
Maximum water temperature	:	
Ambient temperature	:	
Maximum start/stop cycles	:	
Minimum flowrate (to avoid heat)	:	

B) Equipment description

The Trojan UV3000TMPTP is made of several components (some of which are optional):

- UV Module
- UV Lamps
- Quartz Sleeves, Springs, Spacers
- Lamp Holder Seal Assembly
- Effluent Channel
- Transition Boxes
- Power Distribution Receptacle
- Monitoring System UV Sensor
- Level Control Weir
- UV Module rack

UV Module

The UV module is the basic unit of the flowthrough UV bank. A bank is made up of UV modules placed in parallel within a single channel.

UV Lamps

Trojan supplied __ inch long UV lamps. The UV output after one year of use is approximately 80% of the output after the 100 - hour burn-in period. It should also be noted that frequent cycling shortens the life of the lamps.

Quartz Sleeves, Springs, Spacers

The quartz sleeves are made of Type 214 clear fused quartz circular tubing. They are rated 89% for UV transmittance and are not subject to solarisation. The sleeves protect the lamps from breakage and in conjunction with the spacer rings, they provide insulation. This assures minimum lamp temperature variations, which could affect the lamps performance.

Lamp Holder Seal Assembly

The open end of the lamp sleeve is sealed with a type 316 stainless steel sleeve nut which threads onto a sleeve cup and compresses the sleeve o-ring. The knurled surface of the sleeve nut allows a positive handgrip for tightening; it does not require any tools for removal. The lamp is held in place with a moulded lamp holder, which incorporates a triple seal. The lamp holder seals against the inside of the quartz sleeve to act as a second seal in series with the external o-ring seals.

Another seal on the lamp holder isolates and seals the lamp from the module frame and all other lamps in the module. If a quartz sleeve fracture happens, the seals of the lamp holder prevent moisture from entering the lamp module frame and the electrical connections to the other lamps in the module.

Effluent Channel (Type K)

The effluent channel is typically made of 14 Type 304 stainless steel gauges, and comes complete with drain, UV module support rack and downstream serpentine weir.

Transition Boxes (optional)

Transition boxes are conceived to provide transition between the UV channel and flanged inlet and outlet pipes. The inlet transition box helps to ensure a plug flow condition that is conducive to more efficient disinfections.

Power Distribution Receptacle

The PDR consists of duplex ground fault interrupter receptacle that can be mounted in a location which allows convenient hook-up of UV Modules. The PDR is provided with a weatherproof cover. However, direct water sprays should be avoided.

Monitoring System UV Sensor

The submersible UV Sensor measures the UV intensity within each bank of UV lamp modules. The UV Sensor is mounted on a representative UV lamp module. The UV Sensor is calibrated in the factory and should not be altered, or its calibration changed. The monitoring system offers the main following features:

- A UV Sensor that continuously monitors the UV intensity produced in each bank of UV lamp modules.
- A 3 character display that indicates UV intensity in milliwatt per square centimeter (mW/cm2). This display will flash when the intensity drops below the Low UV Intensity Alarm setpoint.
- A 5 character display that indicates elapsed time in hours. The Elapsed Time display will flash when lamps will need to be changed in a near future.

Level Control Weir (optional)

A water level control weir controls the effluent level within the UV channel.

UV Module Rack

The UV Module Rack is a stainless steel support frame, which supports each bank of UV modules.

D) Operation and maintenance

To ensure maximum performance, it is essential that the quartz sleeves containing the UV lamps are kept clean. If coating is to building up on the sleeves, the amount of UV light transmitted to water is reduced. The cleaning interval for the UV modules depends on the effluent quality. Often, a hosing off of foreign matter clinging to the unit may be all that is required. Over a period of time, however, a coating will build up on the quartz sleeves and it will be necessary to clean them thoroughly.

Always clean quartz sleeves when intensity falls below 2,8 mW/cm2. Clean the UV Sensor at the same time.

CAUTION : ***Wear cotton gloves when handling quartz sleeves and lamps.***

The Trojan UV3000TMPTP sleeves' cleaning method is to manually hand wipe the quartz sleeves using a Trojan approved cleaning agent. The cleaning agent is applied using a cleaning cloth or sprayed on the quartz sleeves, then wiped off. See the Trojan Instruction Manual for the complete maintenance procedure.

The crest of the Level Control Weir and the channel must be clean periodically.

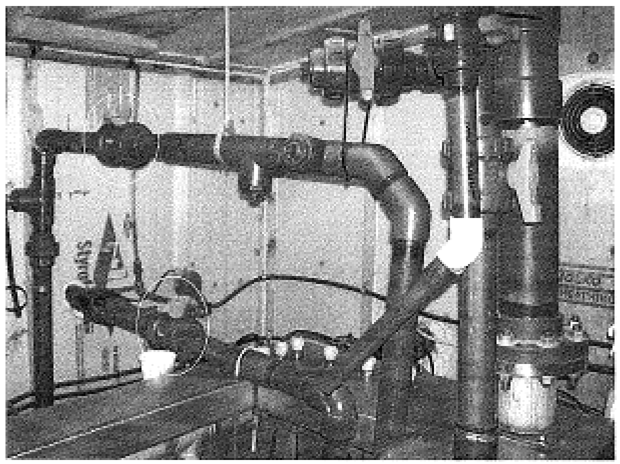
Lamps must be typically replaced every 8760 hours of operation (1 year), although the actual time varies according to the following factors: effluent temperature, power levels of lamps, and frequency of switching lamps ON and OFF. To ensure lamps are replaces at the proper time, it is best to replace all lamps in a scheduled operation, and to maintain a record of lamp replacement dates and elapsed timing on all lamps.

3.2.6 Lifting station n° 3

Pumping station LS-3 received the final effluent of the STP and grey waters (untreated) of Main Camp and Nova Camp wastewaters.

This station is equipped with two (2) MYERS submersible pumps and forces back waters towards the Tailing Storage Facility. Pumps control is ensured by four (4) level switch floats. Both pumps run simultaneously when the water level in the station reaches the level switch n° 3. Timers for the pumps' running time figured on the control panel.

The dimensions of the wet well are very limited (1,20 m x 0,9 m x 0,9 m), as well as the pumping flowrate capacity of the station. **No overflow pipe is present.** Overflowing can thus occur, particularly when pumps upstream are manually started for more than a few minutes. For that reason, the ball valves installed on both grey waters 2 inches inlet pipes must be maintained partially closed (see photo below). Furthermore, Nova Camp's grey waters are pumped during the night, a low flow period.



4. PROCESS CONTROL

4.1 Summary

Operation of the RBC system is more than "just turning it on and letting run itself". The operator has a number of options even in plants with limited flexibility if he is willing to use his ingenuity.

Certain visual indicators, such as the appearance of different biomass colors, presence of odours and amounts of solids in the effluent of clarifiers and RBC overflow points, give and indication of how the process is working. These have been described in the lesson; however, they have to be related to the individual plant before they have true significance to the operator. They are valuable and should not be overlooked or discounted.

Additionally, certain lab tests are also described to tell whether the first stage is overloaded, whether nitrification might be expected in later stages, whether nitrification is occurring and reducing pH, how much DO is present, etc. Test results should be used to make process control decisions, not simply to satisfy some regulatory requirement. Use of this information has been described.

Maintenance must be performed routinely and preventive steps taken to keep the process healthy. Lubrification of bearings, maintenance of other moving parts such as shafts, belts, chains, and media are all part of standard operation duties. The importance of this has been mentioned above.

Finally, the RBC units are depending on the correct functioning of the other processes. When all the parts of the process reviewed as tools needed to produce the final products, namely disposable solids and acceptable effluent, the operator can be proud of his job.

4.2 Sampling procedures

The analytical results of a sample are only as accurate as the quality of the sample taken. If your technique for collecting the samples is poor, then no matter how accurate your lab procedures are, the results will be poor. Buy sampling according to set procedures, you reduce the chance of error and increase the accuracy of your samples results.

Wastewater sampling is generally performed by one of two methods:

- grab sampling
- composite sampling

Grab sampling is just what it sounds like; all of the test material is collected at one time. As such, a grab sample reflects performance only at the point in time when the sample was collected, and only if the sample was properly collected.

Composite sampling consists of a collection of numerous individual discrete samples taken at regular intervals over a period of time, usually 24 hours. The material being sampled is collected in a common container over the sampling period. The analysis of this material, collected over a period of time, will therefore represent the average performance of a wastewater treatment plant during the collection period.

Numerous industry references list various parameters for wastewater testing and whether samples should be collected using grab sampling or composite sampling methods. For example, grab sampling allows the analysis of specific types of unstable parameters such as pH, dissolved oxygen, chlorine residual, and temperature.

However, the most widely used indicators of treatment plant performance, including BOD_5 (biochemical oxygen demand), TSS (total suspended solids) normally require the use of a 24 hours composite sampling techniques because routine variations in the volume and strength characteristics of incoming wastewater create fluctuations in the quality of treatment plant effluent. Therefore, an effluent grab sample taken at one specific time throughout the daily flow pattern will not be representative of the system performance over the entire day.

In the absence of an automatic composite sampler on Meadowbank site, all the water samples collected to control and monitor the process are taken using grab samples.

Once a sample is taken, the constituents of the sample should be maintained in the same condition as when collected. When it is not possible to analyze collected samples immediately, samples should be preserved properly. Biological activity such as microbial respiration, chemical activity such as precipitation or pH change, and physical activity such as aeration or high temperature must be kept to a minimum. Methods of preservation include cooling, pH control, and chemical addition. Freezing is usually not recommended. The length of time that a constituent in wastewater will remain stable is related to the character of the constituent and the preservation method used.

4.3 Sampling points location

In order to make appropriate adjustments to the treatment plant, the operator should be able to take representative water sample at the following location of the STP as shown on Table 4.1.

NORDIKeau INC.
EXPERTS TECHNIQUES EN GESTION DE L'EAU

Table 4.1 Sampling points location

Sampling point	Location	Test to perform		Comments
		On site by operator (each day)	Independant laboratory (each week)	
STP Influent		pH temperature	BOD5 COD TSS NH3-NH4 P tot	
Biodisks (First stage)		pH Temperature D.O. Media observation		
Biodisks (Last stage)		pH Temperature D.O. Media observation		
STP Effluent		pH Temperature D.O. Turbidity	BOD5 COD TSS NH3-NH4 P tot NO2-NO3 Fecal coliform	

4.4 Analysis results interpretation

There are a number of parameters and analyses that should be tested and tracked, beyond those required by the Government. This chapter is intended to introduce the reader to laboratory tests interpretation.

4.4.1 Independent laboratory analysis results

Biochemical Oxygen Demand (BOD) is the rate at which micro-organisms use the dissolved oxygen in the wastewater while stabilizing or breaking down decomposable organic matter. In decomposition, the organic matter serves as food for the bacteria.

The BOD is an index of the amount of oxygen that will be consumed by the decomposition of the organic matter in a wastewater.

The analysis consists of measuring the initial dissolved oxygen concentration in a water sample, and measuring the final dissolved oxygen after incubation for five (5) days (BOD_5) at 20 °C.

The STP has been designed to reduce total BOD of the effluent to approximately 15 mg/L.

The organic loading apply on a RBC must generally not exceed 5 g BOD / m² of Bio support media / day.

An increase of BOD on the effluent treated water is a sign of deterioration of the treatment process.

Chemical Oxygen Demand (COD) is a measure of the water capacity to consume oxygen during the decomposition of organic matter and the oxidation of inorganic chemicals such as ammonia and nitrite. Chemical Oxygen Demand is measured as a standardized laboratory assay in which a closed water sample is incubated with a strong chemical oxidant under specific temperature conditions and for a particular period of time. A commonly used oxidant in COD assays is potassium dichromate ($K_2Cr_2O_7$) which is used in combination with boiling sulfuric acid (H_2SO_4). Because this chemical oxidant is not specific to oxygen-consuming chemicals that are organic or inorganic, both of these sources of oxygen demand are measured in a COD assay.

Generally, COD is preferred to BOD in process control applications because results are more reproducible and are available in just a few hours rather than five (5) days.

The COD test is not a direct substitute for the BOD test; however, a ratio usually can be correlated between the two (2) tests. This requires COD versus BOD testing over a specified period of time.

On typical domestic wastewater, a ratio COD/BOD between 2 and 3 is usual. On treated effluent a ratio COD/BOD between 4 and 6 is usual.

Total Suspended Solids (TSS) are the particles which are either suspended in solution or slowly settled to the bottom. Wastewater treatment plants are designed to remove TSS from wastewater.

TSS of a water sample is determined by pouring a carefully measured volume of water through a pre-weighed filter of a specified pore size, then weighing the filter again after drying to remove all water. The gain in weight is a dry weight measure of the particulates present in the water sample expressed in units derived or calculated from the volume of water filtered (typically milligrams per litre or mg/L).

Although turbidity purpose is to measure approximately the same water quality property as TSS, the latter is more useful because it provides an actual weight of the particulate material present in the sample. In water quality monitoring situations, a series of more labor intensive TSS measurements will be paired with relatively quick and easy turbidity measurements to develop a site-specific correlation.

The STP has been designed to reduce TSS of the effluent to approximately 15 mg/L.

An increase of TSS on the effluent treated water is probably a sign of insufficient sludge extraction in the biodisks's final clarifier.

Ammonia nitrogen (NH_3 and NH_4^+) is a form of nitrogen, which is a nutrient necessary for both plant and animal life. The Nitrogen Cycle is the natural conversion of nitrogen from one form to another through various biological processes. Wastewater treatment plants are generally designed to remove NH_3 from wastewater.

Large concentrations of ammonia create a large oxygen demand due to the conversion of ammonia to nitrate (NO_3) by nitrifying bacteria. Approximately 4.3 mg O_2 are consumed for every mg of ammonia-nitrogen oxidised to nitrate-nitrogen.

Nitrification is possible if sufficient detention time is created. There are two (2) bacterial species involved. *Nitrosomonas sp.* bacteria which oxidize ammonia to nitrite, while Nitrobacter bacteria convert nitrite to nitrate, with both species utilising the energy released by the reactions.

Between 7 to 8 mg of alkalinity in the form of HCO_3^- are consumed per mg of ammonia-nitrogen oxidised. This is quite a substantial amount of alkalinity and it will over a period of time dramatically change the character of the water during the treatment process, affecting pH stability. Nitrification process is the main reason of the pH water drop during the RBC treatment process.

The increase of nitrites ($NO_{2)}$ and nitrates (NO_3) during the treatment process, and the decrease of ammonia nitrogen (NH_3 and NH_4^+) and pH is also an indication of the rate of nitrification during the treatment process.

Even if the STP system has been designed for ammonia/nitrate removal, there is no Government effluent quality limits for these parameters.

Controlling **phosphorus** discharged from municipal wastewater treatment plants is a key factor in preventing eutrophication of surface waters. The overall total phosphorus removal obtained in a conventional biological wastewater treatment like the Meadowbank STP is generally very low, less than 20%.

4.4.2 On site analysis results

Temperature is an important factor for the treatment process. Settling properties are more effective at higher temperatures whereas colder conditions reduce the biological activity and organic removal efficiency decreases at wastewater temperatures below 15 °C.

Water will hold more dissolved oxygen at colder temperatures as compared to warmer temperatures. Water in the winter can hold almost twice as much Dissolved Oxygen (DO) as in the summer.

Biological activity and nitrification process decreases, however, as temperature decreases.

Covers on RBC provide protection against drop of water temperature and protect equipment and media from freezing during winter.

The term **pH** is a measure of the acidity or alkalinity of a liquid. The pH scale ranges from 0 to 14, with the acceptable range for wastewater typically being 6.0 to 8.5.

The microbiological organisms begin to become stressed at higher and lower pH which in turn results in lower treatment efficiencies.

Turbidity is the cloudiness or haziness of a fluid caused by individual particles (suspended solids) that are generally invisible to the naked eye, similar to smoke in the air. The measurement of turbidity is a key test of water quality.

A property of the particles —they will scatter a light beam focused on them — is considered a more meaningful measure of turbidity in water. Turbidity measured this way uses an instrument called a nephelometer with the detector setup to the side of the light beam. More light reaches the detector if there are lots of small particles scattering the source beam than if there are few. The units of turbidity from a calibrated nephelometer are called Nephelometric Turbidity Units (**NTU**). To some extent, how much light reflects for a given amount of particulates depends on properties of the particles like their shape, color, and reflectivity.

For this reason (and that heavier particles settle quickly and do not contribute to a turbidity reading), a correlation between turbidity and total suspended solids (TSS) is somewhat unique for each location or situation.

Dissolved Oxygen (DO)

In an aerobic RBC system, a biofilm is allowed to form on the medium, which is partly submerged in the wastewater and partly exposed to the air. The rotation alternately exposes this biofilm to atmospheric oxygen and wastewater. Oxygen transfers from the air to the RBC unit in three (3) ways: by oxygen absorption of the liquid film over the biofilm surface when the biofilm is in the air; by direct oxygen transfer to the air-water interface; and by direct oxygen absorption by the microorganisms during the air exposures.

Usually, as a consequence of an active respiration in the initial stages, the oxygen concentration reaches minimal levels, increasing along the reactor where substrate concentration is low.

During operation oxygen levels must be properly controlled and, to prevent from becoming a limiting factor, initial stages should have at least 1 mg/L of D.O.

Oxygen demand is the amount of DO required by bacteria and microorganisms to oxidize the influent organic waste. It is directly proportional to the organic strength of the influent waste. Therefore, oxygen requirements are dependent on BOD loading as well as the degree of treatment.

Alkalinity

Alkalinity is an indication of the acid neutralizing wastewater capacity. It is a measure of wastewater's resistance to changes in pH. The major components of alkalinity are carbonate (CO_3) and bicarbonate (HCO_3) species.

BOD removal causes a slight decrease in alkalinity. Ammonia (NH_3) removal, also known as nitrification, causes a significant decrease in alkalinity. During nitrification, NH_3 is converted to NO_3. Theoretically, 7.14 mg of alkalinity is consumed during the oxidation of 1 mg of NH_3.

When DO is not available, nitrate (NO_3) is used as an oxygen source. NO_3 removal, also known as denitrification, causes a slight increase in alkalinity. NO_3 is converted to N2 gas. Theoretically, 3.57 mg of alkalinity is created during the reduction of 1.0 mg of NO3.

When DO and NO_3 are not available, sulfate (SO_4) is used as an oxygen source. Organic nitrogen is used as a food source, which causes a significant increase in alkalinity. This leads to the generation of ammonia (NH_3).

4.5 Other process interpretations

4.5.1 Observing the media

Rotating biological contactors use bacteria and other living organisms growing on the media to treat waste. Because of this, you can use your senses of sight and smell to identify problems. The slime growth or biomass should have a brown to gray color, no algae present, a shaggy appearance with a fairly uniform coverage, and very few or no bare spots. The odour should not be offensive, and certainly there should be no sulfide (rotten egg) smells.

During operation, observations of the RBC movement, slime color and appearance are helpful in determining system performance; that is, they can indicate process conditions. If the unit is covered, observations are usually limited to that portion of the media that can be viewed through the access door.

A gray, shaggy appearing biological slime is indicative of a system designed strictly for BOD removal. A brown, thinner, less shaggy biological slime is indicative of a nitrifying system.

The Rotorzone is subdivided into four (4) sections, with disk banks in each. The wastewater first enters the Rotorzone in the section marked "1" in the sketch (furthest away from the inlet to the plant). The flow then proceeds through sections 2, 3, and 4 before entering the final settling tank.

The accumulation of biological growth will be greatest in section 1, and gradually decrease through subsequent sections. Generally, the growth will be thick, and often filamentous ("stringy"), in section 1, becoming thinner and more compact through sections 2-4.

The colour of the growth will typically be dark brown to black in Section 1. Some grey growth may also be noticed, depending on the relative load and type of wastewater being treated. Growth in sections 2-4 will typically vary from medium brown to a light brown or tan growth in section 4.

Black appearance

If the appearance becomes black and odours, which are not normal to occur, then this could be an indication of solids or BOD overloading. These conditions would probably be accompanied by low DO in the plant effluent. Compare previous influent suspended solids and BOD values with current test results to determine if there is an increase. To solve this problem, place another rotating biological contactor unit in service, if possible, or try to pre-aerate the influent to the RBC unit. Also review the operation of the primary clarifiers and sludge digesters to be sure they are not the source of the overload.

White appearance

A white appearance on the disc surface also might be present during high loading conditions. This might be due to a type of bacteria which feeds itself on sulfur compounds. The overloading could result from industrial discharges containing sulfur compounds upon which certain sulfur loving bacteria thrive and produce a white slime biomass. Corrective action consists of placing another RBC unit in service or trying to pre-aerate the influent to the unit. During periods of severe organic or sulfur overloading, remove the bulkhead or baffle between stages one and two.

Another cause of overloading may be sludge deposits that have been accumulating in the bottom of the bays. To remove these deposits, drain the bays, wash the sludge deposits out and return the unit to service. Be sure the orifices in the baffles between the bays are clear.

Sloughing

Sloughing is the term used to refer to the process in which excess microbrial growth separates from the media and is washed to the secondary clarifiers with the treated wastewater. The excess slime will settle out in the secondary clarifiers and be removed from the system. Natural biological sloughing will occur from any fixed film reactor. It is a normal consequence of media growth.

If severe sloughing or low growth of biomass occurs after the start-up period and process difficulty arises, the causes may be due to the influent wastewater containing toxic or inhibitory substances that kill the organisms in the biomass or restrict their ability to treat wastes. To solve this problem, steps must be taken to eliminate the toxic substance even though this may be very difficult and costly. Biological processes will never operate properly as long as they attempt to treat toxic wastes. Until the toxic substance can be located and eliminated, loading peaks should be dampened (reduced) and a diluted uniform concentration of the toxic substance allowed reaching the media in order to minimize harm to the biological culture.

Another problem which could cause low biomass growth is an unusual variation in flow and/or organic loading. In small communities, one cause may be high flow during the day and near zero flow at night. During the day, the biomass is receiving food and oxygen and starts growing; then the night flow drops to near zero, available food is reduced and nearly stops. The biomass starts sloughing off again due to lack of food. Considering the presence of the Equalization tank, this problem should not occur.

4.5.2 Smell

In a well-functioning unit with the appropriate feed of wastewater, there will be an earthy, humus-like ("musty") smell inside the Biodisks. A substantial sour, "sewage" smell may be an indication of sub-optimal conditions in the treatment process.

When undesirable septic conditions appear, a classic "rotten egg" odour is noticeable. It results from the bacterial breakdown of organic matter in the absence of oxygen (anaerobic digestion). Remember that Hydrogen sulfide is a toxic gas.

4.5.3 Observing the clarifiers and final effluent

Clarification in the secondary clarifier is another major factor that affects performance. For example, shallow clarifier, as installed in Meadowbank, normally have difficulty containing the typically low density sludges. Low density sludge blanket are also easily disturbed by hydraulic (flow) fluctuations, and such disturbances can cause the loss of sludge particles (TSS) in the final effluent.

Rising sludge ('pop-ups') are particles or chunks of sludge floating to the surface of the clarifier. The sludge can be carried over the effluent weir, which results in elevated effluent TSS levels. The sludge is carried to the surface by bubbles of gas formed in the sludge blanket at the bottom of the clarifier or from sludge hung up on the walls of the clarifier. The gas may be either nitrogen or hydrogen sulfide gas (H_2S) formed from the biological decomposition of the sludge.

Some differences of the gas can be used to determine if the sludge is denitrifying or going septic at the bottom of the tank. Pop-ups caused by nitrogen are usually light brown to brown in color, and have no odour when broken up by a hose or cleaning brush. When pop-ups are caused by septic conditions, a classic "rotten egg" odour is noticeable when the sludge is hosed down or otherwise broken up, due to release of the hydrogen sulfide gas. The pop-ups are usually dark brown to black.

If sludge extraction frequency is too low, sludge can accumulate and be washed into the effluent or the sludge may remain in the clarifier but have no DO, causing the higher microorganisms to die or the bacteria to denitrify or go anaerobic and cause gas bubbles and rising sludge.

The effluent near the outlet at the backside of the final clarifier should be relatively clear and colourless and relatively free of suspended matter. The turbidity measurement of the final effluent is a quick and easy method of checking the operation and performance of the RBC process. An increasing effluent turbidity indicates an unfavourable trend in process operation which should be promptly investigated and corrected.

Turbidity in the final effluent is chiefly due to biological floc that has carried out over in the clarifier effluent. Monitoring the sludge blanket in the clarifier is the most direct method available for determining when sludge extraction must be done.

4.5.4 Determination of the sludge blanket

The sludge levels accumulation can be directly measure with the Sludge Interface Detector supplied on site. The Raven SID-10200 utilizes the infrared light dispersion technology sensor probe to accurately determines the sludge blanket solid/liquid interface depth in primary tanks and clarifiers.

Sludge levels should be measured at several locations in each settlement tank to ensure a reasonably accurate calculation of accumulated volumes. This is required since sludge accumulation levels are not uniform; being highest at the inlet ends of both clarifiers, and, below the slot at the bottom of the first section of the Rotorzone.

If the accumulated levels equal or exceed design values, it is time to remove the sludge from the unit.

4.6 Process parameters

4.6.1 Percent Removal Calculations

BOD, TSS, and NH_3 are all pollutants, which are present in large concentrations in the influent wastewater coming into a treatment plant. Through the treatment process, the concentrations of BOD, TSS and NH_3 are reduced.

The Percent Removal Calculation is used to determine the percentage of the incoming concentration of a particular pollutant (BOD, TSS or NH_3) that was removed through the treatment process. It is calculated as follows:

$$\text{Percent Removal (\%)} = \frac{\text{(Influent Concentration, mg/L)} - \text{(Effluent Concentration, mg/L)}}{\text{(Influent Concentration, mg/L)}} \times 100$$

Example

Influent BOD = 250 mg/L
Effluent BOD = 15 mg/L

$$\text{Percent Removal (\%)} = \frac{\text{(Influent Concentration, mg/L)} - \text{(Effluent Concentration, mg/L)}}{\text{(Influent Concentration, mg/L)}} \times 100$$

$$\text{Percent Removal (\%)} = \frac{\text{(250 mg/L)} - \text{(15 mg/L)}}{\text{250 mg/L}} \times 100$$

Percent Removal (%) = 94%

4.6.2 Organic loading

Organic loading is defined as the grams of Biochemical Oxygen Demand (BOD) introduced into the RBC basin per square meter of media surface area per day. The design of the media optimizes its available surface with the use of ridges and void spaces. Consequently, the media surface can not be accurately calculated by an operator and is provided by the manufacturer. See table in section 2.2.

Typical organic loading of a RBC is 4 to 6 grams BOD/day/m².

Increased organic loadings lead to increased biological slime thickness where dissolved oxygen becomes depleted. With higher organic loadings sulfur reducing filamentous bacteria (*Beggiatoa*) become abundant due to DO deficient conditions. This phenomenon is indicated by a white/gray colored biomass

Organic Load is calculated as follows:

$$\text{Organic Load (g BOD/day/m}^2) = \frac{(\text{BOD, mg/L}) \times (\text{Flow, m}^3/\text{d})}{(\text{Area, ft2})}$$

Example 1

Calculate the organic loading on L333 Biodisks if the operation data are the following:

- Media Surface Area of L333 = 3390 m² (see table on Section 2.2)
- Influent Flow = 55 m³/d (flowmeter on P5 and P6 pumps of the EQT)
- Influent BOD = 240 mg/L (last result from independant laboratory)

$$\text{Organic Load} = \frac{(240\text{ mg/L}) \times (55\text{ m}^3/\text{d})}{(3390\text{ m}^2)}$$

$$\text{Organic Load} = 3{,}9\text{ g BOD/day/m}^2$$

Example 2

Calculate the organic loading on the four (4) Biodisks if the operation data are the following:

- Media Surface Area of L333 = 3390 m² (see table on Section 2.2)
- Media Surface Area of each LJ-100 = 487 m² (see table on Section 2.2)
- Influent Flow = 78 m³/d (flowmeter on P5 and P6 pumps of the EQT)
- Influent BOD = 280 mg/L (last result from independent laboratory)

$$\text{Organic Load} = \frac{(280\text{ mg/L}) \times (78\text{ m}^3/\text{d})}{(4851\text{m}^2)}$$

$$\text{Organic Load} = 4{,}5\text{ g BOD/day/m}^2$$

4.7 Process troubleshooting guide

This section of the manual presents troubleshooting procedures for solving common operating problems experienced in the Rotating Biological Contactors (RBC) process.

With each problem or observation, a list is included for the probable causes, checks to determine the cause, and the suggested corrective measures. You, the operator, must determine and select one or more of the corrective measures that will restore the process to its full efficiency with the least adverse effect on the final effluent quality.

There are different problems presented that frequently occur in operating the RBC process. In all of the guides presented, the probable cause given for the observation should be looked at concurrently because many times one problem may have several causes.

Table 7.3 – Troubleshooting Guide — Rotating Biological Contactors

(Adapted from *PERFORMANCE EVALUATION AND TROUBLESHOOTING AT MUNICIPAL WASTEWATER TREATMENT FACILITIES,* Office of Water Program Operations, US EPA, Washington, DC.)

INDICATOR/OBSERVATION	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTION
1. Decreased treatment efficiency.	1a. Organic overload.	1a. Check peak organic loads — BOD, SS, DO, pH, temperature.	1a. 1. Improve pretreatment of plant. 2. Place another RBC in service if available. 3. Remove bulkhead between stages 1 and 2 for larger first stage. 4. Recycle effluent as a possible short-term solution.
	1b. Hydraulic overload.	1b. Check peak hydraulic loads — if less than twice the daily average, should not be the cause.	1b. 1. Flow equalization; eliminate source of excessive flow. 2. Balance flows between reactors. 3. Store peak flows in collection system, monitor possible overflows of collection system.
	1c. pH too high or too low.	1c. Desired range is 6.5 - 8.5 for secondary treatment; 8 - 8.5 for nitrification.	1c. 1. Eliminate source of undesirable pH or add acid or base to adjust pH. When nitrifying, maintain alkalinity at 7 times the influent NH_3 concentration. 2. Sodium bicarbonate can be used to increase both pH and alkalinity.
	1d. Low wastewater temperatures.	1d. Temperatures less than 55°F will reduce efficiency.	1d. 1. Cover RBC to contain heat of wastewater. 2. Heat influent to unit or building.
2. Excessive sloughing of biomass from discs.	2a. Toxic materials in influent.	2a. Determine material and its source.	2a. 1. Eliminate toxic material if possible — if not, use flow equalization to reduce variations in concentration so biomass can acclimate. 2. Recycle effluent for dilution.
	2b. Excessive pH variations.	2b. pH below 5 or above 10 can cause sloughing.	2b. Eliminate source of pH variations or maintain control of influent pH.
	2c. Unusual variation in flow and/or organic loading.	2c. Influent flow rate(s) and organic strength.	2c. Eliminate/reduce variations by throttling peak conditions and recycling from the secondary clarifier or RBC effluent during low flows.
			2d. Monitor industrial contributors for flow variations.
3. Development of white biomass over most of disc area.	3a. Septic influent or high H_2S concentrations.	3a. Influent odor.	3a. Pre-aerate wastewater or add sodium nitrate or hydrogen peroxide or place another RBC unit in service. Prechlorination of influent will also control sulfur-loving bacteria.
	3b. First stage is overloaded organically.	3b. Organic loading on first stage.	3b. 1. Improve pretreatment of plant. 2. Place another RBC in service, if available. 3. Adjust baffles between first and second stages to increase total surface area in first stage.
4. Solids accumulating in reactors.	4a. Inadequate pretreatment.	4a. Determine if solids are grit or organic.	4a. Remove solids from reactors and provide improved grit removal or primary settling.

Reprinted, with permission, from *Operation of Wastewater Treatment Plants*, Vol. 1, 4th ed., Office of Water Programs, California State University, Sacramento Foundation

7-10

ACTIVATED SLUDGE PROCESS
SECONDARY CLARIFIER

TROUBLESHOOTING GUIDE NO. 3 — SOLIDS WASHOUT/BILLOWING SOLIDS

OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	REMEDIES	REFERENCES
1. Localized clouds of homogenous sludge solids rising in certain areas of the clarifier. Mixed liquor in settleability test settles fairly well with a clear supernatant.	A. Equipment malfunction.	1. Refer to Troubleshooting Guide No. 1, Observations 1-A, 2-A, and 2-B.		
		2. Check the following equipment for abnormal operation. a. Calibration of flow meters. b. Plugged or partially plugged RAS or WAS pumps and transfer lines. c. Sludge collection mechanisms, such as broken or worn out flights, chains, sprockets, squeegees, plugged sludge withdrawal tubes.	2) Repair or replace abnormal operating equipment.	pg II-77
		3. Check sludge removal rate and sludge blanket depth in clarifier.	3) Adjust RAS rates and sludge collector mechanism speed to maintain sludge blanket depth at 1 to 3 feet from clarifier floor.	pg II-29

ACTIVATED SLUDGE PROCESS
SECONDARY CLARIFIER

TROUBLESHOOTING GUIDE NO. 3 — SOLIDS WASHOUT/BILLOWING SOLIDS (continued)

OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	REMEDIES	REFERENCES
	B. Air or gas entrapment in sludge floc or denitrification occurring.	1. Perform sludge settleability test and gently stir sludge when settling to see if bubbles are released.	1) If the process is not nitrifying, refer to Probable Cause A above, and Troubleshooting Guide No. 7, Observation 2.	pg II-90
		2. If bubbles are released, check nitrate mg/l in secondary effluent to see if the process is nitrifying.	2) If the process is nitrifying, refer to Troubleshooting Guide No. 5, Probable Cause A.	
	C. Temperature currents.	1. Perform temperature and D.O. profiles in clarifier.	1) If temperatures exceed 1 to 2 degrees between top and bottom of clarifier, use an additional aeration tank and clarifier if possible.	pg II-81
		2. Check inlet and outlet baffling for proper solids distribution in clarifier.	2) Modify or install additional baffling in clarifiers.	pg II-81
			3) Refer to Probable Cause A-1, and A-2 above.	
	D. Solids washout due to hydraulic overloading.	1. Check hydraulic detention time in aeration tank and clarifier, and surface overflow rate in clarifier.	1) If hydraulic loadings exceed design capability, use additional aeration tanks and clarifiers if possible.	pg II-78
			2) Reduce RAS rate to maintain high sludge blanket depth in clarifier.	pg II-29
			3) If possible, change process operation to sludge reaeration or contact stabilization mode.	pg III-15
			4) Refer to Probable Causes B-1, B-2, and C-2 above.	

I-11

ACTIVATED SLUDGE PROCESS
SECONDARY CLARIFIER

TROUBLESHOOTING GUIDE NO. 3 — SOLIDS WASHOUT/BILLOWING SOLIDS (continued)

OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	REMEDIES	REFERENCES
2. Localized clouds of fluffy homogenous sludge rising in certain areas of the clarifier. Mixed liquor in settleability test settles slowly, leaving stragglers in supernatant.	A. Overloaded aeration tank (low MLSS) resulting in a young, low density sludge.	1. Check and monitor trend changes which occur in the following: a. Decrease in MLVSS, mg/l. b. Decrease in MCRT, Gould Sludge Age. c. Increase in F/M ratio. d. Lower air SCFM rate to maintain D.O. level.	1) Decrease WAS rates by not more than 10% per day to bring process back to optimum parameters.	pg II-97 & II-36

ACTIVATED SLUDGE PROCESS
SECONDARY CLARIFIER

TROUBLESHOOTING GUIDE NO. 5 — SLUDGE CLUMPING

OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	REMEDIES	REFERENCES
1. Sludge clumps (from size of a golf ball to as large as a basketball) rising to and dispersing on clarifier surface. Bubbles noticed on clarifier surface. Mixed liquor in settleability test settles fairly well, however a portion of and /or all of the settled sludge rises to the surface within four hours after test is started.	A. Denitrification in clarifier.	1. Check for increase in secondary effluent nitrate level.	1) Increase WAS rate by not more than 10% per day to reduce or eliminate level of nitrification. If nitrification is required, reduce to allowable minimum.	pg II-90 & II-36
		2. Check loading parameters.	2) Maintain WAS rates to keep process within proper MCRT, Gould Sludge Age, and F/M ratio.	pg II-36
		3. Check D.O. and temperature levels in the aeration tank.	3) Maintain D.O. at minimum level (1.0 mg/l). Be sure adequate mixing is provided in the aeration tank.	pg II-24
		4. Check RAS rates and sludge blanket depth in clarifier.	4) Adjust RAS rate to maintain sludge blanket depth of 1 to 3 feet in clarifier.	pg II-29
	B. Septicity occurring in clarifier.	1. Refer to Troubleshooting Guide No. 1, Observation No. 2.		
		2. See 3 and 4 above.		

ACTIVATED SLUDGE PROCESS
SECONDARY CLARIFIER

TROUBLESHOOTING GUIDE NO. 6 — CLOUDY SECONDARY EFFLUENT

OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	REMEDIES	REFERENCES
1. Secondary effluent from clarifier is cloudy and contains suspended matter. Mixed liquor in settleability test settles poorly, leaving a cloudy supernatant.	A. MLSS in aeration tank low due to process start-up.	1. Refer to Troubleshooting Guide No. 2, Observation No. 1.		
	B. Increase in organic loading.	1. Perform microscopic examination on mixed liquor and return sludge. Check for presence of protozoa.	1) If no protozoa are present, possible shock organic loading has occurred.	pg II-93 & IV-18
		2. Check organic loading on process.	2) Reduce WAS rate by not more than 10% per day to bring process back to proper loading parameters and increase RAS rates to maintain 1 to 3 foot sludge blanket in clarifier.	pg II-42 & II-36
		3. Check D.O. level in aeration tank.	3) Adjust air SCFM rate to maintain D.O. level within 1.0 to 3.0 mg/l.	pg II-24
	C. Toxic shock loading.	1. Perform microscopic examination on mixed liquor and return sludge. Check for presence of inactive protozoa.	1) If protozoa are inactive, possibility of recent toxic load on process. 2) Refer to Troubleshooting Guide No. 2, Observation No. 1-C.	pg II-93

I-17

ACTIVATED SLUDGE PROCESS
SECONDARY CLARIFIER

TROUBLESHOOTING GUIDE NO. 6 — CLOUDY SECONDARY EFFLUENT (continued)

OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	REMEDIES	REFERENCES
	D. Overaeration causing mixed liquor floc to shear.	1. Perform microscopic examination on mixed liquor. Check for dispersed or fragmented floc and presence of active protozoa.	1) Refer to Troubleshooting Guide No. 1, Observation No. 1-A.	pg IV-18
	E. Improper D.O. levels maintained in aeration tank.	1. Refer to Troubleshooting Guide No. 1, Observation No. 2.		

5. TROUBLESHOOTING GUIDES

This section presents a summary of Troubleshooting Guides gathered in the available Operation and Maintenance Manuals.

The Troubleshooting Guide in this section only applies to trouble, probable cause, and corrective solution that can occur on mechanical equipment. The problems and solutions related to the process are in Section 4.

For more information, refer to Operation and Maintenance Manual before working on equipment.

5.1 MOTOR AND GEARBOX – BIODISK L333

See appendix A

5.2 TROJAN UV 3000 – BIODISK L333

See appendix B

5.3 PYROTENAX INDUSTRIAL HEAT TRACING – BIODISK LJ-100

See appendix C

5.4 SEVERN TRENT ULTRADYNAMIC UV SYSTEM – BIODISK LJ-100

See appendix D

5.5 GREY LINE FLOWMETER DFM 4.0 - EQT

See appendix E

5.6 YSI ENVIRONMENTAL – YSI 550A DISSOLVED OXYGEN METER

See appendix F

5.7 HACH – SENSION 6 DISSOLVED OXYGEN METER

See appendix G

6. RECORD KEEPING

The operators of the Sewage Treatment Plant (STP) are important players behind any effluent treatment successful story. In successful organizations, the operators are typically tasked with specific responsibilities that include daily chores such as general daily inspection of the STP to ensure that there is no effluent pipe leakages or equipment breakdown, preventive maintenance and performance monitoring, sampling, record keeping, etc. These activities need to be conducted in a coordinated manner to ensure proper functioning of all the STP components.

Monitoring, recording, and reporting of the STP performance are required to demonstrate that the treatment system is functioning correctly and the effluent standards are being complied with.

A successful effluent treatment depends on all components of the STP being operational and in optimal condition. Problems with any system components will affect the overall efficiency of the STP, resulting in poor effluent quality. To ensure a successful treatment and regulatory compliance, each of the treatment processes (unit processes and unit operations) needs close monitoring on a regular basis.

It is recommended to maintain the performance monitoring data and corrective actions taken record to address problems encountered in the STP daily operation. The tables recommended to use are shown in the next pages. The record should be kept in a log or in a file and should be available on demand.

SECTION 7 TROUBLESHOOTING

7.1 Error Codes

Error codes inform the user of an out-of-range value or meter problem. *Table 6* outlines the operator assistance codes available in the meter series.

Table 6

Error Code	Error Type	Possible Remedy
E-1	Data error in the non-volatile memory.	Turn off the meter, then turn it on again.
E-3	Failure to correctly store a reading.	Call Service. Meter cannot store data in at least one location, but is otherwise functional.
E-9	Failure to correctly retrieve a reading that was stored earlier.	Call Service.
E-10	Sample temperature is out of range (0 to 50 °C).	

Note: *To display the electric current coming from the dissolved oxygen electrode, press the* **READ** *and* **CONC %** *keys simultaneously.*

Appendix A

MOTOR AND GEARBOX – BIODISK L333

7.0 - TROUBLE SHOOTING

7.1 - MECHANICAL HARDWARE

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Noisy chain	1. Loose chain 2. Faulty lubrication 3. Misalignment 4. Worn Parts 5. Moving parts rubbing stationary parts	1. Tighten chain 2. Lubricate properly 3. Correct sprocket alignment 4. Replace worn chain 5. Align & tighten chain to clear oil bath
Rapid wear on chain	1. Faulty lubrication 2. Loose or misalign parts	1. Lubricate properly 2. Align & tighten entire drive
Chain climbing sprockets	1. Worn out chain and sprockets 2. Loose chain	1. Replace worn out parts 2. Tighten chain
Stiff chain	1. Misalignment 2. Worn out chain or sprockets 3. Faulty lubrication 4. Rust corrosion	1. Correct alignment 2. Replace worn out parts 3. Lubricate properly 4. Clean and lubricate
Noisy Bearing	Rollers or bearings damaged	Replace bearing cartridge
Bearing grease discoloured or mixed with water	Insufficient grease in the bearings	Purge bearing with grease and increase lubrication interval
Hot bearing	1. Improper lubrication 2. Rollers or bearing race damaged	1. Purge bearing with grease and decrease lubrication interval 2. Replace bearing cartridge
Reducer temperature rises above 200 degrees Fahrenheit.	Oil level too high or too low	Maintain proper oil level
Oil leakage from reducer	1. Oil seals need to be replaced 2. Ventilators/breather plugged causing pressure build-up inside the reducer. 3. Oil level too high	1. Replace oil seals 2. Clean Ventilators 3. Correct oil level
Noisy reducer	1. Bearing failure 2. Misalignment in worm gear inside 3. Coupling between motor and reducer worn out and misalign	1. Check bearings and replace if necessary 2. Align worm gear shafts. 3. Replace coupling between motor and reducer. Align coupling hub vertically
Noisy Motor	Bearing damage	Replace damaged bearings
Motor overheating	1. Reducer overheating 2. Cooling fins on motor are clogged 3. Overload 4. Rotor rubbing on stator 5. Over greasing or lubrication	1. Check reducer 2. Clean fins 3. Check for excess friction or imbalance 4. Replace bearings 5. Avoid packing grease too tightly
Motor won't start	1. Power trouble 2. Single phasing at station 3. Fuse blown	1. Check source of power supply 2. Do not try to make it go and "fry" motor. Check starter windings 3. Replace fuse
Knocking/rumbling on motor bearings	1. Bearing worn due to lack of lubrication or excessive mechanical overload 2. Bearings slack in housing	1. Replace bearing and put new grease of recommended grade. 2. Fir new end shields
Rotordisk® shaft doesn't turn	1. Power failure 2. Motor failure 3. Reducer failure 4. Chain drive failure	1. Check power supply 2. Check and replace motor and bearings. 3. Check teeth worn gears and bearings. Replace necessary parts 4. Replace chain

Motor Trouble Shooting Chart

Problem	Likely Causes	What To Do
Motor fails to start upon initial installation.	Motor miswired.	Verify motor is wired correctly.
	Motor damaged and rotor is striking stator.	May be able to reassemble; otherwise, motor should be replaced.
	Fan guard bent and contacting fan.	Replace fan guard.
Excessive humming	High voltage.	Check input line connections
Motor had been running, then fails to start.	Fuse or circuit breaker tripped.	Replace fuse or reset breaker.
	Stator is shorted or went to ground. Motor will make a humming noise and the circuit breaker or fuse will trip.	Contact NORD for assistance
	Motor overloaded or load jammed.	Inspect to see that the load is free. Verify amp draw of motor versus nameplate rating.
Motor runs but dies down.	Voltage drop.	If voltage is less than 10% of the motor's rating contact power company or check if some other equipment is taking power away from the motor.
	Load increased.	Verify the load has not changed. Verify equipment hasn't got tighter. If fan application verify the airflow hasn't changed.
	Bad bearings.	Noisy or rough feeling bearings should be replaced.
	Voltage too low.	Make sure that the voltage is within 10% of the motor's nameplate rating. If not, contact power company or check if some other equipment is taking power away from the motor.
Motor runs in the wrong rotation.	Incorrect wiring.	Disconnect from power source and interchange any two of the three line leads from the three-phase motor.
Vibration	Rubbing between rotating parts and stationary parts.	Isolate and eliminate cause of rubbing.
	Resonance.	Tune system or contact NORD for assistance.
Motor overload protector continually trips.	Load too high.	Verify that the load is not jammed. If motor is a replacement, verify that the rating is the same as the old motor. If previous motor was a special design, a stock motor may not be able to duplicate the performance. Remove the load from the motor and inspect the amp draw of the motor unloaded. It should be less than the full load rating stamped on the nameplate.
	Ambient temperature too high.	Verify that the motor is getting enough air for proper cooling. Most motors are designed to run in an ambient temperature of less than 40° C. (Note: A properly operating motor may be hot to the touch.)
	Winding shorted or grounded.	Inspect stator for defects, or loose, cut wires that may cause it to go to ground.

NORD Gear Corporation
National Customer Service Toll Free 888-314-6673

www.nord.com

NORD Gear Limited
Toll Free in Canada 800-668-4378

WEST
1121 Railroad Street
Building 101
Corona, CA 92882
Phone 909-279-2600
Fax 888-408-6673

MIDWEST
PO Box 367
800 Nord Drive
Waunakee, WI 53597
Phone 608-849-7300
Fax 800-373-6673

SOUTH
100 Forsyth Hall Dr.
Building 100B
Charlotte, NC 28273
Phone 704-529-1255
Fax 888-259-6673

CANADA
41 West Drive
Brampton, Ontario L6T 4A1
Phone 905-796-3606
Fax 905-796-8130

TROUBLE SHOOTING

PROBLEM WITH THE REDUCER		POSSIBLE CAUSES	SUGGESTED REMEDY
Runs Hot	Overloading	Load exceeds the capacity of the reducer	Check rated capacity of reducer, replace with unit of sufficient capacity or reduce load
	Improper lubrication	Insufficient lubrication	Check lubricant level and adjust up to recommended levels
		Excessive lubrication	Check lubricant level and adjust down to recommended levels
		Wrong lubrication	Flush out and refill with correct lubricant as recommended
Runs Noisy	Loose foundation bolts	Weak mounting structure	Inspect mounting of reducer. Tighten loose bolts and/ or reinforce mounting and structure
		Loose hold down bolts	Tighten bolts
	Worn RV Disc	Overloading unit may result in damage to disc	Disassemble and replace disc. Recheck rated capacity of reducer.
	Failure of Bearings	May be due to lack of lubricant	Replace bearing. Clean and flush reducer and fill with recommended lubricant.
		Overload	Check rated capacity of reducer.
	Insufficient Lubricant	Level of lubricant in the reducer not properly maintained.	Check lubricant level and adjust to factory recommended level.
Output Shaft Does Not Turn	Internal parts are broken	Overloading of reducer can cause damage.	Replace broken parts. Check rated capacity of reducer.
		Key missing or sheared off on input shaft.	Replace key.
		Coupling loose or disconnected.	Properly align reducer and coupling. Tighten coupling.
Oil Leakage	Worn Seals	Caused by dirt or grit entering seal.	Replace seals. Autovent may be clogged. Replace or clean.
		Overfilled reducer.	Check lubricant level and adjust to recommended level.
		Autovent clogged.	Clean or replace, being sure to prevent any dirt from falling into the reducer.
		Improper mounting position, such as wall or ceiling mount of horizontal reducer.	Check mounting position. Name tag & verify with mounting chart in manual.

NORD Gear Corporation
National Customer Service Toll Free 888-314-6673 www.nord.com

NORD Gear Limited
Toll Free in Canada 800-668-4378

WEST
1121 Railroad Street
Building 101
Corona, CA 92882
Phone 909-279-2600
Fax 888-408-6673

MIDWEST
PO Box 367
800 Nord Drive
Waunakee, WI 53597
Phone 608-849-7300
Fax 800-373-6673

SOUTH
100 Forsyth Hall Dr.
Building 100B
Charlotte, NC 28273
Phone 704-529-1255
Fax 888-259-6673

CANADA
41 West Drive
Brampton, Ontario L6T 4A1
Phone 905-796-3606
Fax 905-796-8130

Appendix B

TROJAN UV 3000 – BIODISK L333

13.1 Basic System Troubleshooting

UV module (UVM) troubleshooting

Condition	Symptom	Possible Cause	Solution
1. One UV lamp status LED is off	Corresponding lamp is off	Lamp failure	Replace lamp
		Lamp holder / wiring	Inspect lamp holder and wiring and replace as necessary
		Water intrusion	Inspect and replace lamp, sleeve and o-ring as necessary
	Corresponding lamp is on	Module Board (MCB)	Replace module board
2. Two UV lamp status LEDs are off (lamps 1&2 or lamps 3&4)	Corresponding lamps are off	Lamp failure	Replace lamps
		Lamp holder / wiring	Inspect lamp holder and wiring and replace as necessary
		Water intrusion	Inspect and replace lamp, sleeve and o-ring as necessary
		Ballast failure	Replace ballast
	Both LEDs are off in a two-lamp module	No power to the module	Inspect module power cable – is it plugged-in or damaged? Reset ground fault of PDR or reset PDR supply breaker
	Corresponding lamps are on	Module Board (MCB)	Replace module board
3. All UV lamp status LEDs are off	All lamps are off	Lamp failure	Replace lamps
		Lamp holder / wiring	Inspect lamp holder and wiring and replace as necessary
		Water intrusion	Inspect and replace lamp, sleeve and o-ring as necessary
		Ballast failure	Replace ballast
	All lamps are on	Module Board (MCB)	Replace module board
IF YOU HAVE CHECKED ALL POSSIBLE CAUSES, PLEASE CALL TROJAN TECHNOLOGIES FOR TECHNICAL ASSISTANCE AT 1-800-666-9459			

Power Distribution Receptacle (PDR) Troubleshooting

Condition	***Symptom***	***Possible Cause***	***Solution***
1. Ground Fault (GFI) trips	GFI trips for a specific module only	Cracked sleeve causing water intrusion	Replace sleeve
		Faulty o-ring causing water intrusion	Replace o-ring
		End-cap assembly causing water intrusion	Inspect and repair or replace end-cap assembly
		Faulty or cut wiring	Inspect and repair or replace faulty wiring
	GFI trips for any module	Faulty wiring at GFI	Inspect and repair or replace wiring as necessary
		Faulty GFI receptacle	Replace GFI receptacle
IF YOU HAVE CHECKED ALL POSSIBLE CAUSES, PLEASE CALL TROJAN TECHNOLOGIES FOR TECHNICAL ASSISTANCE AT 1-800-666-9459			

Monitoring System Troubleshooting

Condition	*Symptom*	*Possible Cause*	*Solution*
1. Elapsed Time display flashing		Elapsed time displays 9500-10,000, 19,500-20,000… hours	Replace lamps. Display will stop flashing after 10,000, 20,000… hours
2. UV intensity display is flashing and displaying 0.0mW/cm^2		Sensor cable is not connected to monitoring system	Reconnect UV sensor to monitoring system
		Fouled sleeve and/or sensor	Clean sleeve and sensor as required
		Loose or no connection at TB5 terminal in monitoring system enclosure	Tighten or reconnect wiring at terminal
3. UV intensity display is flashing and displaying value less than alarm set point (1.6 mW/cm^2)		Fouled sleeve and/or sensor	Clean sleeve and sensor as required
IF YOU HAVE CHECKED ALL POSSIBLE CAUSES, PLEASE CALL TROJAN TECHNOLOGIES FOR TECHNICAL ASSISTANCE AT 1-800-666-9459			

Appendix C

PYROTENAX INDUSTRIAL HEAT TRACING
BIODISK LJ-100

10 Troubleshooting Guide

Symptom	Probable Causes	Corrective Action
Insulation resistance less than expected	1. Rainy or high humidity. 2. Nicks or cuts in heating cable sheath, with moisture present. 3. Kinked or crushed heating cable. 4. Arcing created by damage to the heating cable. 5. Physical damage to heating cable is causing a direct short. 6. Presence of moisture in terminations or connections. 7. Damaged termination.	(1) Dry tails and face of seal. (2, 3, 4) Visually inspect cable for damage, especially at elbows, flanges, and around valves. If damaged, repair or replace heating cable. Inspect power connection box for moisture or signs or tracking. Dry out connections and retest. (5) Check for visual indications of damage around the valves, pump, and any area where there may have been maintenance work. Look for crushed or damaged insulation along the pipe. Replace damaged sections of heating cable. (6) Dry out cold lead and/or connections and replace termination if necessary. (7) Replace termination

Symptom	Probable Causes	Corrective Action
Circuit breaker trips	1. Circuit breaker undersized. 2. Defective circuit breaker. 3. Short circuit in electrical connections. 4. Excessive moisture in connection boxes. 5. Nicks or cuts in heating cable sheath, moisture present. 6. Kinked or crushed heating cable. 7. Ground-fault protection device (GFPD) is undersized (5mA used instead of 30mA) or miswired.	(1) Recalculate circuit load current. Resize breaker as required. (2) Repair or replace breaker. (3, 4) Eliminate short circuit. Thoroughly dry connections. Install conduit drains as required. (5, 6) Repair damaged section or replace heating cable. (7) Replace undersized GFPD with 30mA GFPD. Check the GFPD wiring instructions.

Note: *If the corrective actions above do not resolve the problem, verify that the installation is as per design.*

38

39

10 Troubleshooting Guide

Symptom	Probable Causes	Corrective Action
Power output appears correct but pipe temperature is below design maintain temperature.	1. Wet or missing insulation. 2. Insufficient heating cable on valves, flanges, supports, pumps, and other heat sinks. 3. Temperature controller set incorrectly. 4. Improper thermal design used. 5. Temperature sensor in wrong location. 6. Low fluid temperature entering pipe.	(1) Remove wet insulation and replace with dry insulation and secure it with proper weather-proofing. (2) Confirm compliance with system design. (If valve, flange, and pipe support types and quantities have changed, additional heating cable may be required.) (3) Reset temperature controller. (4) Contact your Tyco Thermal Controls representative to confirm the design and modify as recommended. (5) Confirm that sensor is in the correct location. (6) Verify temperature of fluid entering pipe.

Symptom	Probable Causes	Corrective Action
Power output is zero or incorrect	1. No input voltage. 2. Temperature controller wired in the normally open (N.O) position. 3. Broken or damaged heating element, hot-cold joint, end cap, or broken tail. 4. Wrong cable used. 5. Improper voltage used.	(1) Repair electrical supply lines and equipment. (2) Confirm wiring using the normally closed (N.C.) terminals so that contacts close with falling temperature. (3) Repair or replace heating cable. (4) Verify installation as per design and replace cable if necessary. (5) Verify voltage and connect to proper voltage if necessary.

Note: *If the corrective actions above do not resolve the problem, verify that the installation is as per design.*

40

41

Appendix D

SEVERN TRENT ULTRADYNAMIC UV SYSTEM – BIODISK LJ-100

6 TROUBLESHOOTING CHART

Trouble	Probable Cause	Corrective Action
1. Low UV Output	a. Dirty quartz jacket b.Old or broken quartz jacket c.Old Uv lamps d.Water or condensation inside quartz jacket	a.Remove and clean quartz jacket b.Replace quartz jacket c.Replace UV Lamps d.Remove jacket and dry internal quartz
2.Low voltage output	a.Bad regulator	a.Replace regulator
3.Lamp out	a.Bad lamp b.Bad ballast	a.Replace lamp b.Replace ballast
4.Low UV transmission	a.dirty, cloudy or high mineral count	a.Install pre-filter or de-mineralizer
5.Sensor inoperative	a.Dirty sensor lens	a.Remove and clean lens
6.Sensor malfunctioning	a.Water or condensation inside sensor b.Sensor calbe not connected	a.Remove and dry inside sensor b.Verify that the sensor cable is connected to the monitor
7.Monitor not operating	a.Sensor cable not connected b.Monitor switch in the OFF position c.No power to monitor d.Incorrect power supply to monitor.	a.Verify that the sensor cable is connected to the monitor b.Verify that the monitor switch is in the ON position c.Verify power to monitor. d.Verify power supply voltage to monitor, either 120 Vac or 240 Vac.

Design improvements may be made without notice.
Represented by:

Severn Trent Services
3000 Advance Lane Colmar, PA 18915
Tel: 215-997-4000 • Fax: 215-997-4062
Web: www.severntrentservices.com
E-mail: marketing@severntrentservices.com

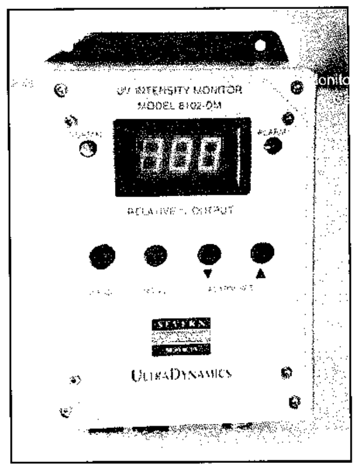
Maintenance:

(Reference Figure 1 & 3)
Listed in the below table are possible causes for a reduced reading of UV intensity.

Indication	Cause	Corrective Action
Gradual loss of UV intensity over several weeks or months	Fouled quartz sleeve	Follow UV System instruction manual for quartz sleeve cleaning procedure
Gradual loss of UV intensity over a 1 year period	Lamp degradation	Replace UV lamp - lamps last for 1 year Refer to UV system instruction manual
Total loss of UV intensity Check lamp status alarm	Lamp failure	Replace UV lamp Refer to UV system instruction manual
Gradual or total loss of intensity after the above have been ruled out	Change in water quality	Increase in suspended or dissolved solids may require installation of pre-filter

When cleaning the UV system quartz sleeve it is also necessary to clean the UV sensor probe. Shut off water, relieve the system pressure and/or isolate (valve out) the UV chamber. Remove the monitor by unscrewing the white retaining nut and sliding the probe out of the sensor port.

Deposits on the sensor probe are mostly caused by suspended and dissolved solids and minerals naturally occurring in the water. This coating can be easily removed by applying a small amount of lemon juice to a soft dry cloth and gently rubbing the sensor probe until clean, rinsing with hot water.



Detailed Menu Level Description

L01 Press the menu key once. L01 will be displayed. Press the menu key again. The preset alarm level will be displayed. Use the up and down keys to select the new alarm level. Press the menu key return to return to the Relative % Output display. The new alarm level will be set. If the up or down keys are not activated for longer then two seconds, the unit will default to the Relative % Output display.

L02 This function is not used on the Series 8102–DM /P. Changing this value will have no affect on the unit's operation.

L03 Press the menu key once. Press the up key twice to display L03. Press the menu key once. The absolute detector current will be displayed in milliamperes. Press the menu key again to return to the Relative % Output display.

L04 Press the menu key once. Press the up key three times to display L04. Press the menu key once. The absolute detector voltage will be displayed in Volts. Press the menu key again to return to the Relative % Output display

L05 Consult Factory, not for customer use.

Appendix E

GREYLINE FLOWMETER DFM 4.0 EQT

GREYLINE instruments inc.

DFM 4.0 Doppler Flow Meter
Manual Series A.2

FIELD TROUBLESHOOTING

Possible Causes:	*Corrective Action:*
METER READING LOWER THAN EXPECTED	
Calibration Error	• Review UNITS/MODE menu and Pipe ID
Lower flow rate than expected	• Investigate pump/valves. Compare velocity with alternate instrument
Signal not penetrating far enough into the flow stream	• Relocate sensor closer to elbows or flow disturbances
Improper mounting of sensor	• Reinstall Sensor with careful application of Coupling Compound
Pipe is not full	• Remount Sensor on vertical pipe
METER READING WHEN THERE IS NO FLOW	
Vibration on pipe	• Install in another location
Local electrical noise	• Ensure all Flowmeter wiring is in METAL conduit and sensor shield is properly grounded. • Ensure correct power input Ground connection (<1 ohm resistance). • Ensure 4-20mA Shield connected to Instrument Ground stud.
Cross talk between two or more DFM 4.0 flowmeters on same pipe	• Turn OFF one flowmeter or relocate the second flowmeter at a greater distance.
Variable Speed Drive interference	• Follow Drive manufacturers wiring and Grounding instructions • Relocate Flowmeter electronics, Sensor and wiring away from VSD
Valve leak or Reverse flow	• Test Valve. Relocate Sensor farther from valve • Use Backflow Rejection
Sensor connections incorrect	• Refer to Connections diagram

GREYLINE instruments inc.

DFM 4.0 Doppler Flow Meter
Manual Series A.2

Possible Causes:	*Corrective Action:*
METER READING ERRATIC	
Sensor mounted too close to valve, pump or elbow	• Change sensor placement. Recommended 6-10 diameters from elbows, and 30 diameters from pumps, controlling valves, orifice plates, nozzles or open pipe discharge
NO FLOW INDICATION	
Not enough suspended particles or gases in the fluid	• Relocate sensor in more turbulent pipe section. Mount sensor at 12 o'clock position on horizontal pipe
Coupling compound washed out, or sensor loose on pipe	• Remount sensor • Use Dow Corning Silicone #4
Slave selected in SPECIAL FUNCTIONS menu with no Synchronization input from Master.	• Select Master in SPECIAL FUNCTIONS menu.
Power interruption. No flow.	• Check fuse/breaker. Confirm flow
METER READING TOO HIGH	
Calibration error	• Review UNITS/MODE menu and Pipe ID
Vibration or noise on the pipeline	• Install in another location.
Pipe is not full	• Remount Sensor on vertical pipe
Nearby velocity increasing device (pump, valve, orifice plate)	• Relocate sensor >30 pipe diameters from velocity increasing device
Local electrical noise	• Ensure all Flowmeter wiring is in METAL conduit and sensor cable shield is connected to Ground stud
Variable Speed Drive interference	• Follow Drive manufacturers wiring and Grounding instructions • Relocate Flowmeter electronics, Sensor and wiring away from VSD

Page 20

Possible Causes:	*Corrective Action:*
METER READING DOES NOT TRACK FLOW	
Sensor and GND wires reversed or not properly connected	• Check Sensor connections
Improper AC power input Ground	• Use direct connection with 12 AWG wire to nearest Ground pole (<1 ohm resistance).

Appendix F

YSI ENVIRONMENTAL – YSI 550A DISSOLVED OXYGEN METER

TROUBLESHOOTING

NOTE: An error displayed briefly during the first few seconds after turning the instrument on does NOT indicate a problem.

SYMPTOM	POSSIBLE SOLUTION
1. Instrument will not turn on, LCD displays "LO BAT", or Main display flashes "OFF"	A. Low battery voltage, replace batteries B. Batteries installed incorrectly, check battery polarity C. Return system for service
2. Instrument will not calibrate.	A. Replace membrane and electrolyte B. Clean probe electrodes C. Return system for service
3. Instrument "locks up".	A. Remove batteries, wait 15 seconds for reset, replace batteries B. Replace batteries C. Return system for service
4. Instrument readings are inaccurate.	A. Verify calibration altitude and salinity settings are correct and recalibrate. B. Probe may not have been in 100% water saturated air during calibration procedure. Moisten sponge in calibration chamber and recalibrate. C. Replace membrane and electrolyte. Recalibrate. D. Clean probe electrodes. E. Return system for service.
5. Main display reads "Over" or "Undr".	A. Sample O_2 concentration is more than 60 mg/L or 500%, or less than –0.02 mg/L or -0.3%. B. Verify calibration altitude and salinity settings are correct and recalibrate. C. Replace membrane and electrolyte. Recalibrate. D. Clean probe electrodes. E. Return system for service.
6. Main display reads "Over" or "Undr" during calibration.	A. Replace membrane and electrolyte. Recalibrate. B. Clean probe electrodes. C. Return system for service.
7. Secondary display reads "Ovr" or "Undr".	A. Sample temperature is less than -5° C (23°F) or more than +45°C (122°F). Increase or decrease the sample temperature to bring within the allowable range. B. Return system for service.

Appendix C: STP Sample Sheets

MEADOWBANK STP - MONTHLY REPORT

Month: **February 2010** **Average flow:**

PARAMETER	INFLUENT	EFFLUENT	EFFICIENCY	COMMENTS
Independant laboratory				
BOD (mg/L)				
COD (mg/L)				
TSS				
TKN				
NH3-NH4				
NO2-NO3				
P tot				
Fecal Coliform				
On site				
pH				
Alkalinity				
D.O.				
Turbidity				
Temperature		22		

Sludge extractions (m^3)	Primary tanks	Final Clarifier	Comments
LJ-1			
LJ-2			
LJ-3			
L-333			
Total			

MEADOWBANK STP - WEEKLY ANALYSIS

Month: ____________________

DATE:						Average
STP - INFLUENT						
BOD_5 (mg O_2/L)						
COD (mg O_2/L)						
TSS (mg/L)						
TKN (mg N/L)						
NH_3-NH_4 (mg N/L)						
P tot (mg/L-P)						
STP - FINAL EFFLUENT						
BOD_5 (mg O_2/L)						
COD (mg O_2/L)						
TSS (mg/L)						
TKN (mg N/L)						
NH_3-NH_4 (mg N/L)						
NO_2-NO_3 (mg N/L)						
P tot (mg/L-P)						
Fecal Coliform (UFC/100 mL)						

Comments :

MEADOWBANK MINE - SEWAGE TREATMENT PLANT

Month: ____________________ 201____

Date	Time	Operator	Concentration of gaz at L-333				COMMENTS
			CO Level (ppm)	O_2 Level (%)	Comb/Ex	H_2S (ppm)	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							

MEADOWBANK MINE - SEWAGE TREATMENT PLANT

Month: ____________________ **201** ____

Date	Time	Operator	LJ -1				LJ -2				L 333			FINAL EFFLUENT				Grey Water LS-3	
			D.O In (mg/L)	D.O Out (mg/L)	pH Out	Temp Out (°C)	D.O In (mg/L)	D.O Out (mg/L)	pH Out	Temp Out (°C)	D.O Out (mg/L)	pH Out	Temp Out (°C)	D.O (mg/L)	pH	Temp. (°C)	Colour	pH	Temp (°C)
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
16																			
17																			
18																			
19																			
20																			
21																			
22																			
23																			
24																			
25																			
26																			
27																			
28																			
29																			
30																			
31																			

Appendix D: Site Services Protocols and Procedures

Changing the length of time the pumps will pump from the EQ tank into the Bio-Disks

		PROCEDURE NUMBER:	**MBK-SIT-0025**
People concerned	**Site Services**	**Prepared by**	Services Department
		Approved by	Alain Hamel Services General Superintendent
Issuing date :	2012-04-11		

This procedure corresponds to the required minimum standard. Each and every one also has to comply with the rules and regulations of the Nunavut Government in terms of health and safety at work.

Objective:

To

Concerned departments:

Site services

Required employee preparation:

- Every person is required to have Hepatitis A & B and Tetanus shots before doing any work at the STP that will bring them in contact with contaminants i.e. sewage, sludge, effluent, influent, etc.
- ✓

Impacts			
Health & Safety	Process/Quality	Costs	Environment

Changing the length of time the pumps will pump from the EQ tank into the Bio-Disks

Procedure	Risks/ Impacts
The screen in the top left corner of the panel is what is used for controlling the pumps	
1. Start at the screen "SYSTEM STATUS MENU"	Prevent incident and /or accident; health issues
2. If the screen is not at "SYSTEM STATUS MENU" press "DISP" (DISPLAY)	Prevent incident and /or accident; health issues
3. If the "DISP" is not showing but a "PREV" is, press the "PREV" until you come to "DISP"	
4. Press the "DISP" key and that will take you to the "SYSTEM STATUS MENU"	
5. For pumps 1 & 2 which currently feed LJ #1 press PAIR 1 , "ON & OFF SCREEN"	
6. For pumps 3 & 4 which currently feed LJ #3 press PAIR 2 , "ON & OFF SCREEN"	
7. For pumps 5 & 6 which currently feed L333 press PAIR 3 , "ON & OFF SCREEN"	

8. After pressing the pair of pumps you want to change press NEXT (middle right)	
9. You will see the "PUMP PAIR " screen	
10. Press Next	
11. You will now be at the "FLOW RATE & ENABLE " screen	
12. Press ADFI(l/s) (top left corner)	
13. Curser will be flashing on the last number on right	
14. Using the BS (Back space key) press until you are at the number you would like to change	
15. i.e. +0.4500 on the screen presently	
16. Each time you press the BS key you will remove a number from the left	

Changing the length of time the pumps will pump from the EQ tank into the Bio-Disks

17. Pressing BS 4 times will bring you to +0	
18. If you want to change it to +0.5150 , press the 5 , then the 1 , and the 5, not necessary to press 0	
19. After you have done this press "ENT" (bottom left)	
20. The ADF(Average Daily Flow) on the pump has now been changed	
21. To get back to the main menu	
22. Press "PREV"(bottom middle)	
23. Then press "DISP"	
24. You are now back to the main menu	
25. The above instructions are for pairs #1 & #3	

Changing the length of time the pumps will pump from the EQ tank into the Bio-Disks

26. **Pair # 2 is a little different**	
27. **You will notice that in pairs #1 & #3 the number you have programmed into the" ADFI (l/s)" screen of the "FLOW RATE & ENABLE" screen is the same as in the "PUMP PAIR " screen**	
28. **Pump #2 will have a lower number in the "FLOW RATE & ENABLE" screen than in the "PUMP PAIR" screen *(It is just the way it has been programmed)***	
29. **i.e. in order to get 45 seconds on the "PUMP PAIR " screen you have to enter +0.2800 in the ADFI(l/s) screen of the "FLOW RATE & ENABLE" screen**	
30. **The ADFI(l/s) number is approx. 63% of the seconds (not including the decimal point)**	
31. **You will just need to play with it a bit to get the number you want**	
32. **Important:** If you happen to press "ENABLE" in the "FLOW RATE & ENABLE" screen by mistake and it is now at "DISABLE" just press the "DISABLE" and it will go back to "ENABLE"	
33. **When you are at the first menu ("SYSTEM STATUS MENU") ensure that the pairs 1 , 2 & 3 all have an "EN" displayed if all pumps are being used**	
34. If not , go to the pair that has a "DIS" on it , press that pair	

Changing the length of time the pumps will pump from the EQ tank into the Bio-Disks

35. Press "NEXT" to get to the "FLOW RATE & ENABLE" screen	
36. Press on "DISABLE" to change it back to "ENABLE"	
37. Press "PREV"	
38. Press DISP"	
39. You should be back at the Main Menu	

Personal Hygiene at STP

Personal Hygiene Protocol to follow when working at the Sewage Treatment Plant and Lift Stations

Daily Inspection and readings

Lab coat

Boot covers

Nitrile gloves

Safety glasses

- Shower not required
- Thorough washing and disinfection of hands before leaving decontamination unit

Testing - every second day

Lab coat

Boot covers

Nitrile gloves

Safety glasses

- Shower not required
- Thorough washing and disinfection of hands before leaving decontamination unit

Cleaning Lift Station #3

Tyvek suit

Boot covers

Nitrile gloves

Safety glasses

- Shower not required
- Thorough washing and disinfection of hands before leaving decontamination unit

Cleaning/Changing U.V. lamps - Little Johns/L333

Tyvek suit

Boot covers

Nitrile gloves

Safety glasses

- Shower not required
- Thorough washing and disinfection of hands before leaving decontamination unit

Personal Hygiene Protocol to follow when working at the Sewage Treatment Plant and Lift Stations

Sludge measurement

Tyvek suit

Boot covers

Nitrile gloves inside rubber gloves

Safety glasses

- Shower not required
- Thorough washing and disinfection of hands before leaving decontamination unit

Sludge removal

Tyvek suit

Boot covers

Nitrile gloves inside rubber gloves

Safety glasses with full face shield/full face respirator

- Shower required

Changing Pumps in influent lift stations/working on pipes - raw sewage (plumbers?)

Tyvek suit

Boot covers

Nitrile gloves inside rubber gloves

Safety glasses

- Shower required

Changing Pumps in effluent lift stations/working on pipes (plumbers?)

Tyvek suit

Boot covers

Nitrile gloves - rubber gloves if required

Safety glasses

- Shower required

SAMPLING AND TESTING

TARGET ANALYSIS RESULTS

	TARGET	ACCEPTABLE
pH	6.5 - 8.0	6.0 - 8.5
D.O. in	> 1.0 ppm	> .3 ppm
D.O. out	> 4.0 ppm	> 2.0 ppm
Temperature	20 - 25 C	15 - 30 C
Turbidity	< 20 NTU	< 40 NTU

L J = Little Joh S = Lift Station

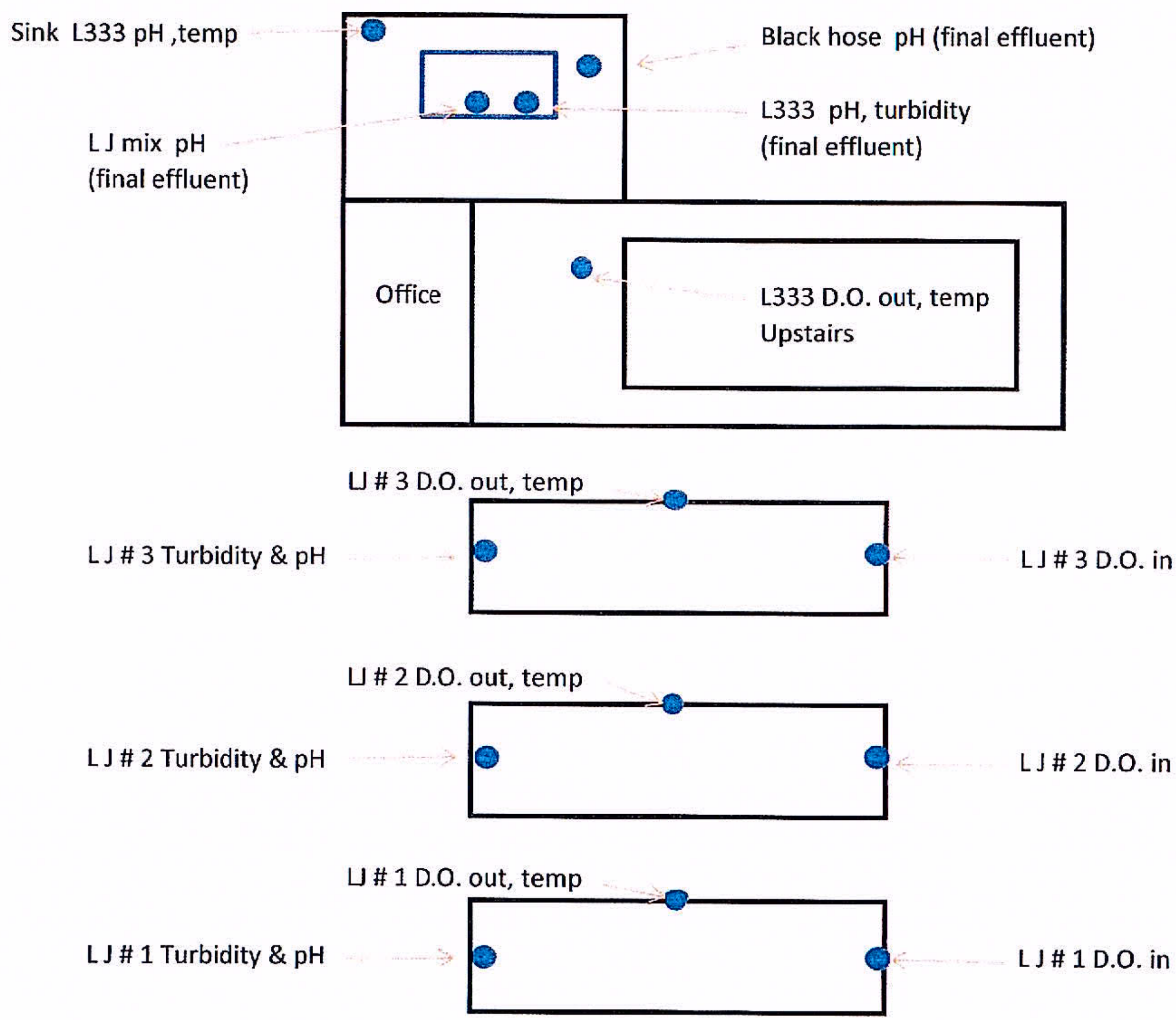
STP SAMPLING POINTS

Location	Sampling Points	Frequency	Parameters	pH for Environment
Lift station #3 room	STP IN (Sink close to LS #3)	Every second day	pH temperature	**Every Monday or whenever requested by environment department**
L J back door	**L J # 1 & # 3** IN	Every second day	D.O.	
L J side door	**L J # 1 & # 3** OUT	Every second day	D.O. temperature	
L J double doors	**L J #1 & # 3** FINAL EFFLUENT (Sample line in LJ close to the flowmeter above the clarifier)	Every second day	pH turbidity	**Every Monday or whenever requested by environment department**
L333 upstairs	L333 OUT (D.O. is marked on sample point)	Every second day	D.O. temperature	
Lift station #3 room	L333 FINAL EFFLUENT (3/8 " sample line above LS #3)	Every second day	pH turbidity	**Every Monday or whenever requested by environment department**
Lift station #3 room	L J MIX FINAL EFFLUENT (1" sample line above LS #3)		pH	**Every Monday or whenever requested by environment department**
Lift station #3 room	FINAL EFFLUENT (black hose from pipe beside flowmeter at LS #3)		pH	**Every Monday or whenever requested by environment department**

Note: Mondays pH tests done for the Environment Dept must be given to them that day

23/06, .2

Sample points at the STP



L J = Little John L333 = Big Bertha

Calibration of pH meter

		PROCEDURE NUMBER:	**MBK-SIT-0023**
People concerned	**Site Services**	**Prepared by**	Services Department
		Approved by	Alain Hamel Services General Superintendent
Issuing date :	2012-04-11		

This procedure corresponds to the required minimum standard. Each and every one also has to comply with the rules and regulations of the Nunavut Government in terms of health and safety at work.

Objective:

To

Concerned departments:	**Required equipment**
Site services	

Impacts			
Health & Safety	Process/Quality	Costs	Environment

Calibration of pH meter

Procedure	Risks/ Impacts
For better accuracy, frequent calibration of the instrument is recommended	Prevent incident and /or accident; health issues
Calibrate once a week and record on calibration report	Prevent incident and /or accident; health issues
1. From the normal measuring mode, **press and hold** the MODE button until OFF and until the secondary LCD is replaced by CAL	
2. Release the button. The LCD enters the calibration mode displaying "pH 7.01 USE"	
3. After 1 second the meter activates the automatic buffer recognition feature	
4. For a two point calibration, place the electrode in pH 7.01 buffer solution. After the first calibration point has been accepted, the "pH 4.01 USE" message appears	
5. If no valid buffer is recognized, then the "WRNG" message is shown. It may be time to change the buffer solutions	
6. If a valid buffer (4.01) is detected, then the meter completes the calibration procedure	

7. When the buffer is accepted, the LCD shows the accepted value with the "OK 2" message and then the meter returns to the normal measuring procedure mode	
8. ***THE ELECTRODE MUST STAY WET DURING STORAGE. ENSURE THAT THERE IS ALWAYS WATER IN THE STORAGE CAPSULE***	
9. ***Taking pH Measurements***	
10. **Submerge** the electrode **in the solution** to be tested while **stirring it gently**	
11. The **measurement** should be **taken when** the stability symbol **(clock)** on the top left of LCD **disappears**	

Testing at the STP

		PROCEDURE NUMBER:	**MBK-SIT-0022**
People concerned	**Site Services**	**Prepared by**	Services Department
		Approved by	Alain Hamel Services General Superintendent
Issuing date :	2012-04-11		

This procedure corresponds to the required minimum standard. Each and every one also has to comply with the rules and regulations of the Nunavut Government in terms of health and safety at work.

Objective:

To

Concerned departments:

Site services

Required employee preparation:

- Every person is required to have Hepatitis A & B and Tetanus shots before doing any work at the STP that will bring them in contact with contaminants i.e. sewage, sludge, effluent, influent, etc.

Required equipment

✓ PPE : Safety glasses , hard hat, nitrile gloves, gas detector

Impacts			
Health & Safety	Process/Quality	Costs	Environment

AGNICO EAGLE

Testing at the STP

Procedure	Risks/ Impacts
1. Turn on the D.O and calibrate before testing	Prevent incident and /or accident; health issues
2. Turn on the pH meter and calibrate if necessary(once a week)	Prevent incident and /or accident; health issues
3. Turn on the turbidity meter and calibrate if necessary(once a month)	
4. Check the chart on the wall for schedule and locations of sampling points	
5. Procedures for each sampling point are posted at each location	
6. Record all test results and enter into computer	

Procedures For Little John's

Procedures for Changing U.V. Lamps and

Changing/Cleaning Tubes in Little John U.V. Lamp Units

Every person is required to have Hepatitis A & B and Tetanus shots before doing any work at the STP that will bring them in contact with contaminants i.e. sewage, sludge, effluent, influent, etc.

- ✓ **Warning : Do not look at the U.V. lamps when they are on**

There are 2 sealed U.V. lamp units , both have 6 U.V. lamps inside each unit

- ✓ **PPE: Tyvek suit, boot covers, nitrile gloves, safety glasses, hard hat, locks for locking out electrical panel**

1) Check for gases with gas detector before entering the U.V. lamp area
2) Shut off and lock out one of the U.V. lamps units
3) Using a step ladder close the valves on both sides of the unit being cleaned
4) Place a pail under the drain hose and open the valve
5) Crack the outlet valve a bit to allow the unit to drain
6) Once the unit has been drained remove the sensor
7) The sensor is located on the side of each unit and is threaded in
8) With the 50% Lime Away solution spray bottle clean the sensor by spraying it and then wiping it down with a soft paper towel/kleenex
9) Take another dry paper towel/kleenex and wipe the sensor dry
10) Take the water hose and spray water into the sensor hole and let it drain to remove some of the dirt inside the unit
11) Thread sensor unit back into chamber
12) Close the valve on the drain hose
13) Remove the wiring harness from the U.V. lamps
14) Remove the U.V. lamps being very careful not to break them
15) Some end caps may need to be removed to get the lamps out(very tight spot)
16) These will need to be disposed of as HAZMAT
17) Remove the threaded end caps from the unit if removing the tubes
18) If the tubes are not being taken out the end caps do not need to be removed
19) If the tubes are being cleaned or replaced remove them as well by pulling them out
20) Be careful not to lose the o rings and stainless steel washers
21) Clean the tubes with Lime away if they are going to be cleaned
22) Install cleaned or new tubes

23) Install the U.V. lamps being careful not to get them dirty
24) Thread the end caps back into place
25) Put the wiring back on the lamps taking note that the wires are numbered to match with the unit
26) Unlock the Unit
27) Turn the unit back on for approximately 2 minutes
28) Open up the inlet and outlet valves
29) Wait for a few minutes to ensure that the lamps are working properly by checking the reading on the monitor.
30) The unit will now need to be calibrated
31) See the manual for calibrating
32) After calibrating the unit % will be at 100
33) The % will fluctuate at times as the effluent flows and particles of dirt get on the sensor
34) Enter the date the U.V lamps/tubes were changed in the back of the daily log book

<u>Procedures for Cleaning Little John U.V. Lamp Sensor (downstairs)</u>

Every person is required to have Hepatitis A & B and Tetanus shots before doing any work at the STP that will bring them in contact with contaminants i.e. sewage, sludge, effluent, influent, etc.

✓ **Warning : Do not look at the U.V. lamps when they are on**

There are 2 sealed U.V. lamp units , both have 6 U.V. lamps inside each unit

✓ **PPE: Tyvek suit, boot covers, nitrile gloves, safety glasses, hard hat, locks for locking out electrical panel**

1) Check for gases with gas detector before entering the U.V. lamp area
2) Shut off and lock out the U.V. lamp unit that is being cleaned
3) Using a step ladder close the valves on both sides of the unit being cleaned
4) Place a pail under the drain hose and open the valve
5) Crack the outlet valve a bit to allow the unit to drain
6) Once the unit has been drained remove the sensor
7) The sensor is located on the side of each unit and is threaded in
8) With the 50% Lime Away solution spray bottle clean the sensor by spraying it and then wiping it down with a soft paper towel/kleenex
9) Take another dry paper towel/kleenex and wipe the sensor dry
10) Take the water hose and spray water into the sensor hole and let it drain to remove some of the dirt inside the unit
11) Thread sensor unit back into chamber
12) Close the valve on the drain hose
13) Unlock the Unit
14) Turn the unit back on for approximately 2 minutes
15) Open up the inlet and outlet valves
16) Wait for a few minutes to ensure that the lamps are working properly by checking the reading on the monitor.
17) When all is working well the number should be around 100% after a cleaning
18) The % will fluctuate at times as the effluent flows and particles of dirt get on the sensor
19) Record the date the sensor was cleaned in the daily log book

Procedures for dumping sewage into and removing solids/sludge from lift station #2 at the STP

Workers are required to have Hepatitis A & B and Tetanus shots before doing any work that will bring them in contact with contaminants i.e. sludge, effluent, influent,sewage etc.

All sewage from bathroom facilities around the Meadowbank site including the Exploration and Emulsion plants must be dumped into lift station #2 at the Sewage Treatment Plant.

All other liquids including the liquids from the grease traps should be off loaded at the tailings pond.

Twice a week, Wednesdays and Sundays 1 load of solids should be removed from lift station #2 and unloaded at the tailings pond.

If other jobs or poor weather come up and the solids cannot be done during these days removing solids can be done on other days.

There is a sheet at the STP just inside the door of the decontamination unit which is to be filled out by the vacuum truck operator.

The operator will fill in the date, initials of driver of vacuum truck, size of sewage load in or size of solids load out. This size of the load will be entered in the appropriate column , example *¾ S or 75% S.*
(S for small truck, B for big truck)

Also on this sheet under comments enter why the solids were not able to be done if it happens example, " *blizzard , truck broke* down, *too busy*" or any other information the driver may need to enter example "*broken paddle needs to be repaired*"

Occasionally the STP operator will also ask for the sludge to be removed from the bottom of lift station #2 but this will come as a formal request.

Measuring Sludge in the Little Johns

		PROCEDURE NUMBER:	**MBK-SIT-0004**
People concerned	**Site Services**	**Prepared by**	Site Services
		Approved by	Roger Sauvé Services General Supervisor
Issuing date :	2012-04-11		

This procedure corresponds to the required minimum standard. Each and everyone also have to comply with the rules and regulations of the Nunavut Government in terms of health and safety at work.

Objective:

Sludge is required to be measured every 2 weeks in the primary and clarifier tanks(final stage)

Concerned departments:

Site services

Required employee preparation:

- Every person is required to have Hepatitis A & B and Tetanus shots before doing any work at the STP that will bring them in contact with contaminants i.e. sewage, sludge, effluent, influent, etc.

Required equipment

- Gas detector , safety glasses ,hard hat, Tyvek suit and boot covers, nitrile/rubber gloves, locks for locking out bio-disk

Impacts				Location	
Health & Safety	Process/Quality	Costs	Environment	Control Room	Field

Measuring Sludge in the Little Johns

Procedure	Risks/ Impacts
1. Ensure proper PPE is worn	Prevent incident and /or accident; health issues
2. Two (2) people to be present when measuring sludge	
3. Shut off and lock out the bio-disk	
4. Keep gas tester on person or close at hand	
5. Little Johns primary tank measurement : side door/opening on the left side when facing the Little Johns from the big double doors – 1 measurement	
6. Turn the sludge meter on	
7. Turn the alarm on the sludge meter	
8. Slowly drop the sensor into the effluent allowing in to go to the bottom	

9. The alarm will sound as it starts to hit the sludge	
10. Take note of the depth of the tank by reading the numbers on the cord (measured in 6" intervals)	
11. Slowly lift the sensor/cord until the alarm goes off	
12. Record the difference on the cord from when the alarm is on at the bottom to when the alarm goes off	
13. This difference is the depth of the sludge	
14. Follow the same procedures in the Little Johns clarifier tank	
15. Little Johns clarifier tank measurement : open double doors and take measurements on both sides of the tank	
16. Once the sludge measurements have been taken and recorded, the bio-disk can be unlocked and restarted	
17. Clean up tools and put things away where they belong	

AGNICO EAGLE

MEADOWBANK GOLD PROJECT

TAILINGS STORAGE FACILITY

Operation, Maintenance and Surveillance Manual

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

Version 7
March 2017

TAILINGS STORAGE FACILITY

OPERATION, MAINTENANCE AND

SURVEILLANCE MANUAL

MEADOWBANK GOLD PROJECT

AGNICO EAGLE MINES LIMITED

IMPLEMENTATION SCHEDULE

This Plan is immediately implemented.

DISTRIBUTION LIST

AEM - General Manager Meadowbank

AEM- Environment Superintendent

AEM- Mine Operations Superintendent

AEM- Engineering Superintendent

AEM- General Services Manager

AEM- Site Services Superintendent

AEM- Corporate Environment Director

AEM- Health and Safety Superintendent

Golder- Dike Design Engineer

DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
(first revision)	February 2012	All	All	
V2	August 27, 2013	All	All	
V3	September 15, 2013	All	All	Updated items mentioned by MDRB and the Mine Inspector in the Annual Geotechnical Inspection in September 2013
V4	January 2015	All	All	
V5	October 2015	All	All	
V6	February 2016	All	All	
V7	March 2017	All	All	

Approved by: ____________________
Pierre McMullen
Engineering Assistant Superintendent

____
Jamie Quesnel
Environment Superintendent

TABLE OF CONTENTS

DOCUMENT CONTROL ..... **V**

LIST OF TABLES ..... **VIII**

LIST OF FIGURES ..... **VIII**

LIST OF APPENDICES ..... **VIII**

SECTION 1 • INTRODUCTION **1-1**

1.1 Purpose 1-1
1.2 Registered Manual Holders and Revisions 1-1
1.3 Regulatory, CDA and MAC Guideline Requirements 1-1
1.4 Dam Classification 1-2
1.5 Annual Review of Manual 1-2
1.6 Reference Documents and Drawings 1-2

SECTION 2 • ROLES AND RESPONSIBILITIES **2-1**

2.1 Roles, Responsibilities and Authority 2-2
2.2 Required Levels of Knowledge 2-2

SECTION 3 • FACILITY DESCRIPTION **3-1**

3.1 Background 3-1
3.2 Design and Operational Criteria 3-3
3.3 Facility Components 3-3
3.3.1 Perimeter Containment Structures 3-3
3.3.2 Internal Deposition Structures 3-3
3.3.3 Perimeter Water Control Structures 3-3
3.4 Tailings Distribution System 3-3
3.5 Water Management System and Piping 3-5
3.6 Facility Closure 3-5
3.7 Instrumentation 3-5
3.8 Public Safety 3-5

SECTION 4 • OPERATIONS **4-1**

4.1 Operational Philosophy 4-1
4.2 Deposition Planning Criteria and Constraints 4-1
4.3 Water Management 4-1

SECTION 5 • MAINTENANCE **5-1**

5.1 Containment Structures 5-1
5.2 Ditches and Sumps 5-1
5.3 Instrumentation 5-1
5.4 Pipelines and Pumps 5-1

SECTION 6 • SURVEILLANCE 6-1

6.1 Inspections 6-1
6.1.1 Routine Inspections 6-1
6.1.2 Special Inspections 6-2
6.1.3 Annual Inspection 6-3
6.2 Instrumentation and Survey 6-3
6.2.1 Ground Temperature and Piezometric Level Monitoring 6-6
6.2.2 Anomalous Measurements 6-6
6.2.3 Seepage Monitoring 6-7
6.3 Water Quality 6-7

SECTION 7 • REPORTING AND DATA MANAGEMENT 7-1

7.1 Reporting 7-1
7.1.1 Inspection Documents 7-1
7.1.2 Instrumentation Measurements 7-1
7.1.3 Emergencies 7-1
7.2 Data Management 7-1

SECTION 8 • EMERGENCY PREPAREDNESS PLAN 8-1

8.1 Emergency Procedures 8-1
8.1.1 Operation 8-1
8.2 Emergency Details 8-1
8.2.1 Access to the Project Site 8-2
8.2.2 Emergency Assessment 8-2
8.2.3 Emergency Communication and Actions 8-2
8.2.4 Site Emergency Procedure 8-2
8.2.5 Communication Equipment Location 8-3
8.3 Medical and First Aid Services 8-4
8.4 On Site Equipment and Material 8-4
8.4.1 Pumping Equipment 8-4
8.4.2 Mobile Equipment 8-5
8.4.3 Earthwork Material and Equipment 8-2

SECTION 9 • EMERGENCY RESPONSE REFERENCE DOCUMENTS 9-1

SECTION 10 • REFERENCES 10-1

LIST OF TABLES

Table 1-1 List of Registered OMS Manual Holders 1-3
Table 1-2 Record of OMS Manual Revisions and Addenda 1-4
Table 1-3 Regulatory Requirements 1-5
Table 1-4 Classification of Dams in Terms of Consequences of Failure (after CDA 2007) 1-6
Table 1-5 Tailings Storage Facility Documentation Summary 1-7
Table 1-6 Listing of Specifications for Tailings Storage Facility 1-8
Table 1-7 List of Construction Drawings for Embankment Structures 1-9
Table 1-8 List of Construction Drawings for Infrastructure and Piping 1-10
Table 2-1 Roles and Responsibilities 2-1
Table 2-2 Recommended Minimum Knowledge of OMS Manual 2-3
Table 3-1 Design and Operational Criteria 3-5
Table 6-1 Surveillance Items and Frequencies 6-4
Table 9-1 Emergency Response Reference Documents 9-1
Table 9-2 Potential Effects or Causes of Embankment Failure Mechanisms 9-1
Table 9-3 Threshold Criteria During Operation (Excluding Central Dike) 9-3
Table 9-4 Threshold Criteria During Operation (Central Dike Only) 9-4
Table 9-5 Communication Charts for Each Emergency Level 9-5
Table 9-6 Responsibilities of Persons for Each Emergency Level 9-5
Table 9-7 Names and Contact Details (to be updated as required) 9-6

LIST OF FIGURES

Figure 1 AEM Tailings Storage Facility Management Structure 2-2
Figure 2 Plan of Tailings Storage Facilities 3-2
Figure 3 Spigot Locations 3-4
Figure 4 Approximate Location of Current Instrumentation 6-5
Figure 5 Earthwork Material and Equipment location 8-2

LIST OF APPENDICES

Appendix I Water Quality and Flow Monitoring Plan
Appendix II Tailings Storage Facility - Inspection Form
Appendix III Dike Failure Scenario

LIST OF ACRONYMS AND ABBREVIATIONS

%	Percent
°C	Degrees Celsius
1:100	1 in 100 years (return period)
2H:1V	Slope of 2 horizontal units to 1 vertical unit
AEM	Agnico Eagle Mines Limited
CDA	Canadian Dam Association
Elev.	Elevation
EPP	Emergency Preparedness Plan
ERP	Emergency Response Plan
g	Gravitational acceleration constant (9.80 m/s^2)
Golder	Golder Associates Ltd.
m	Metre
M	Million
MAC	Mining Association of Canada
OMS	Operation, maintenance and surveillance
SD1	Saddle Dam 1
SWD	Stormwater Dike
TSF	Tailings Storage Facility
tpd	Tonnes per day

LIST OF DEFINITIONS

Active Layer: Ground above the top of permafrost. This layer freezes and thaws seasonally.

Permafrost: Bedrock or soil at a temperature at or below 0^oC for a continuous period of two or more years. It is important to note that permafrost is not permanent. It is also important to note that the term permafrost does not imply the presence or absence of ice in the bedrock or soil.

SECTION 1 • INTRODUCTION

1.1 PURPOSE

This operation, maintenance and surveillance (OMS) manual provides a reference document to be used by the personnel responsible for the operation, maintenance and surveillance of the Tailings Storage Facility (TSF) at the Meadowbank Gold Project that is owned and operated by Agnico Eagle Mines Limited (AEM).

The TSF is the permanent surface storage facility for tailings produced during the operation of the mine. Refer to Section 3.0 for description details of the TSF.

Qualified personnel shall be used for the operation, maintenance and surveillance of the TSF and adequate records shall be maintained for regulatory, general and reference purposes. As the management structure changes, the OMS manual should be revised and distributed accordingly. A primary objective during the early phases of operation and development of the TSF, especially during that of the North Cell, was to optimize these activities for use during subsequent development phases.

This OMS manual addresses the operational issues of the TSF. It does not examine design, construction or closure issues in detail. Details of the design and construction requirements for the TSF are presented in the references provided later in this document. Details on closure are included in the Closure Plan.

1.2 REGISTERED MANUAL HOLDERS AND REVISIONS

Each copy of this OMS manual is assigned a unique identification number.

The AEM Engineering Superintendent is responsible for maintaining an up-to-date list of the registered holders of this OMS manual in Table 1-1.

The AEM Engineering Superintendent is also responsible for the issue of all revisions and addenda to all Registered Manual Holders of this OMS manual. Revisions will be made, as and when required, by re-issuing a complete section, table and/or appendix so that the superseded section, table and/or appendix can be removed and replaced. All Registered Manual Holders are responsible for placing the revisions and addenda in their copy of the OMS manual and for recording receipt of the same in Table 1-2.

1.3 REGULATORY, CDA AND MAC GUIDELINE REQUIREMENTS

This OMS manual sets out procedures to ensure compliance with the AEM regulatory requirements which are summarized in Table 1-3.

The Canadian Dam Association (CDA) Dam Safety Guidelines (CDA 2007) states, "Dam operation, maintenance and surveillance encompass a number of activities and constraints defined to ensure that the dam is managed with appropriate regard for safety." The preparation and use of this OMS manual achieve this requirement. Reference to CDA (2007) was made in the preparation of this OMS manual.

The Mining Association of Canada (MAC) has prepared two reference documents for management of tailings facilities: "A Guide to the Management of Tailings Facilities" (MAC 2008) and "Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities" (MAC 2005). Both of these documents were used in preparation of this OMS manual.

1.4 DAM CLASSIFICATION

Table 1-4 presents the classification information and the following is noted for the perimeter containment structures of the TSF (i.e. Saddle Dams 1 to 5, inclusive, the Stormwater Dike and the Central Dike):

- Loss of life: the embankment is classified as “high” due to the limited number of workers in the Portage and Goose Pits downstream of the Central Dike coupled with AEM’s procedures for pit evacuation in the event of an emergency;
- Environmental and Culture Values: the embankment is classified as “high” due to the water license requirements and environmental permitting considerations;
- Infrastructure and Economic Losses (third parties): the embankment is classified as “high” due to the water license requirements and environmental permitting considerations; and
- The dam classification for the TSF perimeter containment structures is determined by the highest of the three ratings above; therefore, these structures are classified as “high” consequence structures.

1.5 ANNUAL REVIEW OF MANUAL

This OMS manual will be reviewed by AEM on an annual basis and revised as necessary to accommodate changes in the condition and operation of the TSF. The Registered Manual Holders of the OMS manual are encouraged to provide comments and suggestions for improvement of the OMS manual and the procedures specified in it to the AEM Engineering Superintendent. The comments and suggestions communicated will be considered in the annual review.

1.6 REFERENCE DOCUMENTS AND DRAWINGS

A summary of the documentation prepared for the TSF, including design reporting, as-built reporting, technical specifications, construction drawings, instrumentation installation reporting and deposition planning, is presented in Table 1-5. The most current technical specifications and construction drawings referenced in Table 1-5 are presented in Table 1-6 to Table 1-8, inclusive. All design and as-built documents can be found in hard copy onsite in the engineering department, as well as in electronic copies on the dikes server.

Table 1-1 List of Registered OMS Manual Holders

Name / Position / Address or Location	OMS Manual Copy No.
General Mine Manager / Bertin Paradis, Luc Chouinard (asst.) / OFFICE	1
Environment Superintendent / Jamie Quesnel / OFFICE	2
Mine Operations Superintendent / Yan Côté, Eric Steinmetzer (asst.) / OFFICE	3
Engineering Superintendent / Julie Belanger, Pierre McMullen (asst.) / OFFICE	4
Logistics Coordinator / Mathieu Grenier / OFFICE	5
Energy and Infrastructure Superintendent / Christian Soucy / OFFICE	6
Vice President, Environment / Michel Julien / AEM Toronto Office	7
Health and Safety Superintendent / Norman Ladouceur, Yves Levesque (asst.) / OFFICE	8
Dike Design Engineer / Golder Associates Ltd./ 500 – 4260 Still Creek Drive, Burnaby, BC, V5C 6C6	9
Update as Required	

Table 1-2 Record of OMS Manual Revisions and Addenda

Revision No.	Section	Table	Appendix	Addenda No.	Date of Revision
1	All	All	All	-	February 2012
2	All	All	All	-	August 2013
3	All	All	All	-	September 2013
4	All	All	All	-	January 2015
5	All	All	All	-	October 2015
6	All	All	All	-	March 2016
7	All	All	All	-	March 2017

Table 1-3 Regulatory Requirements

Document	Document Reference and/or No.	Review Date
Territorial Lands Act – Land Lease	Production Lease KVPL08D280	Expires December 27, 2027
Environmental Impact Assessment	NIRB Project Certificate No. 004	Only required if substantial modifications to original application are to be carried out
Water License Type “A”	Nunavut Water Board Water Licence 2AM-MEA0815	Expires July 22, 2025

Table 1-4 Classification of Dams in Terms of Consequences of Failure (after CDA 2007)

Dam Class	Population at Risk [Note 1]	Incremental losses		
		Loss of Life [Note 2]	**Environmental and Cultural Values**	**Infrastructure and Economics**
Low	None	0	Minimal short-term loss No long-term loss	Low economic losses; area contains limited infrastructure or services
Significant	Temporary only	Unspecified	No significant loss or deterioration of fish or wildlife habitat Loss of marginal habitat only Restoration or compensation in kind highly possible	Losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes
High	**Permanent**	**10 or fewer**	**Significant loss or deterioration of *important* fish or wildlife habitat** **Restoration or compensation in kind highly possible**	**High economic losses affecting infrastructure, public transportation, and commercial facilities**
Very high	Permanent	100 or fewer	Significant loss or deterioration of *critical* fish or wildlife habitat Restoration or compensation in kind possible but impractical	Very high economic losses affection important infrastructure or services *(e.g., highway, industrial facility, storage facilities for dangerous substances)*
Extreme	Permanent	More than 100	Major loss of *critical* fish or wildlife habitat Restoration or compensation in kind impossible	Extreme losses affecting critical infrastructure or services *(e.g., hospital, major industrial complex, major storage facilities for dangerous substances)*

Note 1. Definitions for population risk:

None – There is no identifiable population at risk, so there is no possibility of loss of life other than through unforeseeable misadventure.

Temporary – People are only temporarily in the dam-breach inundation zone *(e.g., seasonal cottage use, passing through on transportation routes, participating in recreational activities).*

Permanent – The population at risk is ordinarily located in the dam-breach inundation zone *(e.g., as permanent residents)*; three consequence classes (high, very high, extreme) are proposed to allow for more detailed estimates of potential loss of life (to assist in decision-making if the appropriate analysis is carried out).

Note 2. Implications for loss of life:

Unspecified – The appropriate level of safety required at a dam where people are temporarily at risk depends on the number of people, the exposure time, the nature of their activity, and other conditions. A higher class could be appropriate, depending on the requirements. However, the design flood requirement, for example, might not be higher if the temporary population is not likely to be present during the flood season.

Table 1-5 Tailings Storage Facility Documentation Summary

Item	Description	Reference
TSF Design Basis	Report	Golder (2008)
Stormwater Dike and Saddle Dam 1 Geomembranes	Technical Memorandum	Golder (2009)
Revised configuration for Saddle Dam 1	E-Mail	Golder (2009; no formal document issued)
Deposition Plan (North Cell)	Report	Golder (2011, 2012)
Construction Report TSF	Report	AEM (June 2013)
North Cell Diversion Ditches	Report	AEM (July 2013)
Deposition Plan (North & South Cells)	Presentation	AEM (2013 to 2016)
Central Dike As-Built Report	Report	GAL(February 2017)
Saddle Dam 3 As-Built Report	Report	GAL (February 2017)
Saddle Dam 4 As-Built Report	Report	GAL(February 2017)
Saddle Dam 5 As-Built Report	Report	GAL (February 2017)
Update as Required		

Table 1-6 Listing of Specifications for Tailings Storage Facility

Item (Prepared By)	Specification No. and Title	Revision No. and Title	Date of Revision
Golder	Specification-TSF Dike Construction	Doc. 795 Rev. 0	October 16, 2009
Golder	Central Dike Design Changes	Doc 1453 1312210034 TME Rev0	April 24, 2014
Golder	Detailed Design Report for Saddle Dams 3, 4 and 5	Doc 1504 1416081 SD3,4 & 5 Design Rev1	May 12, 2015
Update as Required			

Table 1-7 List of Construction Drawings for Embankment Structures

Drawing No. (Prepared by)	Title	Revision No.	Date of Revision
4100-30 to 4100-39 (Golder)	Tailings Storage Facility – Stormwater Dike	0	July 10, 2009
4100-50 to 4100-60 (Golder)	Tailings Storage Facility – Saddle Dam 1	0	July 10, 2009
SD2-SD3-01 to SD2-SD3-13 (Golder)	Tailings Storage Facility –Saddle Dam 2 and Saddle Dam 3	A	August 25, 2010
SD6-01 to SD6-11 (Golder)	Tailings Storage Facility – Saddle Dam 6	A	September 13, 2010
Figure 1—Supersedes Drawing Nos. 4100-30, 4100-31, and 4100-32 (Golder)	Agnico-Eagle Mines Limited, Meadowbank Gold Project Nunavut, Stormwater Dike Staged Layout Plan	N/A	August 5, 2009
Figure 2—Supersedes Drawing Nos. 4100-33, Detail 3 on 4100-34 (Golder)	Tailings Storage Facility Typical Cross-Section and Details	N/A	August 5, 2009
Figure 1—Supersedes Drawing Nos. 4100-51, 4100-52, 4100-53, and 4100-58 (Golder)	Tailings Storage Facility Saddle Dam 1 Rockfill Plan and Liner Details	N/A	August 17, 2009
All drawings in the Construction Report TSF (AEM)	Construction Report Tailings Storage Facility	N/A	June 15, 2013
All drawings in the Detailed Design Report for Saddle Dams 3, 4 and 5 Doc 1504 1416081 SD3,4 & 5 Design Rev1	Detailed Design Report for Saddle Dams 3, 4 and 5	N/A	May 12, 2015
Update as Required			

Table 1-8 List of Construction Drawings for Infrastructure and Piping

Drawing No. (Prepared by)	**Title**	**Revision No. and Title**	**Date of Revision**
All Booster Pump Design Drawings	Booster Pump Design Drawings, MEAD-360	N/A	June 26, 2012
Weekly Update Geotech Planning (AEM)	Weekly Geotech Update	Updated Weekly	N/A
Tailing deposition plan (AEM)	Integrated deposition plan	Updated Bi-Annually	July 2016
All drawings in the Construction Summary Report North Cell Diversion Ditches (AEM)	Construction Summary Report North Cell Diversion Ditches	N/A	July 27, 2013
All South Cell Infrastructures Drawings (AEM)	Reclaim pump drawings 61-430 Pig launcher drawings 61-360	N/A	October 2014
Update as Required			

SECTION 2 • ROLES AND RESPONSIBILITIES

There are several AEM department teams involved in the operation, maintenance and surveillance of the TSF:

The Engineering Department has a team of people that:

- Plan and oversee the construction of the embankments of the TSF;
- Provides the overall management of the TSF;
- Oversees the design, development, construction and deposition activities of the TSF;
- Monitors the thermistor instrumentation of the TSF;
- Monitors quantity and manages the water of the TSF, including the perimeter water control structures;
- Planning the operation, maintenance and surveillance of the tailings distribution system;
- Conducts visual inspections of the TSF, including the perimeter water control structures;
- Monitors the water level elevations of the perimeter sumps and the embankment slope monitoring points; and
- Coordinates activities and ensure compliance with the regulatory requirements of the TSF.

The Energy and Infrastructures department has a team of people that:

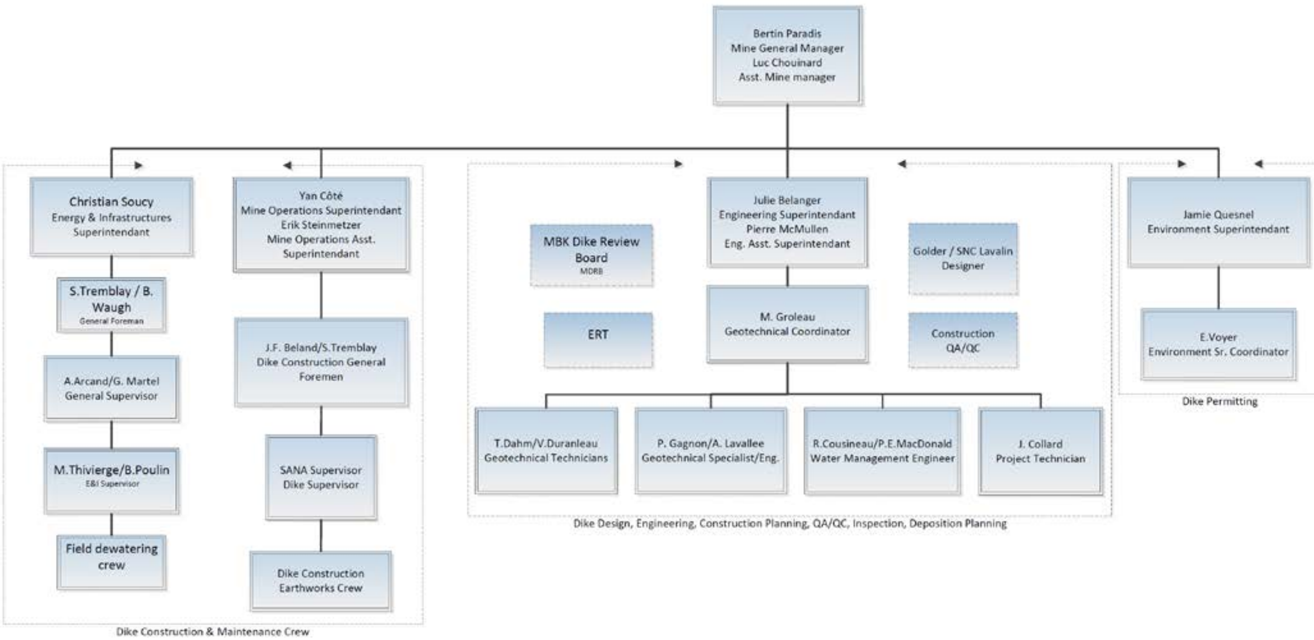
- Carry out the operation, maintenance and surveillance of the tailings distribution system;

The Environment Department has a team of people that:

- Monitors the water quality from the sumps of the TSF; and
- Coordinates activities and ensure compliance with the regulatory requirements of the TSF.

The organizational chart of the current management team is shown on Figure 1. This chart shall be updated to reflect changes in management and/or changes in operational criteria in accordance with AEM's overall management and operational requirements.

Figure 1 AEM Tailings Storage Facility Management Structure



Note: To be updated as required

2.1 **ROLES, RESPONSIBILITIES AND AUTHORITY**

The roles and responsibilities for each AEM position and the authority during the operational cycle of the TSF are listed in Table 2-1. The roles and responsibilities of each position should be updated to reflect changes to the overall management structure.

All site personnel are responsible for informing their Superintendent of any indications of abnormal situations that may be observed.

2.2 **REQUIRED LEVELS OF KNOWLEDGE**

The recommended minimum levels of knowledge by the various positions are as summarized in Table 2-2. Training of personnel shall be carried out to ensure the minimum levels of knowledge set out in Table 2-2 are attained by all personnel and positions involved in the operation of the facility. AEM's training department, with support from relevant personnel, shall carry out all training. Training shall be logged and registered according to the department protocols.

Table 2-1 Roles and Responsibilities

Position	Role	Responsibility
General Mine Manager	Oversees mine development and planning, operations and permitting	Initiate and oversee emergency or contingency protocols during emergency events. Oversight of Mine, Engineering, and Environment Superintendents tasks and responsibilities as laid out in the OMS Manual. Ensures that proper planning is carried out and that required resources are made available. Oversees and provides input in all matters arising in the operation and management of the mine including the TSF.
Engineering Superintendent /Geotechnical Coordinator/ Geotechnical Engineer/Speci alist	Overall TSF management	Coordinates all TSF management related activities. Coordinates with Environmental Superintendent on environmental issues. Ensures Mining Association of Canada (MAC) compliance. Ensures Canadian Dam Association (CDA) compliance. Ensures monitoring is carried out in accordance with the TSF monitoring program, other applicable programs, approved protocols and frequency. Reviews existing and assess future monitoring requirements. Reviews construction designs and schedules. Reviews the QA/QC system to meet construction design. Reviews TSF operating and training manuals – assists in completion of manuals. Ensures documentation and records related to TSF development, construction and operations are kept and are up-to-date. Authorizes emergency work in the event of non-compliance or emergency operational requirements. Reports operational issues to the Mine Superintendent. Ensures all systems are properly maintained. Prepares TSF development, construction, QC and activity reports. Coordinates and reviews regular facility inspections by AEM staff.
Dewatering Foreman	Oversees TSF maintenance	Maintains access to the TSF, road surface repairs, dust control and snow removal. In charge of piping installation and maintenance.
Dike Construction Foreman	Oversees TSF development	Oversees and provides input in construction of the TSF matters. In charge of earthwork construction Supervises Contractor(s).
Environment Superintendent	Oversees environmental data collection	Liaise with external stakeholders including NIRB, Nunavut Water Board and government agencies Assesses current and future monitoring requirements.

Position	Role	Responsibility
	and processing	Reviews government permits and recommends monitoring for compliance Reviews TSF development and deposition plans Prepares TSF water management reports. Oversees TSF water, collection pond and groundwater sampling in accordance with approved protocols. Interprets environmental (facility water quality) data Monitors compliance with water quality and quality from the TSF, and reports non-compliance events and/or trends to Operations Manager. Supervises Environmental Coordinator. Indicates water quality sampling locations, sample collection protocols and analytical parameters in coordination with the Environmental Consultant. Senior TSF environmental oversight. Acts as AEM's contact for governmental oversight of TSF. Reports environmental issues to the General Manager and Operations Manager. Ensures with Engineering Superintendent TSF instrumentation data collection, processing and reporting. Reviews government permits and recommends monitoring for compliance. Assesses future monitoring requirements. Ensures compliance with regulatory requirements. Validates laboratory test results. Processes laboratory data and prepares summary reports. Ensures compliance with water management protocols. Develops and maintain site wide and TSF water balance. Supervises Environmental Technician.
Geotechnical Engineering Consultant	TSF annual inspections	Provides construction-level design, reports, drawings and technical specifications. Provides deposition planning design and reporting. Communicates through Engineering Superintendent and Environment Superintendent. Performs regularly scheduled Third Party Inspections. Performs Special Inspections, as required. Reviews as-built and monitoring reporting. Reviews field quality assurance (QA) and quality control (QC) programs. Reviews geotechnical designs relative to actual field conditions.

Table 2-2 Recommended Minimum Knowledge of OMS Manual

Position	Recommended Minimum Knowledge
General Mine Manager / Assistant Mine Manager	Review of the OMS Manual with an understanding of the operational requirements. Detailed knowledge of emergency response procedures.
Mine Operations Superintendent	Basic knowledge of the OMS Manual, with an understanding of the design and operational requirements. Detailed knowledge of emergency response procedures.
Engineering Superintendent/ Geotechnical Coordinator/ Geotechnical Engineer/Speciali st	Detailed understanding of the OMS Manual, with a complete understanding of the design and operational requirements. Detailed and ongoing review of all monitoring, inspections and embankment safety reviews. Complete understanding of all related technical documents for design, operation, risk assessment and emergency response. Review of the operations manuals on an annual basis. Detailed knowledge of emergency response procedures.
Environment Superintendent	Detailed understanding of the OMS Manual, with an understanding of the design and operational requirements set out in this OMS Manual. Detailed understanding of all operational elements within the facility and their operational and maintenance requirements. Detailed knowledge of emergency preparedness and emergency response procedures.
Environmental Coordinator	Detailed understanding of the OMS Manual, with a complete understanding of the design and operational requirements. Detailed and ongoing review of all monitoring, inspections and embankment safety reviews. Complete understanding of all related technical documents for design, operation, risk assessment and emergency response. Review of the operations manuals on an annual basis. Detailed knowledge of emergency preparedness and emergency response procedures
Process Plant Superintendent	Basic knowledge of the OMS Manual, with an understanding of the design requirements. Detailed knowledge of emergency response procedures.
External Personnel (Consultants and Contractors)	Varied levels of knowledge and understanding depending on involvement. Detailed knowledge of emergency preparedness plan.

SECTION 3 • FACILITY DESCRIPTION

3.1 BACKGROUND

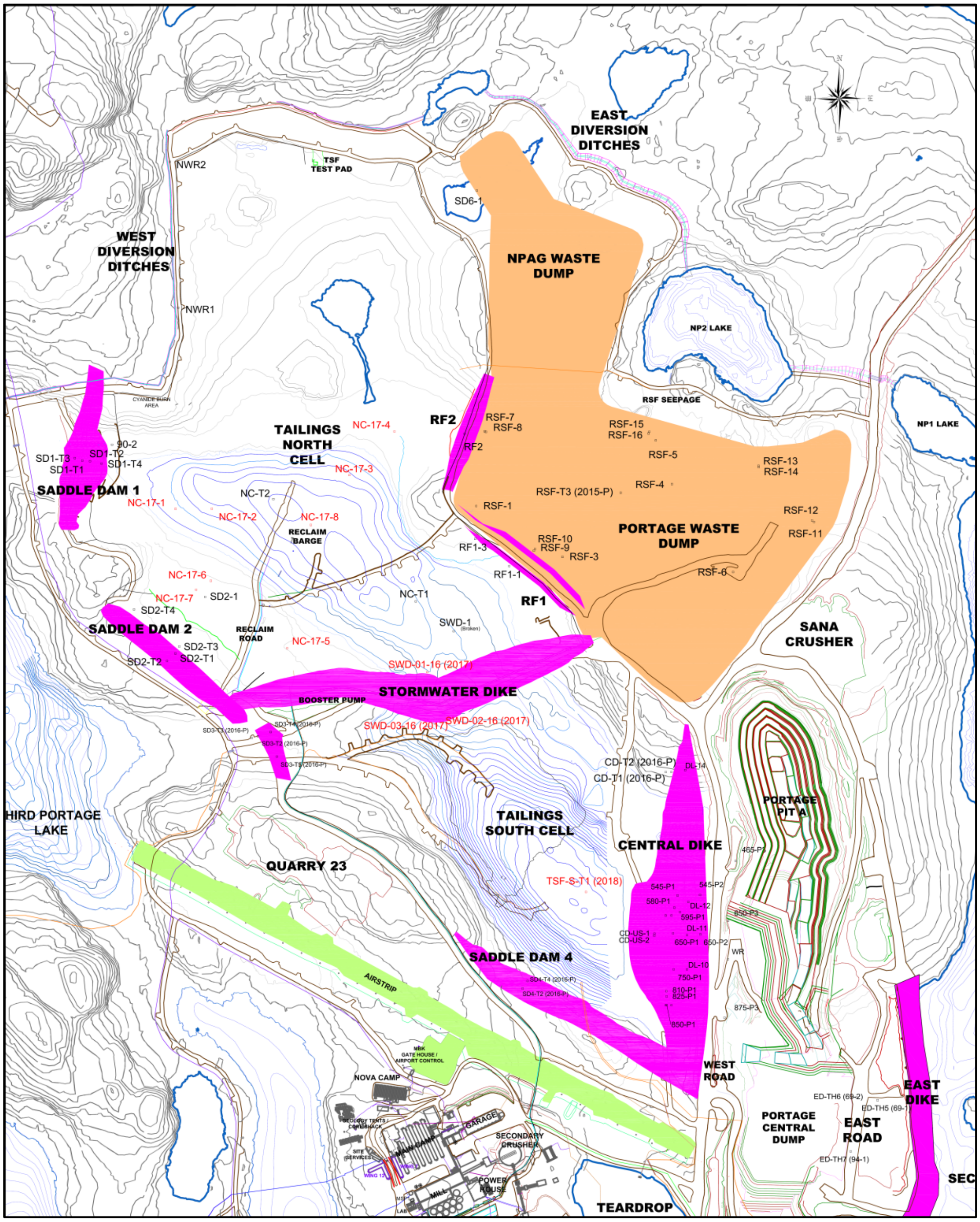
The TSF is the permanent surface storage facility for tailings produced during the operation of the mine. The TSF is located north of the Process Plant Site, as presented on Figure 2, and will be developed in two cells in the following order:

1. North Cell; and
2. South Cell.

The main components of the TSF are:

- Perimeter containment structures (Saddle Dams 1 to 5, inclusive, rockfill structures RF1 & 2 and the Central Dike);
- Seepage and run-off perimeter water control structures;
- Internal deposition structure (Stormwater Dike);
- Deposition infrastructure;
- Dewatering infrastructure;
- Instrumentation; and
- Reclaim water system: supernatant pond and water treatment facility.

Figure 2 Plan of Tailings Storage Facilities



3.2 DESIGN AND OPERATIONAL CRITERIA

The main design and operational criteria for the TSF are summarized in Table 3-1.

3.3 FACILITY COMPONENTS

3.3.1 Perimeter Containment Structures

A series of containment structures comprising of Saddle Dam 1 (SD1), to SD5, inclusive, and the Central Dike form the perimeter of the TSF. These structures are shown on Figure 2.

3.3.2 Internal Deposition Structures

To facilitate deposition within the TSF, the Stormwater Dike (SWD) is located within the facility (refer to Figure 2). This structure divides the North Cell and the South Cell.

3.3.3 Perimeter Water Control Structures

The design objective of the perimeter water control structures, comprising of ditches and sumps, is to collect surface water runoff and seepage from the TSF for pumping back to the tailings facility. The purpose of controlling the runoff and seepage from the TSF is to prevent it from reporting to the downstream environment. The perimeter water control structures will be used throughout the operating life of the TSF. These will continue to be used into the post-closure of the project until both the TSF and adjacent ground returns to pre-development permafrost conditions or the surface runoff and seepage waters are of acceptable quality to be discharged directly to the environment.

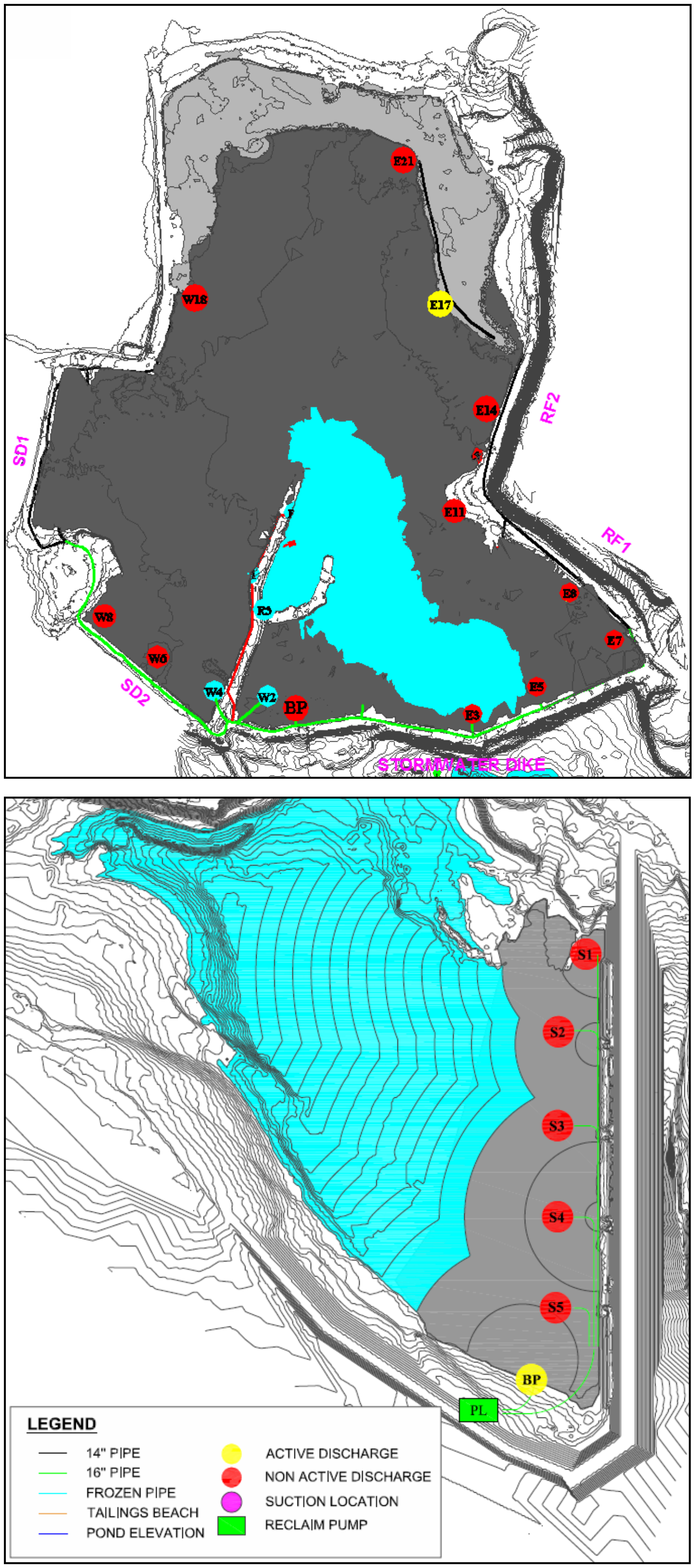
The ditches surrounding the TSF are designed to capture seepage and surface runoff water and provide gravity flow of the water into the sumps.

The sumps are collection points for flows from the ditches and the TSF to enable pumping of water to the water treatment plant.

3.4 TAILINGS DISTRIBUTION SYSTEM

The tailings distribution piping system for transporting slurry from the Process Plant to and for deposition into the TSF is presented on Figure 3.

Figure 3 Spigot Locations



3.5 WATER MANAGEMENT SYSTEM AND PIPING

Water is pumped from the supernatant pond to the Mill Plant for recirculation. Water collected from the non-contact perimeter ditches and sumps is generally directed by the diversion ditches or pumped into the environment if the limits are respected. Water collected from the Saddle Dams seepage collection systems are sent directly to the TSF.

3.6 FACILITY CLOSURE

A cover of non-acid generating waste rock will be placed over the TSF to promote drainage from the surface; no pond will be maintained within the facility. The tailings will begin freezing during operations and remain fully frozen into the post-closure period. Additional details are provided in the closure plan.

3.7 INSTRUMENTATION

The perimeter containment structures of the TSF are instrumented with geotechnical instrumentation and monitored during operations. Monitoring will continue during post-closure. Monitoring is performed to confirm performance of the structures relative to the design.

3.8 PUBLIC SAFETY

Public access to the mine site is restricted by security gates and on-site security upon exiting aircraft and vehicles.

Table 3-1 Design and Operational Criteria

Component	Item	Criteria	Source/Comment
Perimeter Containment Structure Design	Life of mine (LOM Budget2016_V00) Storage Capacity	24.1 Mm^3	Calculated by AEM
	Life of mine total ore	29.9Mt	AEM
	Life of Mine	8 years	AEM
	Canadian Dam Association hazard classification	High	CDA (2007)
	Seismicity for this site: Peak horizontal acceleration based factored 1 in 10,000 year event	0.04 g	Golder (2007)
	Stability: Minimum factor of safety for static load conditions	1.3	Golder (2007)
	Stability: Minimum factor of safety for pseudostatic load conditions	1.1	Golder (2007)
	Embankment crest width	10.0 m (nominal)	Refer to drawings
	Perimeter containment structure downstream side slope*:	1.5H:1V for rock fill	Refer to drawings
	Perimeter containment structure upstream side slope*:	3H:1V (2H:1V for part of Central Dike only)	Refer to drawings

Component	Item	Criteria	Source/Comment
	Interior embankments downstream side slope*:	1.5H:1V for rock fill	Refer to drawings
	Interior embankments upstream side slopes*:	3H:1V	Refer to drawings
Perimeter Water Control Structure Design	Design Event Storage Capacity: Temporary sumps : Perimeter sumps:	1:10 year freshet runoff event 1 :100 year freshet runoff event	Refer to drawings
	Ditch Gradient	Minimum 0.5%	Refer to drawings
Process Plant Rate	Nominal daily processing rate	10,900-12,360 tpd	AEM
Operation	Tailings discharge solids content	52%	AEM
Operation	Dry density planned in modelling	1.22 to 1.44 t/m^3	From measured data. Varies in function of exposed beaches length.
Operation	Deposition slope angle for slurry	SC: sub-aerial: 1.1% ; sub-aqueous: 3.6% NC: sub-aerial: 0.45% ; sub-aqueous: 2.36%	Assumed value pending survey.
Ice	Ice entrapment (by volume)	50% (30% pore water and 20% pure ice entrapment)	Assumed value pending field investigations.
Operation	Specific Gravity for tailings solids	1.6	AEM
Operation: Water Control Structures	Perimeter sump recommended Freeboard	Minimum 1.5 m	Refer to drawings
Operation: Water Control Structures	Design Pump Capacity	Sufficient to dewater a sump for the 1:100 design event in a 2 week period.	

*Note: *Fill placement to be in accordance with the relevant specification.*

SECTION 4 • OPERATIONS

Operation of the TSF requires the management of tailings deposition and storage using inputs from the deposition plan and management of water within the facility.

4.1 OPERATIONAL PHILOSOPHY

Tailings are pumped from the process plant and deposited in the TSF as slurry according to the deposition plan. The objectives of the deposition plan are to:

- Develop long tailings beaches upstream of the perimeter structures;
- Maintain the supernatant pond away from the upstream faces of the perimeter structures;
- Receive tailings from the process plant at all times;
- Limit ice entrapment within the deposited tailings; and
- Provide a flexible plan with the realization that the tailings will be variable in properties (e.g. solids content) and having a variable schedule depending on the processing schedule.

The North Cell diversion ditches intercept surface runoff to limit income of new fresh water in the TSF during operations. The West diversion ditch sump is used to stored water inflow Lake and assesses water quality prior to discharge to the 3rd Portage. Any seepage water from the TSF will be collected in that sump until closure of the North Cell TSF.

4.2 DEPOSITION PLANNING CRITERIA AND CONSTRAINTS

The following constraints were identified as being desirable inputs into the deposition planning work:

- Limit switching between tailings deposition lines so to reduce line flushing requirements;
- Changing between deposition points on a given line will, in general, consist of stopping the flow of tailings in the line, redirecting it through a bypass, flushing the line with water for cleaning and the relocation of the deposition point followed by the reinstatement of tailings flow through the deposition line; and
- All pipelines should be flushed of tailings and fully dewatered prior to periods of non-use to reduce the likelihood of materials and/or water freezing within the pipelines.

Operating Criteria and constraints should be reviewed periodically and updated in the OMS Manual as required (Table 3-1).

4.3 WATER MANAGEMENT

The perimeter ditches will intercept and route runoff and seepage from the TSF to the sumps. The diversion ditches redirect runoff water away from the TSF to the environment. The sumps will provide short-term storage prior to the pumping of the water to the tailing pond. A practical minimum level of water within the sump should be maintained during operations. The maximum operating water level for a given sump is 1.5 m below the sump rim.

SECTION 5 • MAINTENANCE

Maintenance at the TSF is important for safe, continuous operation, and integrity of the facility.

The objectives of the maintenance program are to review and identify maintenance requirements, executing corrective measures and timely repairs of the containment structures, perimeter water control structures, facility access, and infrastructure.

5.1 CONTAINMENT STRUCTURES

Erosion of the rock fill embankments is not expected. However, it is expected that periodic maintenance and re-sloping especially following thawing at the start of each summer may be required at times during operations.

The SWD, as it is an internal structure, is tolerant to settlement. Maintenance during the summer is expected once the frozen materials thaw. Grading, reshaping and nominally compacting additional material should be expected.

The exposed liner should be inspected during the summer season. Repairs shall be done for any damage during that season.

5.2 DITCHES AND SUMPS

Flows may erode the ditches and/or sumps. Sediment, snow and/or ice may accumulate in the ditches and sumps and will require removal to maintain operational functionality and provide storage capacity. Removal of excessive material deposits from the ditches and sumps should be performed as required. The ditches and sumps will require routine monitoring for signs of deterioration and to address any cleaning and maintenance that is required.

Pumps located at the temporary and perimeter sumps will require maintenance based on Manufacturer's specifications and recommendations.

5.3 INSTRUMENTATION

The instrumentation of the TSF shall be maintained to enable collection of the data. Repair, replacement and installation of additional instrumentation should be expected during the development of the TSF.

5.4 PIPELINES AND PUMPS

Maintenance on pumps and tailing pipes should be performed during Mill Plan scheduled shut-down periods or when they are not in operation. General inspection of the pipes should be performed on a regular basis. The heat tracing of the tailings distribution and dewatering pipelines will require maintenance. After each change of deposition point, the pipeline is cleaned and drained with a pig. The pipes are inspected after the cleaning. During winter time, pipe ends are wrapped into a membrane to avoid any snow blockage.

SECTION 6 • SURVEILLANCE

The principal objective of the TSF surveillance program is to identify conditions that would compromise the integrity of the facility well in advance of problems occurring and adjusting the design and/or operation to reduce risk. The TSF surveillance program focuses on four areas of interest:

1. Stability and deformation of the perimeter containment structures;
2. The thermal conditions beneath and within the TSF;
3. The quantity and quality of seepage from the TSF; and
4. Material movement and placement (locations and quantities of all material types being deposited, disposed and placed) in the TSF.

Table 6-1 (see Section 6.2) was developed to determine the items which will be monitored, the monitoring frequency and the responsible party. The items should be monitored at a frequency such that project commitments and/or requirements are satisfied and such that trends may be developed for optimization of the operation of the TSF. Table 6-1 should be reviewed and updated as required while maintaining the project commitments.

6.1 INSPECTIONS

A series of regularly scheduled inspections is required to ensure that the TSF facility is performing as intended and to identify problems and issues so that necessary corrective actions may be implemented in a timely manner. Surveillance tasks include visual inspections, monitoring of instrumentation and water levels and preparation of written and photographic documentation.

The main types of inspections are as follows:

- Routine inspections – performed by AEM geotechnical team;
- Monthly or Bi-Monthly Inspection – performed by AEM geotechnical team;
- Special Inspections – performed by AEM and the Geotechnical Engineering Consultant depending on the event; and
- Annual Inspection – performed by a Geotechnical Engineering Consultant familiar with the design and operation of the facility.

6.1.1 Routine Inspections

Routine visual inspections are to be carried out by AEM personnel at the TSF to assess operational status of various elements of the facility. The frequencies for these inspections are as follows:

- In areas of active deposition: daily; and
- In areas without deposition: monthly.

Inspections of the TSF perimeter containment structures and water control structures are to be conducted and documented. Inspection forms used to conduct and document these inspections are included in Appendix II.

The following is a list of general information which should be recorded during each inspection:

❖ Water Control Structures (by Engineering department):

- Sump water elevation (staff gauge readings) noted and reviewed to ensure normal freeboard;
- General dewatering pipeline condition, signs of leaks or abnormal conditions; and
- Depth of flow in ditches, inspection of ditches and downstream berm condition, signs of potential seepage.

❖ Perimeter Containment Structures (by Engineering department):

- Inspection of the general condition of interior and perimeter embankment crest, toe, and slopes, looking for: settlement, erosion, seepage, cracking, liner deterioration, animal burrows or other abnormal conditions;
- Description and status of embankment construction activities; and
- Inspection of embankment slopes for any signs of instability.

❖ Tailings Distribution System (by Engineering department and Energy and Infrastructure Supervisor):

- General pipeline condition, signs of leaks or abnormal conditions;
- Deposition location point and beach elevation relative to spigot elevation;
- Length of beach; and
- Pipeline flow, slurry density, pipeline pressure.

Documentation of the routine inspections of the TSF perimeter containment structures should be submitted to the Geotechnical Coordinator following each inspection.

The completed Perimeter Containment Structures and Water Control Structures inspection forms are stored in an electronic data base system for the TSF. Hard copies of the inspection forms are catalogued and stored on site.

6.1.2 Special Inspections

Special inspections may be required in addition to the routine inspections such as during, or at the time of: unusual climate events such as heavy rain, rapid snowmelt, anomalous instrumentation readings or significant seismic events. The Geotechnical Engineer/Specialist or Geotechnical

Technician shall perform the special inspection immediately at the time of the event and shall notify the Geotechnical Engineering Consultant.

6.1.3 Annual Inspection

Annual inspections shall be carried out by a qualified Geotechnical Engineering Consultant who is familiar with the design and on-going operation of the TSF. During this inspection, the following tailings management structures will be visited:

- Central Dike;
- Stormwater Dike;
- Saddle Dams 1 to 5;
- RF-1 & 2;
- West Diversion ditches; and
- the perimeter road around the North Cell.

The objective of the inspections is to carry out a detailed review of the conditions of the facilities and facility operation during the spring freshet and prior to freeze up.

The Geotechnical Engineering Consultant issues an inspection report to AEM containing observations and recommendations. This report provides information to be used to revise the operation, maintenance and surveillance programs as necessary and to assist in planning for future operation of the facility.

6.2 INSTRUMENTATION AND SURVEY

Instrumentation is installed to monitor the stability and deformation of the perimeter containment structures, ground temperature, seepage, water quality and to monitor operational performance. Instrumentation is to be maintained, replaced, added, extended and relocated during the development of the TSF; therefore this section should be updated regularly. The current instrumentation locations are shown on Figure 4. Current instrumentation for the TSF includes thermistors. Piezometers are installed at Central Dike. Survey of the water and tailing elevation are also taken at different locations in the TSF.

The instrumentation and survey levels are to be read and recorded at the frequencies shown in Table 6-1.

Table 6-1 Surveillance Items and Frequencies

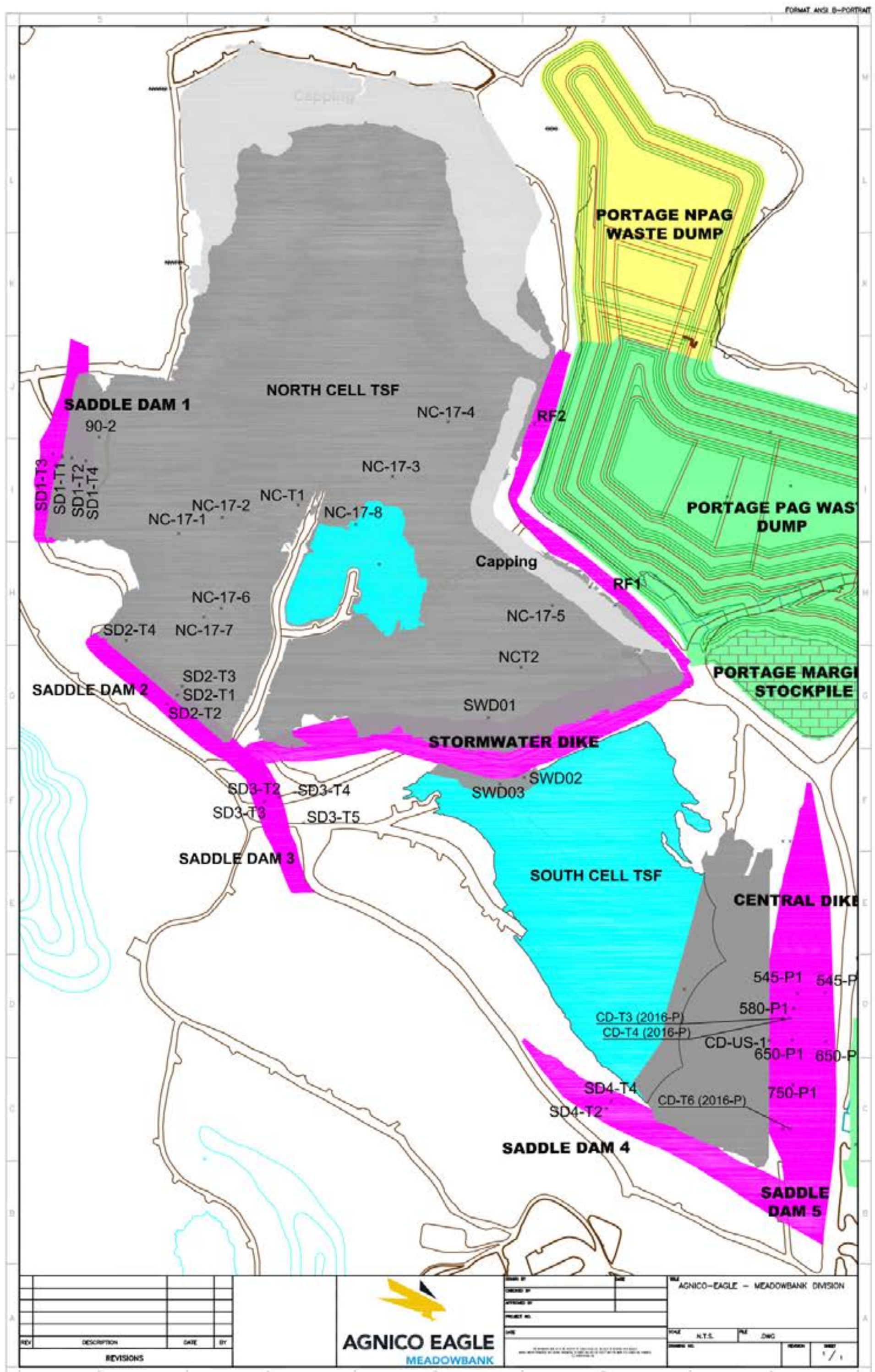
Instrumentation	*Monitored By*	*Reported To*	*Frequency*
Thermistors and Piezometers	• Manually by Engineering and Environment Personnel	Engineering and Environment Superintendent Geotechnical Coordinator	Weekly during winter and every three (3) days during the summer
Survey	• Manually by Engineering Personnel	Engineering and Environment Superintendent Geotechnical Coordinator	Daily during freshet; and Monthly during non-freshet period

The instrumentation is to be monitored by the responsible party and at the frequency shown on Table 6-1 and at any other periods of extended rainfall or run-off. Immediate readings of all instrumentation shall be carried out following a significant seismic or climatic event.

The instrumentation data shall be analyzed and summarized by the engineering and environmental departments.

The instrumentation readings are to be reviewed by the Geotechnical Engineering Consultant performing the third party inspections.

Figure 4 Approximate Location of Current Instrumentation



6.2.1 Ground Temperature and Piezometric Level Monitoring

Thermistors have been installed in the area of the TSF to measure ground temperatures. Piezometers have been installed at Central Dike to measure the piezometric level in the ground. Additional thermistors and piezometers will be installed in the future during operations and closure.

Maintenance and calibration of the instruments and extensions should be carried out according the Manufacturer's recommendations.

Data presented for the thermistors and piezometers should include:

- Time plots (presenting all thermistor nodes on each string); and
- Temperature vs. depth/elevation plots over time.

The plots shall indicate the instruments reference number, date of measurements, elevation, and depth.

6.2.2 Anomalous Measurements

Anomalous instrumentation data includes the following:

- Thermistors:
    - Increase or decrease in measurements (over two or more readings) that cannot be explained by seasonal temperature variations or instrument malfunction.
- Piezometers:
    - Sudden increase or decrease in measurements (over two or more readings) that cannot be explained by normal variation of the piezometric level or instrument malfunction.

If anomalous readings are observed, the following actions should be taken:

1. Inspect the embankment where possible and appropriate;
2. Check data, reductions and calculations for accuracy and correctness;
3. Re-read to verify the reading;
4. Check readout equipment to verify that it is functioning correctly;
5. Verify calibration;
6. If instrument has stopped functioning, notify the Engineering Superintendent and Geotechnical Coordinator immediately. If considered applicable, a replacement instrument should be installed;
7. If the anomalous reading is confirmed, a detailed review of the effects of the reading should be carried out based on the specific inspection and design or remedial actions should be implemented if determined necessary by the Engineering Superintendent and Geotechnical Coordinator; and
8. Increase monitoring frequency to assess progression of anomaly.

6.2.3 Seepage Monitoring

The seepage monitoring performed for the TSF comprises of visual inspections of the perimeter water control structures, the quantity tracking of water pumped to and from the TSF, rate of seepage and water quality of seepage through the embankment, and testing water samples collected from the perimeter sumps.

Visual inspections should document sediment, ice and snow deposits in the ditches and sumps.

Anomalous measurements of the seepage may occur and include the following:

- Increase or decrease in pump rates that are inconsistent with rainfall or runoff events or predictive models;
- Sediments present in the seepage water; and
- Changes in seepage location, flow and quality.

If anomalous readings are observed, the following actions should be taken:

1. Inspect the water control structure area;
2. Check data, reductions, and calculations for accuracy and correctness;
3. Re-read;
4. Check readout equipment to verify that it is functioning correctly;
5. Verify calibration;
6. If the anomalous seepage measurement is confirmed, a detailed review of the effects of the increased seepage should be carried out based on the specific inspection and design or remedial actions should be implemented if determined necessary by the Engineering Superintendent and Geotechnical Coordinator;
7. Manage the seepage properly by collecting it, then pumping the seepage and sending it to a treatment facility, treating it if necessary, then finally discharging the seepage through a final discharge point; and
8. Increase monitoring frequency to assess progression of anomaly.

6.3 WATER QUALITY

The quality of water collected in the sumps and sampled from the water sampling locations is to be monitored. The monitoring plan available in Appendix I summarize water quality and water flow monitoring to be conducted for the Meadowbank gold project.

SECTION 7 • REPORTING AND DATA MANAGEMENT

7.1 REPORTING

7.1.1 Inspection Documents

All inspection documents and reviews shall be submitted to the Engineering Superintendent and the Geotechnical Coordinator and accessible to all in the local network.

7.1.2 Instrumentation Measurements

Instrumentation measurements (thermistors and piezometers) and water quality results collected shall be reported to the Engineering Superintendent and the Geotechnical Coordinator. Pumping rates during dewatering and operation shall be reported to the Engineering Superintendent and the Geotechnical Coordinator.

7.1.3 Emergencies

All documents regarding instrumentation and inspection during an emergency situation and prior to the emergency shall be made available to all parties involved including the General Manager, Assistant General Manager, Environment Superintendent, Engineering Superintendent, Geotechnical Coordinator, Process Plant Superintendent, Mine Operations Superintendent, Maintenance Superintendent, and the Geotechnical Engineering Consultant.

7.2 DATA MANAGEMENT

All surveillance records including visual embankment inspections, instrumentation measurements, flow, and water quality results shall be stored in an electronic library or database system which is easily accessible to staff involved with the TSF. Hard copies shall be catalogued and stored on site. Examples of surveillance data stored, but not limited to, are:

- Routine operation inspection reports, perimeter containment structures visual inspections, water control structure inspections and water management inspections,
- Special Inspections;
- Annual Inspections;
- Instrumentation Measurements;
  - Thermal- thermistor data;
  - Piezometer data; and
- Water quality testing results.

SECTION 8 • EMERGENCY PREPAREDNESS PLAN

The Dam Safety Guidelines prepared by the Canadian Dam Association (2007) states that “A dam which does not impose an unacceptable risk to people or property, and which meets safety criteria that are acceptable to the government, the engineering profession and the public is a safe dam”.

This guiding principle has been taken into account for the design of the TSF embankments and the emergency procedures.

The TSF perimeter containment structures are classified as a “High Consequence of Failure” (CDA 2007) as discussed in Section 1.4.

To respond to possible hazards and emergencies involving the TSF, emergency response plans have been designed. This section provides a summary of the actions, triggers and measures in the event of an emergency.

In case of an emergency, the documents listed in Table 9-1 shall be. The Emergency Response Plan (ERP) shall also be referenced. Dike failure scenarios are presented in Appendix III of this OMS.

8.1 EMERGENCY PROCEDURES

The purpose of the Emergency Preparedness Plan (EPP) is to present a basic procedure for responding to potential failure mechanisms. The procedure identifies various measurable or observable effects or causes of the failure mechanisms and identifies the appropriate people to notify. Potential failure mechanisms are summarized in Table 9-2 with potential measurable and observable causes and effects.

8.1.1 Operation

Table 9-3 and 9-4 summarizes the triggers for implementing the EPP with respect to the potential measurable and observable effects or causes of the various failure mechanisms during operations.

Table 9-5 indicates the chain of communication to follow so persons in charge are notified for different states of emergency.

Table 9-6 indicates the responsibilities of persons for each emergency level in terms of who performs the decision making, mobilization, and action to be taken.

Table 9-7 indicates the names and contact numbers of the persons in charge during an emergency event.

8.2 EMERGENCY DETAILS

In the unlikely event of a catastrophic dike breach that could endanger workers the Code 1 procedure described in Section 8.2.4 would be followed to warn all workers of the situation. Then an evacuation of the affected areas and pits would be carried out and directed by the ERT Team in person and over the emergency channel. In the event of an embankment failure, the following information should be used during the emergency response:

Project Name:	Meadowbank Gold Project
Perimeter Containment Structure Names:	SD1, SD2, SD3, SD4, SD5, Central Dike
Owner's Name:	Agnico Eagle Mines Limited (867) 793-4610
Site Location:	Latitude: 65°01'07''N Longitude: 96°04'26''W

8.2.1 Access to the Project Site

- 80 km north of the Hamlet of Baker Lake;
- Site accessible by all-weather private road from Baker Lake; and
- Site accessible by aircraft and helicopter.

	Name	**Phone Number**
Local Charter Company:	Calm Air International Ltd.	Baker Lake : (867) 793-2873
Local Helicopter Company:	Kitikmeot Helicopters Ltd	(867) 983-2544
Charter Aircraft Company:	Nolinor Aviation	(450) 476-0018

8.2.2 Emergency Assessment

In case of an event, emergency assessment will be done first by AEM Geotechnical Engineering personnel and the Engineering Superintendent on site. Assessment will be done according the criteria stated in the Table 9-2, 9-3 and 9-4.

8.2.3 Emergency Communication and Actions

In case of an event, after the emergency assessment, the persons involved in the emergency response team need to be notified following the chain of command stated in Table 9-5. Contact details of each person are available in Table 9-7.

According to the nature of the event, a decision and action plan will be taken by the persons notified. The action plan will be defined according to the level of emergency and the cause of the event. The immediate action plan will be taken with material and equipment available on site, as listed in Section 8.4.

8.2.4 Site Emergency Procedure

As specified in the Emergency Response Plan, Ver. 9, Section 4:

In the event of an immediate emergency that is or could impact persons or equipment, the employee will have to follow our emergency procedure:

- Emergency is initiated - by calling **6911** on desk type phones, or calling on two-way radio on **"Working Channel" – Code 1 – Code 1 – Code 1.**
- All communication stops except for those involved with the Emergency – i.e.: First Aid Room attendants, Medics, ERT as required.
- All work stops in First Aid Room / Clinic – and in affected area – depending on seriousness of Emergency – the whole site.
- First Aid Room Attendant / Medic will answer the phone and/or radio.

  Note: if the First Aid Room Attendant / Medic do not answer, then Security Guard will answer and/or a Supervisor on radio will answer so that Emergency Response can be initiated.
- **Responder –** will ask where the medic is required.
- **Caller –** will give a brief description of the Emergency – name, location and what is wrong and/or required.
- **Responder –** will confirm location and details of incident and activate the **ERT** team. Security will be notified by responder and a page will be sent out to all **ERT** team members on site. (All **ERT** team members on site now carry pagers).
- The person at the casualty(s) will administer First Aid if trained to do so.
- Incident Commander Center will be immobilized as to ensure that communications, transportation, and effective deployment of **ERT** resources are conducted. It is mandatory that the Official In-Charge be notified immediately.
  - Transportation will be arranged to meet at the **ERT** hall by the two large doors for medical gear and **ERT** team members.

The **ERT** team (minimum of 6 team members) will assemble as quickly as possible. (Expectation – when the pager goes off – all **ERT** team members will make their way expediently to the **ERT** hall).

8.2.5 Communication Equipment Location

Communication equipment can be found at the following locations:

- Phone land lines are located in the main office;
- Base station radios are located in the main office;
- Drills will have either base station radios or handhelds—depending on their distance from camp and will have satellite phones available; and
- Emergency Communication Plans (including emergency contact numbers) are located adjacent to all phones and radios and in each drill.

8.3 MEDICAL AND FIRST AID SERVICES

In case of injury the medic and First Aid station are located in the Service Building. The nearest hospital is located in Baker Lake.

Health Center:	Baker Lake Health Center	*Phone #:*	(867) 793-2816 (867) 793-2817

8.4 ON SITE EQUIPMENT AND MATERIAL

8.4.1 Pumping Equipment

The following is a list of onsite pumping equipment available for use during an emergency event:

Unit Number	Description	Model
61PWA01	Dewatering pump #1	Godwin model HL250M
61PWA02	Dewatering pump #2	Godwin model HL250M
61PWA03	Dewatering pump #3	Godwin model HL250M
61PWA04	Dewatering pump #4	Godwin model HL250M
61PWA05	Dewatering pump #5	Godwin model HL250M
61PWA06	Dewatering pump #6	Godwin model HL250M
61PWA07	Pit Dewatering pump #7	Godwin model CD80M
61PWA08	Pit Dewatering pump #8	Godwin model CD80M
61PWA09	Dike Dewatering pump #9	Godwin model CD100M
61PWA10	Dike Dewatering pump #10	Godwin model CD103M
61PWA11	Dike Dewatering pump #11	Godwin model CD103M
61PWA12	Dike Dewatering pump #12	Godwin model CD103M
61PWA13	Pit Dewatering pump #13	Godwin model HL5MS
61PWA14	Pit Dewatering pump #14	Godwin model HL5MS
61PWA15	Bay-Goose Seepage electric dewatering pump #9	Godwin model CD103M
61PWA16	Bay-Goose Seepage electric dewatering pump #10	Godwin model CD103M
61PWA17	Bay-Goose Seepage electric dewatering pump #11	Godwin model CD103M
61PWA18	Bay-Goose Seepage electric dewatering pump #12	Godwin model CD103M

Note: To be updated as required

8.4.2 Mobile Equipment

The following are lists of onsite mobile equipment of AEM and SANA available for use during an emergency event:

Unit Number	Description	Unit Number	Description	Unit Number	Description	Unit Number	Description	Unit Number	Description	Unit Number	Description
6151COM11	PNEUMATIC COMPRESSOR (AIR)	61GEN10	CUMMINS GEN SET 6CT, TWIN	61HTR28	HAUL TRUCK 150T CAT 785C	61PCK15	PICK UP F350 (MOB.MNTCE CRANE)	61PCK79	PICK-UP F250 MNTCE SUPERINTEND	61TRK07	WATER DELIVERY TRUCK FORD
61ATV01	HONDA ATV	61GEN13	CATERPILLAR GENSET 200KW D200P	61HTR29	HAUL TRUCK 150T CAT 785D 2011	61PCK16	PICK UP F350 (BLASTER)	61PWA01	DEWATERING PUMP # 1	61TRK08	SEPTIC TRUCK TRUCK FORD
61ATV02	HONDA ATV	61GEN16	CATERPILLAR GENSET 30KW D30-8	61HTR30	HAUL TRUCK 150T CAT 785D 2011	61PCK17	PICK UP F350 WAREHOUSE	61PWA02	DEWATERING PUMP # 2	61TRK11	CEMENT TRUCK MAC - AMARUQ
61ATV03	HONDA ATV	61GEN34	WHITEOUT GENERATOR	61HTR31	HAUL TRUCK 150T CAT 785D	61PCK18	PICK UP F350 (GEOLOGY)	61PWA03	DEWATERING PUMP # 3	61TRK12	1 AXLE SHUNT TRUCK
61ATV04	HONDA ATV	61GEN37	JOHN DEERE MODEL 6081AF001	61HTR32	HAUL TRUCK 150T CAT 785D	61PCK19	PICK UP F250 (MOBILE MNTCE)	61PWA04	DEWATERING PUMP # 4	61TRK13	KENWORTH TRUCK
61ATV05	HONDA ATV	61GEN49	ERT GENERATOR	61HTR33	HAUL TRUCK 150T CAT 785D	61PCK20	PICK UP F250 (ENVIRONMENT)	61PWA05	DEWATERING PUMP # 5	61TRK14	KENWORTH TRUCK
61BAC01	BACKOE TEREX O&K RH40-E	61GEN50	ERT GENERATOR	61HTR34	HAUL TRUCK 150T CAT 785D	61PCK21	PICK UP F250 MINE PIT DEWATER.	61PWA06	DEWATERING PUMP # 6	61TRK15	KENWORTH TRUCK
61BAC02	BACKOE CATERPILLAR 345CL	61GEN51	KUBOTA GENSET #1 - AMARUQ	61LGT01	AMIDA TOWER LIGHT AL5080D	61PCK22	PICK UP F250 (MINE RESUCE)	61PWA07	DEWATERING PUMP # 7	61TRK16	KENWORTH TRUCK
61BAC03	BACKOE CATERPILLAR 307	61GEN52	KUBOTA GENSET #2 - AMARUQ	61LGT02	INGERSOLL RAND L20 TOWER LIGHT	61PCK23	PICK UP F250 (ELECT MILL)	61PWA08	DEWATERING PUMP # 8	61TRK17	KENWORTH TRUCK
61BAC04	BACKOE CATERPILLAR 330D	61GEN53	AMARUK ROAD SHELTER GENSET	61LGT03	INGERSOLL RAND L20 TOWER LIGHT	61PCK24	PICK UP F250 MINE HELP/BIT SHO	61PWA09	DEWATERING PUMP # 9	61TRK18	GARBAGE TRUCK KENWORTH
61BAC05	BACKOE CATERPILLAR 345DQ	61GRA01	MOTOR GRADER 16H CAT	61LGT04	INGERSOLL RAND L20 TOWER LIGHT	61PCK25	PICK UP F250 MINE HELP/BIT SHO	61PWA10	DEWATERING PUMP # 10	61TRK19	FIRE TRUCK
61BAC06	BACKOE CATERPILLAR 385C	61GRA02	MOTOR GRADER 160H CAT	61LGT05	INGERSOLL RAND L20 TOWER LIGHT	61PCK26	PICK UP F250 (SITE SERV FIELD)	61PWA11	DEWATERING PUMP # 11	61TRK21	FUEL TRUCK
61BAC07	BACKOE CATERPILLAR 345DL	61GRA03	MOTOR GRADER 16M CAT	61LGT06	INGERSOLL RAND L20 TOWER LIGHT	61PCK27	PICK UP F250 (SITE SERVICE)	61PWA12	DEWATERING PUMP # 12	61TRK22	SNOW PLOW WITH WING&SANDER
61BAC08	BACKOE PC1250 KOMATSU	61GRA04	MOTOR GRADER 16M CAT	61LGT07	INGERSOLL RAND L20 TOWER LIGHT	61PCK28	PICK UP F250 (DYKE SUPER.)	61PWA13	DEWATERING PUMP # 13	61TRK23	SNOW PLOW WITH WING&SANDER
61BAC09	BACKOE 390DL CATERPILLAR	61GRA05	CATERPILLAR GRADER 16M	61LGT08	LIGHT TOWER GEOLOGY	61PCK29	PICK UP F250 MINE.SUP.AUX.EQUI	61PWA14	DEWATERING PUMP # 14	61TRK24	STEAMER TRUCK
61BAC10	BACKOE TEREX O&K RH120-E	61HEA01	FROST FIGHTER IDF-350	61LGT09	WACKER TOWER LIGHT LTC4	61PCK30	PICK UP F250 DIKES /DEWATERING	61PWA15	DEWATERING PUMP # 15	61TRK28	INTERNATIONAL TIRE TRUCK
61BAC11	BACKOE BUCYRUS RH120-E	61HEA02	ALLMAND HEATER MH-1000 MNTCE	61LGT11	WACKER TOWER LIGHT LTC4	61PCK31	PICK UP F250 (MILL)	61PWA16	DEWATERING PUMP #16	61TRK30	LUBE TRUCK
61BAC12	BACKOE TEREX O&K RH120-E	61HEA03	ALLMAND HEATER MH-1000 MNTCE	61LGT12	WACKER TOWER LIGHT LTC4	61PCK32	PICK UP F250 (ELECT. DEPT.)	61PWA17	DEWATERING PUMP #17	61TRK31	MECHANICAL SERVICE TRUCK
61BAC13	BACKOE CAT6030	61HEA05	LANAIR WASTE OIL BURNER MX 300	61LGT13	INGERSOLL RAND L20 TOWER LIGHT	61PCK33	PICK UP F250 (ENGINEERING)	61PWA18	ENVIRONMENT EMERGENCY PUMP	61TRK32	GMC AIR PLANE FUEL TANKER
61BUC06	BUCKET CAT6030	61HEA08	FROST FIGHTER IDF-350	61LGT14	LGT WACKER LTC4L	61PCK34	PICK UP F250 SECURITY ON SITE	61PWA19	150HP ELECTRICAL PUMP	61TRK33	CAT LUBE TRUCK T300
61BUS01	BUS YELLOW BLUE BIRD	61HEA11	FROST FIGHTER IDF-350	61LGT18	AMIDA TOWER LIGHT LT5000-4MH	61PCK35	PICK UP F250 (ROAD CREW)	61RBD01	ROTARY BLAST DRILL 6" ATLAS	61TRK34	STERLING SERVICE TRUCK
61BUS02	MINIBUS BLUE BIRD	61HEA12	FROST FIGHTER IDF-350	61LOA01	LOADER IT14G CAT	61PCK36	PICK UP F250 (ROAD CREW)	61RBD02	ROTARY BLAST DRILL 6" ATLAS	61TRK35	FUEL TRUCK PETERBILT 367
61BUS03	MINIBUS BLUE BIRD	61HEA13	FROST FIGHTER IDF-350	61LOA02	LOADER IT14G CAT	61PCK37	PICK UP F250 (EXPLORATION)	61RBD03	ROTARY BLAST DRILL 6" ATLAS	61TRK36	SNOW PLOW WITH WING&SANDER WHT
61BUS04	BAKER LAKE PASSANGER VAN E350	61HEA14	FROST FIGHTER IDF-350	61LOA03	LOADER 992G CATERPILLAR	61PCK38	PICK UP F250 (EXPLORATION)	61RBD04	ROTARY BLAST DRILL 6" ATLAS	61TRK38	FORD SERVICE TRUCK
61BUS05	BUS RED BLUE BIRD	61HEA15	MILL FROST FIGHTER # 1	61LOA04	LOADER 992G CATERPILLAR	61PCK39	PICK UP E350 AMBULANCE	61RBD05	LONG HOLE DRILL CM785	61TRK39	LUBE TRUCK
61BUS06	BAKER LAKE MINI BUS	61HEA16	MILL FROST FIGHTER # 2	61LOA05	LOADER 420E IT CAT (PEPINE)	61PCK40	PICK UP (IT GREY RENTAL)	61RBD06	DML DRILL 6" ATLAS	61TRK40	CEMENT TRUCK MACK
61BUS07	INTERNATIONAL BUS - AMARUQ	61HEA17	MILL FROST FIGHTER # 3	61LOA06	LOADER 966H CATERPILLAR-AMARUQ	61PCK41	PICK UP F250 (P.A BOSSE)	61RBD07	DML DRILL 6" ATLAS	61TRK41	PUMP TRUCK MACK
61BUS08	BLUE BIRD BUS	61HEA18	MILL FROST FIGHTER # 4	61LOA07	SCRAP-LOADER 966H CATERPILLAR	61PCK42	PICK UP F250 (FIELD TEAM LEAD)	61RBD08	DML DRILL 6" ATLAS	61TRK42	FUEL TRUCK (VAULT)
61BUS09	BUS YELLOW BLUE BIRD	61HEA19	MILL FROST FIGHTER # 5	61LOA08	LOADER TC44H JOHN DEERE	61PCK43	PICK UP F350 (CONSTRUCTION)	61SBL03	SNOWBLOWER T85-R52	61TRK43	WATER TRUCK (VAULT)
61BUS10	USED INTERNATIONAL BUS	61HEA20	FROST FIGHTER IDF-350	61LOA09	LOADER 966H CATERPILLAR	61PCK44	PCK F250 2011 (SUP. BLASTER)	61SCI05	SCISOR LIFT GENIE GS3232	61TRK44	SERVICE TRUCK (VAULT)
61BUS11	BLUE BIRD BUS	61HEA21	FROST FIGHTER IDF-350	61LOA10	LOADER 980H CATERPILLAR	61PCK45	PCK F350 2011 (BLASTER PICK)	61SCI06	GENIE S85	61TRK45	LUBE TRUCK (VAULT)
61BUS12	BLUE BIRD BUS	61HEA22	FROST FIGHTER IDF-350	61LOA11	LOADER 420E CATERPILLAR-AMARUQ	61PCK46	PCK F250 2011 GEOLOGY	61SCI07	MAN LIFT GENIE Z-45/25	61TRK46	FIRE TRUCK
61COM01	DOOSAN MOBILE COMPRESSOR	61HEA24	FROST-FIGHTER IDF-350	61LOA12	LOADER 980H CATERPILLAR	61PCK47	PCK F250 2011 PIT PROD. SUP.	61SCI08	MAN LIFT GENIE Z-45/25	61TRL01	BEDARD TANKER TRAILER
61COM02	MOBILE AIR COMPRESSOR	61HEA26	FROST-FIGHTER IDF-350	61LOA13	WHEEL LOADER 992K CATERPILLAR	61PCK49	PCK F250 2011 DRILL&BLAST SUP	61SCI10	GENIE S85 (OLD 61REN07)	61TRL03	BELLY DUMP TRAILER
61COM03	COMPRESSOR QGD25 QINCY	61HEA27	FROST-FIGHTER IDF-350	61LOA14	TIRE HANDLER LOADER	61PCK50	F-250 BLUE 2011 MINE SERV. SUP	61SCI11	GENIE S85 - AMARUQ	61TRL04	LOW BED TRAILER
61COM04	COMPRESSOR 2545 IR	61HEA28	INGERSOLL RAND	61LOA15	LOADER 980K CATERPILLAR	61PCK51	PCK F250 2012 (S.S FIELD SERV)	61SCI12	GENIE S85	61TRL05	LOW BED TRAILER
61COM05	DOOSAN AIR COMPRESSOR	61HEA33	FROST-FIGHTER IDF-350	61LOA16	LOADER IT14G CATERPILLAR	61PCK52	PCK F450 2011 (WAREHOUSE)	61SCI13	GENIE S125	61TRL06	FUEL TANKER BEDARD 54000L
61COM06	MILL MOBILE COMPRESSOR	61HEA35	FROST-FIGHTER IDF-350	61LOA17	LOADER WA-600 KOMATSU	61PCK53	PICK UP F250 (PROCESS PLANT)	61SCI14	GENIE S125	61TRL07	FUEL TANKER BEDARD
61CPT01	CATERPILLAR COMPACTOR CS76	61HEA36	FROST-FIGHTER IDF-350	61LOA18	LOADER 966H CATERPILLAR	61PCK54	PICK UP F250 (ENGINEERING)	61SCI15	SCISSOR LIFT GENIE 32'	61TRL08	DOUBLE DROP LOW BOY
61CPT02	CATERPILLAR COMPACTOR CS563	61HTR01	HAUL TRUCK 100T CATERPILLAR	61MCR01	CRANE 120T MANITOWOC	61PCK55	PICK UP F250 (SURVEY)	61SCI16	SCISSOR LIFT GENIE 32'	61TRL09	FIRE TRAILER SKID W/ PUMP
61DOZ01	DOZER D8T CATERPILLAR	61HTR02	HAUL TRUCK 100T CATERPILLAR	61MCR02	CRANE 80T TEREX	61PCK56	PICK UP F250 (GEOLOGY)	61SCI17	MAN LIFT JLG 30' MODEL E300AJP	61TRL10	DISPATCH COMM TRAILER
61DOZ02	DOZER D9T CATERPILLAR	61HTR03	HAUL TRUCK 100T CATERPILLAR	61MCR03	CRANE 35T GROVE	61PCK57	PICK UP F250 (ROAD CREW)	61SCI18	MAN LIFT JLG 30' MODEL E300AJP	61TRL11	DISPATCH COMM TRAILER
61DOZ03	DOZER D8R CATERPILLAR	61HTR04	HAUL TRUCK 100T CATERPILLAR	61MCR04	90T LORAINE CRANE	61PCK58	PICK UP F250 - EXPLORATION	61SKD01	SKID STEER 262C CATERPILLAR	61TRL12	DISPATCH COMM TRAILER
61DOZ04	SCRAP - DOZER D7H CATERPILLAR	61HTR05	HAUL TRUCK 100T CATERPILLAR	61MCR05	25T INTERNATIONAL BOOM TRUCK	61PCK59	PICK UP F250 ELEC. SUPERINTEND	61SKD02	SKID STEER 753 CATERPILLAR	61TRL13	DISPATCH COMM TRAILER
61DOZ05	DOZER D9T CATERPILLAR	61HTR06	HAUL TRUCK 100T CATERPILLAR	61MCR06	CRANE 200T AMERICAN	61PCK60	PICK UP F250 (G.F DYKE)	61SKD03	SKID STEER 262C CATERPILLAR	61TRL14	DISPATCH COMM TRAILER
61DOZ06	DOZER D9T CATERPILLAR	61HTR07	HAUL TRUCK 100T CATERPILLAR	61MFT01	MOBILE FUEL TANKER TRAILLER	61PCK61	PICK UP F250 (SITE SERVICE)	61SKD04	SKID STEER 262C CAT	61TRL15	DISPATCH COMM TRAILER
61DOZ07	DOZER D9T CATERPILLAR	61HTR08	HAUL TRUCK 100T CATERPILLAR	61MFT02	MOBILE FUEL TANKER TRUCK	61PCK62	PICK UP F250 (MINE G.F)	61SMD01	MILLER BIG BLUE 400D MOB WELD	61TRL16	DISPATCH COMM TRAILER
61DOZ08	DOZER 834H CATERPILLAR	61HTR09	HAUL TRUCK 50T CATERPILLAR	61MFT03	MOBILE FUEL TANKER TRUCK	61PCK63	PICK UP F250 (A. HAMEL)	61SNC01	SNOWCAT EMERGENCY VEHICULE	61TRL17	DISPATCH COMM TRAILER
61DOZ09	DOZER D6T CATERPILLAR	61HTR10	TOW HAUL 120T	61PCK01	PICK UP F350 (MILL)	61PCK64	FORD EXPEDITION (AIR STRIP)	61SNO01	SNOW MOBILE	61TRL18	DISPATCH COMM TRAILER
61ENG53	BOAT ENGINE HONDA 75 HP	61HTR11	HAUL TRUCK 777F CATERPILLAR	61PCK02	PICK UP F350 (GARBAGE PICK UP)	61PCK65	PICK UP F-350 2008 (WAREHOUSE)	61SNO02	SNOW MOBILE	61TRL19	DISPATCH COMM TRAILER
61FKL02	FORK LIFT HYSTER RH35	61HTR12	HAUL TRUCK 777F CATERPILLAR	61PCK03	PICK UP F350 (MILL MNTCE)	61PCK66	PICK UP F-550 (MOBILE)	61SNO03	SKI DOO SCANDIC	61TRL20	DISPATCH COMM TRAILER
61FKL03	FORK LIFT WAREHOUSE CAT	61HTR13	HAUL TRUCK 777F CATERPILLAR	61PCK04	PICK UP F350 (PROCESS PLANT)	61PCK67	PICK UP F250 TRAINING/ KITCHEN	61TPA01	ZOOM BOOM GENIE GTH844	61TRL21	DISPATCH COMM TRAILER
61FKL04	FORK LIFT ZOOM BOOM RZ2	61HTR14	HAUL TRUCK 777F CATERPILLAR	61PCK05	PICK UP F350 (BLASTER)	61PCK69	PICK UP F250 TRAINING MINE DEP	61TPA02	ZOOM BOOM GENIE GTH844	61TRL22	STEAM-PRESSURE WASH TRAILER
61FKL05	MILL FORK LIFT CAT	61HTR15	WATER TRUCK 773D CATERPILLAR	61PCK06	PICK UP F350 (POWER PLANT)	61PCK70	PICK UP F250 FIELD SITE SERVIC	61TPA03	HYSTER CONTAINER HANDLER	61TRL23	STEAM-PRESSURE WASHER TRAILER
61FKL06	TRUCK SHOP FORKLIFT CAT DP40KL	61HTR20	HAUL TRUCK 150T CATERPILLAR	61PCK07	PICK UP F350 (MINE HELPER)	61PCK71	PICK UP F250 (GEOLOGY)	61TPA04	IR ZOOM BOOM 1056C (OLD REN16)	61TRL24	EXTENSIBLE TRAILER MANAC
61FKL07	RAYMOND LIFT 740DR32IT	61HTR21	HAUL TRUCK 150T CATERPILLAR	61PCK08	PICK UP F350 (MILL MNTCE)	61PCK72	PICK UP F250 (TO REPLACE)	61TPA05	TELEHANDLER VR1056D (OLD REN15	61TRL26	SPLEIPNER
61FKL08	RAYMOND LIFT ETDR40TT	61HTR22	HAUL TRUCK 150T CATERPILLAR	61PCK09	PICK UP F350 (ENGINEERING)	61PCK73	PICK UP F250 - EXPLORATION	61TRK01	KENWORTH WATER TRUCK 4000 GL	61TRL27	MOBILE FUEL TANKER JET-A
61FKL09	TRUCK SHOP FORKLIFT HYSTER	61HTR23	HAUL TRUCK 150T CAT 785D	61PCK10	PICK UP F350 (DEWATERING)	61PCK74	PICK UP F250 (VAULT)	61TRK02	KENWORTH TRUCK	61VSE01	KAWASKI MULE
61FKL10	ZOOM BOOM TL1255C CAT	61HTR24	HAUL TRUCK 150T CAT 785D	61PCK11	PICK UP F350 (SECURITY BAKER)	61PCK75	PICK UP F450 BIT TRUCK (VAULT)	61TRK03	KENWORTH TRUCK	61VSE02	KAWASKI MULE
61FKL11	FORK LIFT R80 CAT	61HTR25	HAUL TRUCK 150T CAT 785D	61PCK12	PICK UP F350 (WAREHOUSE)	61PCK76	PICK UP F250 MTNCE SUPERVISOR	61TRK04	KENWORTH TRUCK	61VSE05	KAWASKI MULE (SITE SERVICES)
61GEN08	CATERPILLAR 3508 GENSET	61HTR26	HAUL TRUCK 150T CAT 785C	61PCK13	MINI-VAN E350 CLUB WAGON (BL)	61PCK77	PICK-UP F250 - EXPLORATION	61TRK05	KENWORTH TRUCK (3AXLE TRACTOR)	61VSE06	KAWASKI MULE
61GEN09	CUMMINS GEN SET 6CT, TWIN	61HTR27	HAUL TRUCK 150T CAT 785C	61PCK14	EXPEDITION XLT MOB.MNTCE SUP.	61PCK78	PICK-UP F250 MINE SUPERINTEND	61TRK06	KENWORTH TRUCK	61VSE08	KUBOTA MULE RTV1100

SANA Mobile Equipment List (to be updated as required)

Qamanittuaq SANA

Dozer	
Cat D8T	438
Cat D8T	443

Excavator	
Cat Bac 345	11-0301
Cat Bac 345	12-0303
Cat Bac 345 DLS	13-0301
Komatsu PC 1250	11-0303
Cat Bac 365 C	12-0305
Komatsu PC 450	16-0304

Loader	
Cat Loader 906	10-0202
Cat Loader 980H	268
Cat Loader 980CR	10-0201
Komatsu Loader WA500	278
Komatsu Loader WA600	11-0201
Komatsu Loader WA600	13-0201

50T Hault Truck	
Cat HTR 773F	1516
Cat HTR 773F	1517
Cat HTR 773F	1518
Cat HTR 773F	1519
Cat HTR 773F	1520
Cat HTR 773F	1535
Cat HTR 773F	1536
Komatsu HD605	16-1001
Komatsu HD605	16-1002
Komatsu HD605	16-1003
Komatsu HD605	16-1004

Heavy Equipment	
Fuel Truck	11-0121
Fardier Mack	1166
Water truck	1231
Water truck	10-0106
Bus Blue Bird	1760
Light truck	1244
White bus	15-0101
Fardier Kenworth	1220
Sableur	1217
Grader 14 M Cat	513

Compacteur	
Compactor Hamm	744
Compactor Cat	11-1101

Light Plant	
Magnum	10-5605
Magnum	11-5602
Magnum	11-5603
Magnum	12-5601
Magnum	12-5602
Magnum	12-5603
Magnum	12-5604
Magnum	12-5605
Magnum	12-5606
Allmand	15-5613
Allmand	15-5615

Drill	
Novamac TCG 03	10-0901
Novamac TCG 04	10-0902
Novamac TCG 05	9928
Tamrock	9932
Tamrock	996

Generator	
Generator	G - 19
Generator	G - 214
Generator	G - 229
Generator	G - 241
Generator	G - 250
Generator	G - 257
Generator	10-5502
Generator	
Generator	

Zoom-Boom	
Zoom-Boom	1773
Zoom-Boom TH255	1779
Zoom-Boom JCB	16-1202

Garage	
Welding machine	S-01
Welding machine	S-02
Welding machine	S-03
Welding machine	S-04
Welding machine	S-05
Welding machine	S-06
Compressor	COMP-01
Compressor	COMP-02

Pickup Truck	
Dodge Ram 2500	1743
Dodge Ram 2500	1744
Dodge Ram 2500	1765
Dodge Ram 2500	1767
Dodge Ram 2500	1769
Dodge Ram 2500	1772
Dodge Ram 2500	1798
Dodge Ram 2500	10-0004
Dodge Ram 2500	10-0005
Dodge Ram 2500	10-0006
Dodge Ram 2500	10-0007
Dodge Ram 2500	10-0008
Dodge Ram 2500	10-0010
Dodge Ram 2500	10-0016
Dodge Ram 2500	11-0014
Dodge Ram 2500	11-0022
Dodge Ram 3500	12-0014
Dodge Ram 3500	12-0015
Dodge Ram 2500	12-0016
Dodge Ram 2500	12-0017
Dodge Ram 2500	16-0006
Dodge Ram 2500	16-0007
Dodge Ram 2500	16-0008
Dodge Ram 2500	16-0009
Ram 2500 Promaster	16-0010

Compressor	
Compressor	919
Compressor	9925
Compressor	15-6902
Compressor	16-6901
Compressor	16-6902

Service Unit	
Service Unit	10-0103
Service Unit	11-0118
Service Unit	11-0119
Service Unit	12-0111

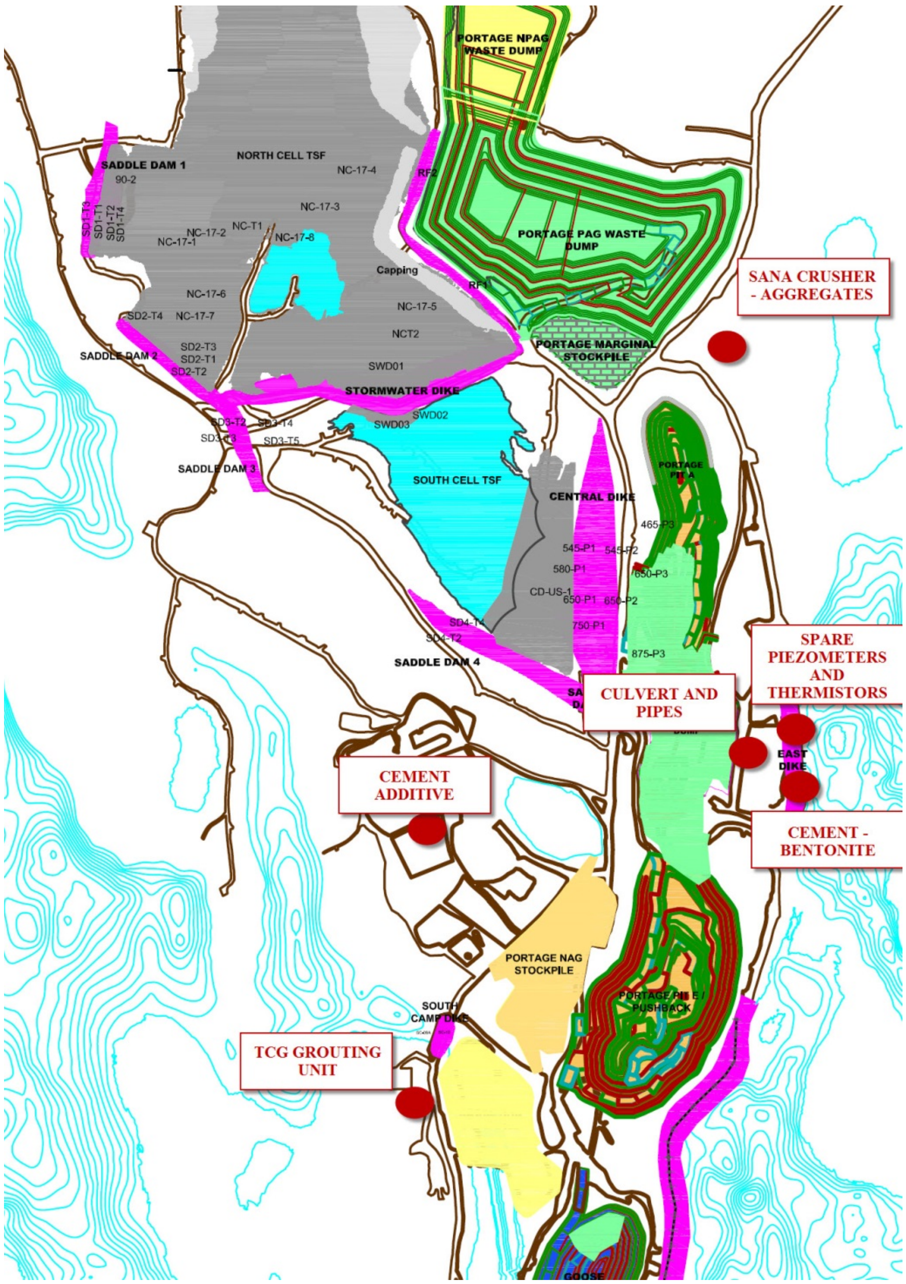
Crusher	
Jaw crusher	7004
Cone crusher and screen	7005
Convoyeur	7006

Ambulance	
Flagro	12-5906
Flagro	

8.4.3 Earthwork Material and Equipment

Figure 5 presents the earthwork material, including geomembrane and cement, available on site in case of an emergency.

Figure 5 Earthwork Material and Equipment location



SECTION 9 • EMERGENCY RESPONSE REFERENCE DOCUMENTS

Table 9-1 Emergency Response Reference Documents

Document	Current Revision
Emergency Response Plan	Updated by AEM. Version 10, August 2016
Emergency Preparedness Plan	In TSF OMS Manual, Version 7, March 2017

Note: To be updated as required

Table 9-2 Potential Effects or Causes of Embankment Failure Mechanisms

Embankment Failure Mechanism	Potential Measurable and Observable	
	Causes	Effects
Overtopping	(1) Slurry/water level within the cell rises. (2) Embankment crest settlement	Increase of seepage leading to erosion of downstream foundation soils. Increase in seepage pumping rate during operations Increase in turbidity / suspended solids of seepage
Internal Erosion	(1) Loss of tailings water, erosion through embankments (2) Loss of mineral soil foundation at defect in embankment section.	Sinkhole observable at crest Increase in seepage pumping rate during operations Increase in turbidity / suspended solids of seepage
Slope Instability	(1) Ice or wave forces, or traffic on crest, seepage, weakness of foundation soils (2) Earthquake seismic event or blasting	Increase in settlement and/or settlement rate Increase in displacement and/or displacement rate of embankment toe Cracks along the embankment crest Sloughing of the face Bulging of embankment toe
Unexpected settlements	Consolidation	Potential slurry/water overtopping the

Embankment Failure Mechanism	Potential Measurable and Observable	
	Causes	Effects
	of foundation soils or embankment fills	embankment leading to erosion of downstream foundation soils. Increase in seepage pumping rate during operations Increase in turbidity / suspended solids of seepage

Table 9-3 Threshold Criteria During Operation (Excluding Central Dike)

		Threshold Criteria During Operation			
		Green Acceptable Situation	**Yellow Areas of Concern**	**Orange High Risk Situation**	**Red Emergency Situation**
Criteria	Cumulative crest settlement from operations start up	No settlement observed	< 0.2 m	> 0.2 m and < 1.0 m Increasing rate of settlement	> 1.0 m Increasing rate of settlement
	Downstream toe displacement	No displacement observed	Affecting seepage collection system	Loss of roadway	Loss of roadway
	Shear crack along rockfill embankment (differential settlement)	No shear crack observed	< 0.4 m deep	> 0.4 m and < 0.8 m deep	> 0.8 m deep
			< 5 m length along the dike	> 5 m and < 10 m length along the dike	> 10 m length along the dike
	Tension crack embankment alignment at crest	No tension crack observed	< 0.25 m deep	> 0.25 m and < 1 m deep	> 1 m deep
			< 0.10 m wide across the dike	> 0.10 m and < 0.20 m wide across the dike	> 0.20 m wide across the dike
			< 5 m length along the dike	> 5 m and < 10 m length along the dike	> 10 m length along the dike
	Sloughing along downstream rockfill embankment face	No sloughing observed	Observed	Observed and worsening from yellow situation	Observed and worsening from orange situation
	Embankment lateral cumulative deformation	No deformation observed	< 0.1 m	> 0.1 m and <0.25 m	> 0.25 m
	Seepage through embankment	No seepage observed	< 1/3 pumping rate capacity	> 1/3 and < 2/3 pumping rate capacity	> 2/3 pumping rate capacity
	Increase of seepage rate	No increase in seepage rate	< 5% per day over five consecutive days	> 5% < 10% per day over four consecutive days	> 10% per day over three consecutive days
	Turbidity of seepage water	No turbidity observed	Turbidity observed for first time	Turbidity observed and source of sediments matching cut-off wall or foundation till mineralogy	Turbidity observed and source of sediments matching cut-off wall or foundation till mineralogy
	Sinkhole on crest	No depressions or sinkholes on crest observed	Localized depression of embankment crest	Observed	Well developed
Action Required			Monitor as normal All cracks filled or repaired If cracks re open implement engineering review Identify source of turbidity	Implement engineering review Suspend activities on embankment crest at chainage of concern Intensify monitoring at chainage of concern	Remove personnel and equipment from pit and suspend activities
Personnel Notified		Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder, if required).	Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder), Specialized Contractor (if required), Mine Operations Manager, Environment Superintendent, Mine Manager, Discuss at MDRB Meeting.	Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder), Specialized Contractor, Mine Operations Manager, Environment Superintendent, Mine Manager, Dike Review Board, Mine Inspector, Health and Safety, ERT (Emergency Personnel, if required).	Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder), Specialized Contractor, Mine Operations Manager, Environment Superintendent, Mine Manager, Dike Review Board, Mine Inspector, Health and Safety, ERT (Emergency Personnel).

Table 9-4 Threshold Criteria During Operation (Central Dike Only)

		Threshold Criteria During Operation			
		Green **Acceptable Situation**	**Yellow** **Areas of Concern**	**Orange** **High Risk Situation**	**Red** **Emergency Situation**
Criteria	Cumulative crest settlement from operations start up	No settlement observed	< 0.2 m	> 0.2 m and < 1.0 m Increasing rate of settlement	> 1.0 m Increasing rate of settlement
	Downstream toe displacement	No displacement observed	Affecting seepage collection system	Loss of roadway	Loss of roadway
	Shear crack along rockfill embankment (differential settlement)	No shear crack observed	< 0.4 m deep	> 0.4 m and < 0.8 m deep	> 0.8 m deep
			< 5 m length along the dike	> 5 m and < 10 m length along the dike	> 10 m length along the dike
	Tension crack embankment alignment at crest	No tension crack observed	< 0.25 m deep	> 0.25 m and < 1 m deep	> 1 m deep
			< 0.10 m wide across the dike	> 0.10 m and < 0.20 m wide across the dike	> 0.20 m wide across the dike
			< 5 m length along the dike	> 5 m and < 10 m length along the dike	> 10 m length along the dike
	Sloughing along downstream rockfill embankment face	No sloughing observed	Observed	Observed and worsening from yellow situation	Observed and worsening from orange situation
	Embankment lateral cumulative deformation	No deformation observed	< 0.1 m	> 0.1 m and <0.25 m	> 0.25 m
	<u>Seepage through embankment</u>	< 750 m^3/h averaged on last 3 days	≥ 750 m^3/h and < 1300 m^3/h averaged on last 3 days	≥ 1300 m^3/h and < 1500 m^3/h averaged on last 3 days	≥ 1500 m^3/h averaged on last 3 days
	<u>Increase of seepage rate[1]</u>	Sudden or cumulative increase of <150m^3/h over last 3 days	Sudden or cumulative increase of >150m^3/h over last 3 days	Sudden or cumulative increase of >350m^3/h over last 7 days	Sudden or cumulative increase of >700m^3/h over last 14 days
	<u>Water Pond Elevation at the D/S of the Dike</u>	Pond elevation stable at < 115.8 MASL	Pond elevation at < 115.8 MASL and loss of control of pond elevation	Pond elevation > 116 MASL	Pond elevation > 116 MASL and evidence of flooding in the pit
	Turbidity of seepage water	No turbidity observed	Turbidity observed for first time	Turbidity observed and source of sediments matching cut-off wall or foundation till mineralogy	Turbidity observed and source of sediments matching cut-off wall or foundation till mineralogy
	Sinkhole on crest	No depressions or sinkholes on crest observed	Localized depression of embankment crest	Observed	Well developed
Action Required	-	Daily inspection of the structure by qualified personal and frequent instrumentation monitoring	Daily inspection of the structure by qualified personal and frequent instrumentation monitoring All cracks filled or repaired If cracks re open implement engineering review Identify source of turbidity	Implement engineering review Suspend activities on embankment crest at station of concern Intensify monitoring at station of concern Suspend deposition activities if needed	Remove personnel and equipment from pit and suspend activities Suspend deposition activities
Personnel Notified	-	Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder, if required).	Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder), Specialized Contractor (if required), Mine Operations Manager, Environment Superintendent, Mine Manager, Discuss at MDRB Meeting.	Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder), Specialized Contractor, Mine Operations Manager, Environment Superintendent, Mine Manager, Dike Review Board, Mine Inspector, Health and Safety, ERT (Emergency Personnel, if required).	Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder), Specialized Contractor, Mine Operations Manager, Environment Superintendent, Mine Manager, Dike Review Board, Mine Inspector, Health and Safety, ERT (Emergency Personnel).

(1) Unexplained by freshet or rain events.

Table 9-5 Communication Charts for Each Emergency Level

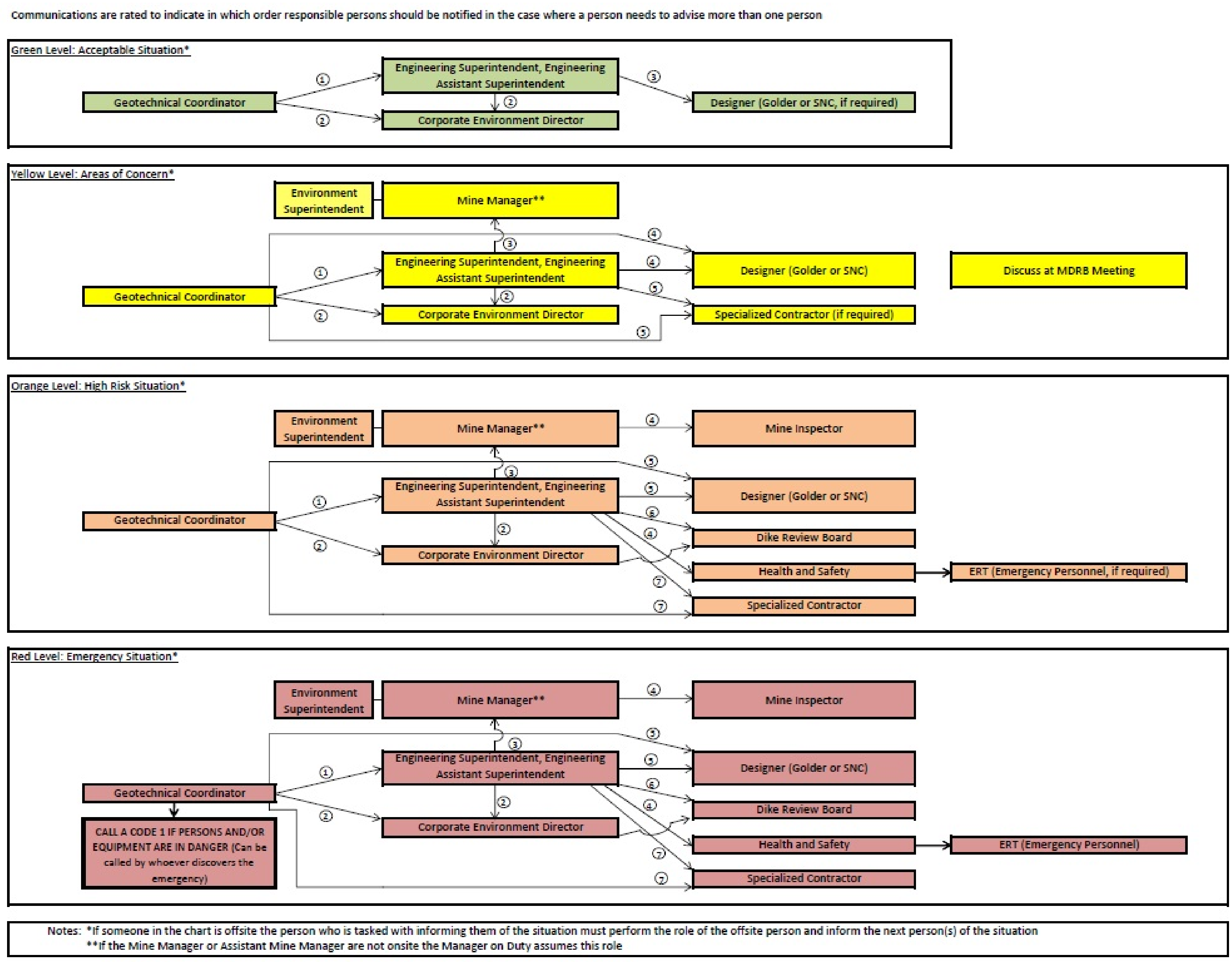


Table 9-6 Responsibilities of Persons for Each Emergency Level

	Decision Making	Mobilization	Performing the Action to be Taken
Green Acceptable Situation	Geotechnical Engineer/Specialist	Geotechnical Engineer/Specialist	Geotechnical Team*
Yellow Areas of Concern	Geotechnical Engineer/Specialist Geotechnical Coordinator Engineering Superintendent Engineering Assistant Superintendent Designer (Golder or SNC)	Geotechnical Engineer/Specialist Geotechnical Coordinator	Geotechnical Team* Specialized Contractor (if required)
Orange High Risk Situation	Geotechnical Engineer/Specialist Geotechnical Coordinator Engineering Superintendent Engineering Assistant Superintendent Designer (Golder or SNC) Corporate Environment Director Dike Review Board Mine Manager Health and Safety (if required)	Geotechnical Engineer/Specialist Geotechnical Coordinator Engineering Superintendent Engineering Assistant Superintendent	Geotechnical Team* Specialized Contractor ERT (if required)
Red Emergency Situation	Geotechnical Engineer/Specialist Geotechnical Coordinator Engineering Superintendent Engineering Assistant Superintendent Designer (Golder or SNC) Corporate Environment Director Dike Review Board Mine Manager Health and Safety	Geotechnical Engineer/Specialist Geotechnical Coordinator Engineering Superintendent Engineering Assistant Superintendent Mine Manager Health and Safety	Geotechnical Team* Specialized Contractor ERT

*The Geotechnical Team consists of the Geotechnical Coordinator, Geotechnical Engineer/Specialist, the Project Technician, Tailings & Water Management Engineers, and the Geotechnical Technicians.

Table 9-7 Names and Contact Details (to be updated as required)

Internal Emergency Response Contact Information Chart		
Position	**Name/Location**	**24-Hour Contact #**
Geotechnical Engineer/Specialist	Patrice Gagnon	Ph: 819-759-3555 ext. 6726 cell: 418-376-0975
	Alexandre Lavallée	Ph: 819-759-3555 ext. 6726 cell: 438-868-1905
Geotechnical Coordinator	Michel Groleau	Ph: 819-759-3555 ext. 6837 cell: 418-670-6590
Engineering Superintendent	Julie Belanger	Ph: 819-759-3555 ext. 6721 cell: 819-856-1667
Engineering Assistant Superintendent	Pierre McMullen	Ph: 819-759-3555 ext. 6721 cell: 819-860-2556
Corporate, Vice-President Environment	Michel Julien	Ph: 461-947-1212 ext. 3738 cell: 514-244-5876
Designer (Golder)	Golder Burnaby: Dan Walker, Fiona Esford Golder Montreal: Yves Boulianne, Annie Beaulieu	Burnaby Office: 604-296-4200 Montreal Office: 514-383-0990
Specialized Contractor	SANA (FGL Group)	Onsite Ph: 819-759-3555 ext. 6963 Ph: 418-615-0559
Environment Superintendent	Jamie Quesnel	Ph: 819-759-3555 ext 6838 Cell: 819-651-2974
Mine Manager	Bertin Paradis	Ph: 819-759-3555 ext. 6725 cell: 819-355-9348
	Luc Chouinard (asst.)	Ph: 819-759-3555 ext. 6725 cell: 819-856-8160
Dike Review Board	Anthony Rattue Norbert Morgenstern Don Hayley	anthony.rattue@bell.net norbertm@ualberta.ca don.hayley@icloud.com
Mine Inspector	Martin VanRooy	Martin.vanRooy@wscc.nu.ca_contact1
Health and Safety	Normand Ladouceur	Ph: 819-759-3555 ext. 6720 cell: 819-860-6258
	Yves Levesque (asst.)	Ph: 819-759-3555 ext. 6720 cell: 819-856-9051
ERT (Emergency Personnel)	Emergency response personnel available on site to assist with spill and emergency response activities	Coordinated by the Emergency Measures Counsellor
Incident Commander	André Rouleau	Ph: 819-759-3555 ext. 6809 cell: 819-355-2191 Code 1
	Normand Ladouceur	Ph: 819-759-3555 ext. 6720 cell: 819-860-6258 Code 1
Emergency Measures Counsellor	André Rouleau Bernard Paradis	Ph: 819-759-3555 ext. 6809 cell: 819-355-2191

Health Professionals / Medical Clinic	Medical Clinic 1	Ph: 819-759-3555 ext. 6734
	Medical Clinic 2	Ph: 819-759-3555 ext. 6751
AEM Management Representative	Bertin Paradis	Ph: 819-759-3555 ext. 6725 cell: 819-355-9348
Human Resource Superintendent	Dominic Richard	Ph: 819-759-3555 ext 6723 cell: 819-856-0426

SECTION 10 • REFERENCES

Canadian Dam Association (CDA) 2007. Dam Safety Guidelines.

Golder Associates Ltd. (Golder) 2008. Detailed Design of Tailings Storage Facility, Meadowbank Gold Project. December 17, 2008. Doc. 784 Ver. 0.

Golder 2009. Stormwater Dike and Saddle Dam 1 Geomembranes, Meadowbank Gold Project. July 20, 2009. Doc. 917 Ver. 0.

Golder 2011. 2011 Tailings Deposition Plan Update, Meadowbank Gold Project. July 18, 2011. Doc. 1272 Ver. 0.

Golder 2015. 2015 Detailed design report for Saddle Dams 3, 4 and 5. Meadowbank Gold Project. May 12, 2015. Doc. 1504 Ver. 1.

Mining Associate of Canada (MAC) 2005 Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities.

Mining Association of Canada (MAC) 2008. A Guide to the Management of Tailings Facilities. Second Edition.

AEM, Emergency Response Plan, Ver.10, August 2016

Appendix I

Water Quality and Flow Monitoring Plan

Appendix II
Tailings Storage Facility - Inspection Form

All parts of this inspection form should be completed. Adverse conditions should be described and location stated. Additional information and relevant photographs should be attached.

Inspecting Officer	
Report No.	
Inspection Date	12/11/2015

Dam ☐ ***Dike*** ☐	
Crest Elevation (m)	
D/S Toe Pond Elev. (m)	
South Cell Water Elev. (m)	

Last Inspection Date						
Weather during the current inspection	C°	Sunny ☐	Overcast ☐	Rain ☐	Snow ☐	Wind ☐
	Comments:					
Main changes occurred since the last inspection						

TABLE OF CONTENT

DOWNSTREAM SLOPE AREA 2
UPSTREAM SLOPE AREA 3
DOWNSTREAM BERMS: 4
UPSTREAM BERMS 5
CREST SURFACE 6
DAM / DIKE INSTRUMENTATION 7
GENERAL CONDITION SUMMARY 8
RECOMMENDATIONS 8
APPENDIX I : PLAN 8
APPENDIX II : PHOTOGRAPHS 10

2) DOWNSTREAM SLOPE AREA

	Presence	Crest	Slope	Toe	Pictures
A) Erosion	☐	☐	☐	☐	☐
B) Settlements	☐	☐	☐	☐	☐
C) Bulging	☐	☐	☐	☐	☐
D) Sloughing	☐	☐	☐	☐	☐
E) Slope Protection	☐	☐	☐	☐	☐
F) Vegetation	☐	☐	☐	☐	☐
G) Animals Burrows	☐	☐	☐	☐	☐
H) Seepage*	☐	☐	☐	☐	☐
I) Ice	☐	☐	☐	☐	☐
J) Snow	☐	☐	☐	☐	☐

* Seepage

Location 1	Downstream Toe of the Dike (freshet in not located, coming from under).							
Rate	Damp	☐	Trickle	☐	Steady	☐		(L/s)
Clarity	Clear	☐	Muddy	☐	*Comments :*			
Sample taken								
Location 2								
Rate	Damp	☐	Trickle	☐	Steady	☐		(L/s)
Clarity	Clear	☐	Muddy	☐	*Comments :*			
Sample taken								

☐ ***Sand boils presence***	Type	
	Location(s)	

Comments :

UPSTREAM SLOPE AREA

		Presence	Crest	Slope	Toe	Pictures
A)	LLDPE	☐	☐	☐	☐	☐
B)	Bituminous Membrane	☐	☐	☐	☐	☐
C)	Sink Holes	☐	☐	☐	☐	☐
D)	Water on Liner	☐	☐	☐	☐	☐
E)	Objects over the Liner	☐	☐	☐	☐	☐
F)	Damages on Liner	☐	☐	☐	☐	☐
G)	Erosion	☐	☐	☐	☐	☐
H)	Settlements	☐	☐	☐	☐	☐
I)	Bulging	☐	☐	☐	☐	☐
J)	Sloughing	☐	☐	☐	☐	☐
K)	Slope Protection	☐	☐	☐	☐	☐
L)	Vegetation	☐	☐	☐	☐	☐
M)	Animals Burrows	☐	☐	☐	☐	☐
N)	Ice	☐	☐	☐	☐	☐
J)	Snow	☐	☐	☐	☐	☐

Comments:

DOWNSTREAM BERMS

	Presence	Pictures with scale
A) Cracks	☐	☐
B) Erosion	☐	☐
C) Settlements	☐	☐
D) Bulging	☐	☐
E) Sloughing	☐	☐
F) Vegetation	☐	☐
G) Animals Burrows	☐	☐
H) Seepage*	☐	☐
I) Drainage Trench	☐	☐
J) Snow	☐	☐

* Seepage

Location 1								
Rate	Damp	☐	Trickle	☐	Steady	☐		(L/s)
Clarity	Clear	☐	Muddy	☐	*Comments :*			
Sample taken								
Location 2								
Rate	Damp	☐	Trickle	☐	Steady	☐		(L/s)
Clarity	Clear	☐	Muddy	☐	*Comments :*			
Sample taken								

☐ **Sand boils presence**	Type	
	Location(s)	

Comments:

3) UPSTREAM BERMS

	Presence	*Pictures with scale*
A) Cracks	☐	☐
B) Erosion	☐	☐
C) Settlements	☐	☐
D) Bulging	☐	☐
E) Sloughing	☐	☐
F) Vegetation	☐	☐
G) Animals Burrows	☐	☐
H) Seepage*	☐	☐
I) Drainage Trench	☐	☐
J) Snow	☐	☐

* <u>Seepage</u>

Location 1								
Rate	Damp	☐	Trickle	☐	Steady	☐		(L/s)
Clarity	Clear	☐	Muddy	☐	*Comments :*			
Sample taken								
Location 2								
Rate	Damp	☐	Trickle	☐	Steady	☐		(L/s)
Clarity	Clear	☐	Muddy	☐	*Comments :*			
Sample taken								

☐ ***Sand boils presence***	Type	
	Location(s)	

<u>Comments:</u>

4) CREST SURFACE

	Presence	Pictures with scale
A) Cracks	☐	☐
B) Erosion	☐	☐
C) Settlements	☐	☐
D) Bulging	☐	☐
E) Sloughing	☐	☐
F) Vegetation	☐	☐
G) Animals Burrows	☐	☐
H) Seepage*	☐	☐
I) Drainage Trench	☐	☐
J) Rutting	☐	☐
K) Mud	☐	☐
L) Pond (Puddle)	☐	☐
M) Saturated Soil	☐	☐
N) Snow	☐	☐

* Seepage

Location 1					
Rate	Damp ☐	Trickle ☐	Steady ☐		(L/s)
Clarity	Clear ☐	Muddy ☐	*Comments :*		
Sample taken					
Location 2					
Rate	Damp ☐	Trickle ☐	Steady ☐		(L/s)
Clarity	Clear ☐	Muddy ☐	*Comments :*		
Sample taken					

☐ ***Sand boils presence***	Type	
	Location(s)	

Comments:

5) DAM / DIKE INSTRUMENTATION

(Plot any newly installed instrumentation on relevant plans and cross-sections)

Instruments	*Operational*	*Damaged*	*Measurement Taken*
☐ ***Inclinometers***	☐	☐	☐ Bi-monthly
☐ ***Piezometers***	☐	☐	☐ Daily 3hrs interval
☐ ***Thermistors***	☐	☐	☐ Daily 3hrs interval
☒ ***Piezometers (Manual) (47)***	☐	☐	☐ Every 3 Days
☒ ***Thermistors (manual) (16)***	☐	☐	☐ Every 3 Days

Instrumentation List :

Comments:

6) GENERAL CONDITION SUMMARY

7) RECOMMENDATIONS

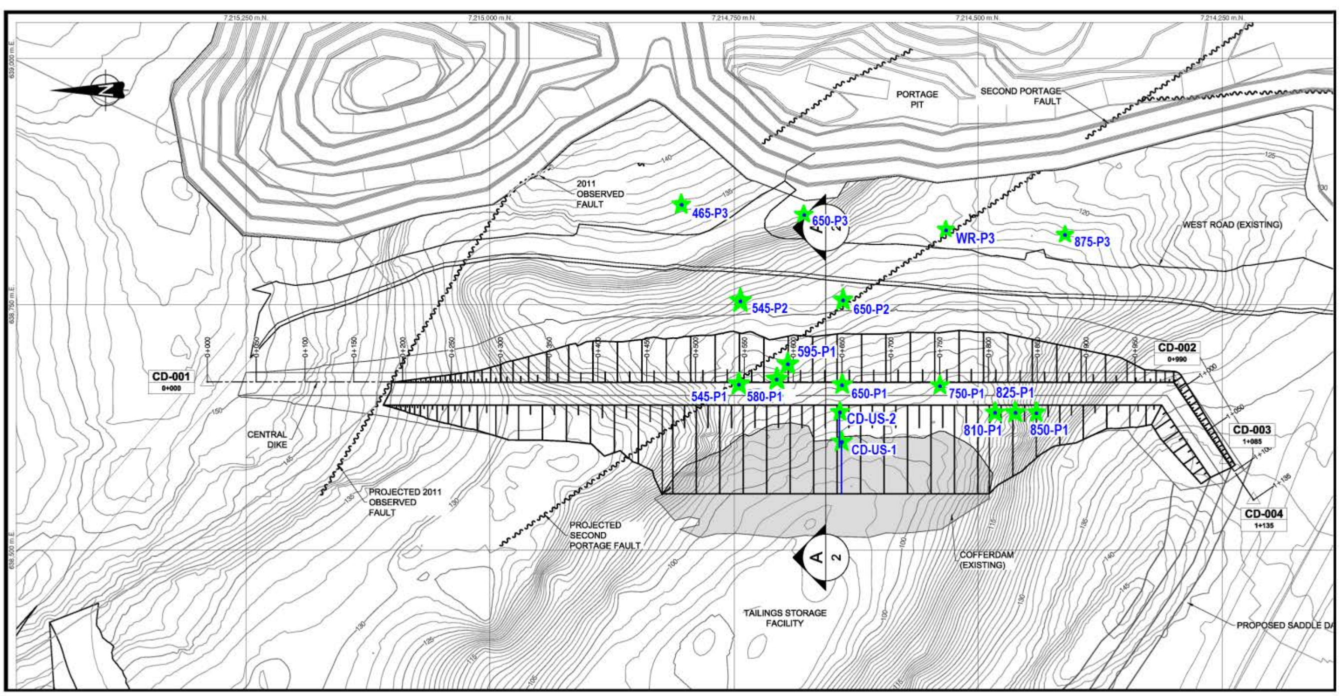
☒ ***Action required***	☐ *None*	☐ *Further monitoring*	☐ *Immediate remediation*
☒ ***Plan or Sketch Attached (3)***	See Appendix I		
☒ ***Photographs (14)***	See Appendix II		

Review Officer: ____________ Review Agency: ____________ Date Reviewed: Click here to enter

(DD/MM/YR)

REVIEW COMMENTS:

8) APPENDIX I : PLAN



APPENDIX II : PHOTOGRAPHS

Figure 2:

Figure 3:

DAILY REPORT
DIKE AND GEOTECHNICAL ENGINEERING
AGNICO-EAGLE MINES MEADOWBANK PROJECT

AGNICO-EAGLE

Date: 12/12/2014 **Technician / Engineer:**

Weather : Sunny ☐ Overcast ☐ Rain ☐ Snow ☐ Wind ☑ Comments:

Health and Safety: Concern / Incident Y ☐ N ☑

Comments:

Dewatering Dikes					
BayGoose Dike		**Field Visit**	Y ☐	N ☑	Comment / Observation:
Instrumentation Piezometers (Auto.)	☑	Photos	Y ☐	N ☑	
	☐				
Thermistors (Auto.)	☑				
Thermistors (4) (Manual)	☐				
Inclinometer	☐	**Work Activity**	Y ☐	N ☑	Description:
SeePage (2,6,7,9,10,11)	☐				
USB key (DL9)	☐				
East Dike		**Field Visit**	Y ☐	N ☑	Comment / Observation:
Instrumentation Piezometers (Auto.)	☑	Photos	Y ☐	N ☑	
Thermistors (Auto.)	☑				
Thermistors (Manual)	☐	**Work Activity**	Y ☐	N ☑	Description:
Inclinometer	☐				
Survey Prisms	☐				
South Camp Dike		**Field Visit**	Y ☐	N ☑	Comment / Observation:
Instrumentation Thermistor (Manual)	☐	Photos	Y ☐	N ☑	
		Work Activity	Y ☐	N ☑	Description:
Vault Dike		**Field Visit**	Y ☐	N ☑	Comment / Observation:
Instrumentation Thermistors (Manual)	☐	Photos	Y ☐	N ☑	
Vault Lake : 2 Flowmeter	☐	**Work Activity**	Y ☐	N ☑	Description:
Instrumentation Piezo. Vpond 11 (Manual)	☐				
Tailings Facilities System					
Stormwater Dike		**Field Visit**	Y ☐	N ☑	Comment / Observation:
		Photos	Y ☐	N ☑	
		Work Activity	Y ☐	N ☑	Description:
Saddle Dam 1		**Field Visit**	Y ☐	N ☑	Comment / Observation:
		Photos	Y ☐	N ☑	
Instrumentation Thermistors (Manual)	☐				
		Work Activity	Y ☐	N ☑	Description:
Saddle Dam 2		**Field Visit**	Y ☐	N ☑	Comment / Observation:
		Photos	Y ☐	N ☑	
Instrumentation Thermistors (Manual)	☐				
		Work Activity	Y ☐	N ☑	Description:
Coffer Dam - Central Dike		**Field Visit**	Y ☐	N ☑	Comment / Observation:
		Photos	Y ☐	N ☑	
Instrumentation Piezometers (Manual)	☐				
Instrumentation Thermistor (Manual)	☐	**Work Activity**	Y ☐	N ☑	Description:
OTHER		**Work Activity**	Y ☐	N ☑	Description:
	☐				
Ground Control Inspection - Open Pit					
Review of Ground Control F Y ☐		N ☑	**Pit Visit** Y ☐	N ☑	Comment/Observations:
Items to Review (num.):					
Items Follow Up in Ground Control Registrer (after visit) Y ☐		N ☑			

X:\General\Reports\Daily Reports\2014\[Template_2014.xlsx]Sheet1

Appendix III
Dike Failure Scenario

Dike Failure Scenarios

A. Central Dike

B. Saddle Dams

C. Storm water Dike

A) Central Dike

The Central Dike system is comprised of a Central Dike, a series of perimeter dikes, and the natural basin of the northwest arm of Second Portage Lake, as shown on the general mine site plan provided at the beginning of this document. The Central Dike cross-section consists of:

- A rockfill embankment, constructed from run-of-mine waste rock, placed in lifts and compacted, with the upstream face designed at 3H:1V and 2H:1V and the downstream face designed at a 1.5H:1V slope;
- An upstream two zones granular filter and inverted granular filter along the foundation;
- A bituminous liner with appropriate cover on the upstream face and part of the foundation;

A central or upstream key trench; The Central Dike is a high consequence structure, based on Dam Safety Guidelines (CDA, 2007). Slope stability analyses show that the dike will meet or exceed design FoS for stability under static and pseudostatic earthquake load conditions. Consequently, the probability of failure of the Central Dike is considered to be very low.

For information on the consequences and monitoring/action for the various embankment failure modes possible at the Central Dike see Table A.2 below.

Table A.1: Meadowbank Tailings Storage Facility Summary of Consequences and Proposed Monitoring / Action for Rare Event Based On Water Retaining Embankment Failure Modes Identified in ICOLD Study (1995)

Failure Mode	Scenario	Consequence	Monitoring/Action
Overtopping	(1) Pond Level rises because of restricted outflow (excessive inflow is a far less likely scenario). Water will spill at the low point on the dike system, which will depend on the construction schedule.	Water spills over the crest but, as this crest is both wide and comprises coarse compacted rock fill, minimal damage to the dike is credible. There will be considerable warning time prior to overtopping given the design freeboard and the storage volume.	Adjust decant and/or deposition rate. Add spillway in Central Dike, Saddle Dam, or natural ground.
	(2) Dam crest settles more than available freeboard over a distance of (say) 50m or so. This scenario requires unexpected foundation condition, such as glacial lake clay deposits. Settlement would occur upon placement of rock fill during dike raise construction. Freeboard is greatest immediately after a raise and this scenario is therefore unlikely to occur.	Water and tailings spill over crest and if settlement was rapid might erode the crest. Travel of tailings will be dependent on volume of water available, and level of thaw. Tailings would only go to the pit, and not reach the lake.	The situation envisaged is unlikely. This scenario would develop slowly during construction of the dike. Crest settlement would be evident at least several weeks before an overtopping event occurred. Easily observed cracks should be evident during summer period, but could be hidden during the winter. Systematic crest settlement monitoring is appropriate, and included in the design. Production and addition of tailings to the Tailings Storage Facility could be stopped to maintain freeboard. A spillway could also be constructed. The tailings deposition plan maintains a long beach between the dike and the pond, which provides additional freeboard to overtopping of the dike by pond water.

Internal Erosion	(1) Dike Section: Upstream bituminous liner contains defects arising from undetected damage during installation. May lead to loss of water, but filter retains tailing.	Loss of water into the rock fill. This is not a catastrophic failure mode, because the rock fill of the dike will be stable, and at its worst, would lead to temporary suspension of mining. Plus the bituminous liner does not propagate a tear like a plastic liner, so undetected damage is typically small and does not grow. Also, the foundation slopes down towards the tailings, so seepage impounds in the rock fill and will tend to reduce further seepage	Not necessary to monitor directly. Will become evident as possible seepage at dike toe. QA/QC program during construction is the main defence against this scenario.
	(2) Dike Section: Upstream bituminous liner contains defects arising from undetected damage during installation. This defect occurs at the same location as a filter defect.	Loss of tailings and water into the rock fill. This is not a catastrophic failure mode, because the rock fill of the dike will be stable, and at its worst, would lead to temporary suspension of mining. Accumulation of ponded water within the rock fill would decrease the head difference driving flow, thereby limiting the potential for a catastrophic failure.	Not necessary to monitor directly. Will become evident as possible intensive seepage at dike toe, and potentially as tailings fines within seepage downstream of the toe. QA/QC program during construction is the main defence against this scenario.
Seepage within Embankment	Seepage on its own is not a credible failure scenario. The rock fill is pervious so seepage will daylight on the downstream face. Flow through the rock fill will not lead to instability. Any seepage related failures must include internal erosion, see above.	No credible consequences.	No scenario specific monitoring required.
Seepage within Foundation	If the till foundation had a zone of more pervious soil (e.g. gravel seams) and the more pervious zone was preferentially exposed to water pressure, then normal seepage would transmit an unexpectedly high fraction of the reservoir head into the downstream part of the dike foundation. This scenario requires construction defects in filters, liner, and cut off trench fill.	This failure mechanism has caused other embankment failures elsewhere because of straightforward pore pressure induced instability. However, it is unclear that it could cause failure of the Central Dike because of its large width compared to the retained water head. The most likely consequence is downstream toe slumping requiring a localized stabilizing berm.	If this mechanism arises it should show itself gradually as the tailings and water level increase in the basin by buildup of pore water pressures in the foundation. This would be detected during routine monitoring of piezometers installed in the foundation. Pressure relief wells could be installed in the foundation during operations. The tailings deposition plan maintains a long beach between the pond and the dike. This will reduce seepage gradients beneath the dike. In addition, the tailings act as an upstream blanket on the bottom of the TSF to limit seepage into the foundation.

Internal Conduit Rupture	There are no water off take works or other structures extending through the dikes.	Not applicable.	Not applicable.
Slope Instability	(1) Normal Operation: The rockfill has high frictional strength and the design widths make it conservative. Slope failure requires failure in the foundation, which would then extend into the overlying dike.	A foundation failure would cause a rotational slip or sliding failure until equilibrium was reached. This mechanism would limit access along the dike until repaired. Failure through the rock fill will not necessarily compromise the tailings or water retaining function of the dike.	Initial stages of failure should be observable as tension cracks in dike crest and movement at dike toe. Walk-over inspection of dikes by a trained inspector is an appropriate monitoring strategy. Survey of crest, face and toe is also appropriate. If movements associated with increases in foundation pore pressures are discovered, then construction could be stopped or staged to allow pore pressure dissipation. Placement of rockfill as a downstream toe berm could help prevent failure.
	(2) Earthquake Induced: Occurrence of an extreme earthquake, a very rare event.	The extreme earthquake loading for site is a low magnitude event. A large earthquake would not be expected to cause a catastrophic failure, rather the dike would settle. The Central Dike rock fill is placed in the dry and compacted, and will therefore have limited settlement. This would not be a failure situation. The crest is also erosion resistant for earthquake induced wave action in the impounded water.	No monitoring is necessary. Dike should be inspected following any earthquakes felt on site.
Liner Failure Due To Foundation Movement	Differential horizontal movement of the dike due to pit wall failure. Creates a breach in the liner and filter. Pit wall failure is unlikely based on assessments of pit wall stability and the setback between the pit and the toe of the dike. Also, the liner and rock fill can withstand significant deformation, making this an unlikely scenario.	Tailings and water escape into the dike rock fill, but pond there because the foundation slopes towards the dike, rather than the pit. It is noted that the tailings pond is operated approximately 500 metres away. Rapid escape of water will therefore be limited.	No enhanced monitoring. Prism monitoring program and visual inspection sufficient. Movement would be evident in setback area between dike and pit. Tailings at face of dike may be excavated to allow repair of liner, or placement of filter material. Other options include freezing tailings at face of dike.
Unexpected Settlements	The foundation till is expected to consolidate during construction and operations. There is no credible mechanism for a large degree of unexpected settlement following construction required to eliminate freeboard and release tailings/water.	A large settlement could lead to water flowing through the rock fill, but this would not cause failure of the rock fill. It could also be readily repaired by placing more end-dumped rock fill, and extending the liner, in a manner similar to the periodic raise.	No enhanced monitoring required, as excessive settlement would be apparent from prism monitoring data, and visual inspection.

A.1.1 Failure Scenario during Operations

In the case of failure of the Central Dike during operations, the 'worst-case' scenario would involve a flow of unfrozen water and tailings in association with a catastrophic failure of the dike in the later stages of mining when personnel and machinery are working in the open pit directly downstream of the Tailings Storage Facility (TSF).

Potential Effect

The failure of the Central Dike could result in the sudden release of dike material and tailings from the TSF into that portion of the Portage Pit immediately adjacent to the dike. This could potentially result in loss of life. This would result in cessation of mining activities, either temporarily or permanently.

There would be no effect on the receiving environment water quality, fish or fish habitat because tailings would be contained within the pit and the dewatering dikes and the area would not yet be flooded.

Mitigation, Management and Monitoring

The calculated FoS for this failure mode, under static and pseudo-static conditions, are above design criteria in the Dam Safety Guidelines (CDA, 2007). Consequently, the probability of such a failure developing is low. Based on the tailings deposition plan, it is expected that the tailings pond will typically be 500 m or more from the face of the Central Dike. Furthermore, thermal modeling indicates the tailings and Central Dike will be frozen or partially frozen, and that the facility will tend to the frozen state in the long term. Therefore, a catastrophic failure of the Central Dike without some form of prior dam distress providing a warning of deteriorating conditions is not considered a credible catastrophic failure mode.

Mitigation against such a failure mode occurring will be to construct the Central Dike to design so that it is physically stable under all loading conditions. A comprehensive quality control and quality assurance program will be undertaken during dike construction to confirm foundation conditions, material type and quality, and to adjust designs as necessary to accommodate actual or unexpected conditions found at site.

- A management plan was developed for the operation of the tailings facility, and includes appropriate operational controls and monitoring activities. During operations, instrumentation will be installed to monitor not only the physical performance of the Central Dike itself, but also the performance of the TSF. The instrumentation installed and to be installed includes thermistors to monitor the thermal regime in the dike and foundations, and deposited tailings.
- Piezometers to measure pressure and to infer flow through the dike and foundation materials
- Prisms to monitor deformations within the dike.

If necessary, the stability of the foundation materials and of the dike during operations can be enhanced through the construction of a stabilizing toe berm or through freezing.

A.1.2 Failure Scenario during Closure

In the case of failure of the Central Dike during or following closure, the ‘worst-case’ scenario would involve a catastrophic failure of the dike and the release of tailings into the lake.

Potential Effect

Failure of the Central Dike during or following closure is not expected to result in loss of life, as mining operations will have finished.

Under this scenario, a catastrophic failure of the Central Dike could result in the sudden and unexpected release of dike material and tailings into the Portage Pit lake area. This could potentially produce a wave of sediment laden water that could over-top the East Dike.

Such a scenario would destroy fish habitat along the dike face and smother benthic habitat outwards from the failure area. Suspended solids and dissolved metals would increase in the water column and would cause displacement of fish and possible toxicity of some bottom sediments, depending on how much tailings material was lost. The new face would be subject to chronic erosion of fine tailings material until such time as a new, stable dike face could be established. Failure of the dike would not cause a change in water level. Impacts would be localized because the Central Dike is situated in the upper part of a blind arm of the lake with an extremely limited drainage area and low turnover. Consequently, transport of suspended sediment away from the area would be restricted and the area of impact would be relatively small.

Mitigation, Management, and Monitoring

The calculated FoS for the Central Dike design are greater than design criteria for post closure for static and pseudo-static (earthquake) conditions. Consequently, the likelihood of a failure occurring is low. Furthermore, thermal modeling indicates the tailings and Central Dike will progressively freeze, and that the facility will tend to the frozen state in the long term. Freezing will increase dike and tailings stability and decrease tailings mobility, and therefore this is not considered a credible catastrophic failure mode.

Mitigation against such a failure mode occurring will be to construct the Central Dike to the design so that it is physically stable under static and pseudo-static loading conditions, and to monitor during the mine life to assess the overall performance of the dike and the TSF. Data gathered during the operational period of the TSF can be used to re-evaluate the performance of the Central Dike structure in the context of longer term stability post closure.

B) Saddle Dams

Five Saddle dams will be constructed around the limits of the tailings basin. Two Saddle Dams were built between 2009 and 2011, the three other Saddle Dams have been built in 2015. The saddle dam locations are shown on the general mine site plan provided at the beginning of this document. The saddle dams will be constructed by dumping a rockfill berm with a crest width of 30 m to allow haul truck traffic. The Saddle Dams will be re-sloped, with a minimum 15 m crest width. The downstream face will be angle of repose, or 1.32H:1V (Horizontal:Vertical), and the upstream face will be 3H:1V. The Saddle Dams will have an upstream two-zone granular filter and a liner. There is a potential for release of attenuation water, reclaim water, or tailings to Third Portage Lake in the event of an overtopping or catastrophic failure.

For information on the consequences and monitoring/action for the various embankment failure modes possible at the Saddle Dams see Table 2.2 for the Central Dike.

2.1 Failure Scenario during Operation

Depending upon the phase of operations, breach or complete failure of a Saddle Dam could result in the uncontrolled release of Attenuation Pond water, Reclaim Pond water or tailings to Third Portage Lake. There is also the possibility of the Saddle Dams being overtopped through the formation of a wave resulting from a slope failure within the Portage Waste Rock Storage Facility and the sudden release of waste rock into the TSF.

A tailings beach will be formed on the toe of each Saddle Dam. As a result, the Reclaim Pond will be pushed away from the Saddle Dams. As the tailings and Saddle Dams are expected to freeze, and freezing will reduce the chance of tailings reaching Third Portage Lake, failure of the Saddle Dams with release of tailings to Third Portage Lake is not considered to be credible.

An overtopping or breach failure of the section of the Saddle Dams located just south of the intersection with the Stormwater Dike could potentially result in flow of Reclaim Pond water and/or tailings toward Third Portage Lake.

<u>Potential Effect</u>

Should an overtopping event or breach occur in a Saddle Dam, water flowing toward Third Portage Lake would consist of Reclaim Pond water which is predicted to exceed Metal Mining Effluent Regulations (MMER) guidelines for a number of constituents.

As a worst case of failure resulting in a dam breach, the total predicted Reclaim Pond volume of 0.75 Mm^3 could be released towards Third Portage Lake. The Saddle Dams would not be expected to fail due to overtopping. This failure mode is not expected to release a considerable volume of water to Third Portage Lake. Given the size of Third Portage Lake, the impacts to water quality and on fish from a release of Reclaim Pond water would likely be localized.

A worst case scenario would also involve the flow of non-frozen tailings into Third Portage Lake. The distance between the toe of the Saddle Dams and Third Portage Lake is on the order of 150 m to 300 m. Such a scenario would destroy fish habitat and smother benthic habitat outwards from the failure area. Suspended solids and dissolved metals would increase in the water column and would cause displacement of fish and possible toxicity of some bottom sediments, depending on how much tailings material was lost.

<u>Mitigation, Management, and Monitoring</u>

The dams are designed according to Dam Safety Guidelines (CDA, 2007), and were and will be constructed under controlled conditions. A comprehensive quality control and quality assurance program was and will be undertaken during construction to confirm foundation conditions, material type and quality, and to adjust designs as necessary to reflect actual conditions found at site. The dams are predicted to eventually freeze, which will enhance stability. Therefore, failure of Saddle Dams by overtopping, full breaching or foundation and slope failure is not considered to be credible.

With respect to slope stability failure, the Saddle Dams are constructed of rockfill, which has high shear strength. Slope stability failures must therefore occur through foundation soils. The calculated FoS for slope stability failure modes through foundation soils are above the design criteria in the Dam Safety Guidelines (CDA, 2007) for static and pseudo-static conditions. Consequently, the probability of such a failure developing is low.

The tailings are expected to freeze, and freezing will reduce the chance of tailings reaching Third Portage Lake. The distance from Saddle Dam 1 to Third Portage Lake is about 300 m at its closest point. Leaks of supernatant water and or tailings from the South Saddle Dam would be most likely to occur during operations. Leaks would be visible, and could be mitigated during operations.

2.2 Failure Scenario during Closure

At closure Reclaim Pond water will be pumped to an Attenuation Pond, the basin behind the Saddle Dams will be drained and filled with run-of-mine, acid-buffering ultramafic waste rock (NPAG). The rock is expected to freeze over time. Failure of the Saddle Dams following closure is not considered to be credible. Further, the lack of water will reduce mobility of tailings if failure occurs.

Potential Effect

No effects to water quality, fish or fish habitat is expected.

Mitigation, Management, and Monitoring

As described previously, the dams were and will be designed to meet Dam Safety Guidelines (CDA, 2007). The dams were and will be constructed under controlled conditions. During the construction of the dams a comprehensive quality control and quality assurance program was and will be undertaken to confirm foundation conditions, material type and quality, and to adjust designs as necessary to reflect actual or unexpected conditions found at site. Monitoring during operations will ensure the Saddle Dams perform as intended. The dams will eventually freeze, which will enhance stability. Therefore, post-closure failure of the Saddle Dams by full breaching or foundation and slope failure is not considered to be credible.

C) Stormwater Dike

The Stormwater Dike is located at the northwest end of Second Portage Lake, within the TSF as shown on the general mine site plan provided at the beginning of this document. The location of the Stormwater Dike was selected to optimize the storage capacity of the main tailings basin, and of the Portage Attenuation Pond. The dike separates the tailings basin from the Attenuation Pond until approximately 2014 at which point the tailing deposition will start in the South tailing Cell. At the end of mine life, any remaining water will be treated within the TSF and released once discharge criteria are met.

The Stormwater Dike was constructed using rock fill, with a upstream slope of 3H: 1V and a downstream slope at angle of repose for rock fill. The minimum crest width is 12 m. Final crest is at elevation 150.0 m. The dike has a filter zone placed on the south face, underlying an impermeable element of bituminous geo-membrane. The maximum height of the dike is about 13 m. At the maximum cross section, the width of the base of the dike is approximately 95 m.

For information on the consequences and monitoring/action for the various embankment failure modes possible at Storm water Dike see Table 2.2.

3.1 Failure Scenario during Operation

If slope failure of the Stormwater Dike were to occur when tailings are at their maximum elevation in the main tailings basin, and if the tailings are not frozen, this could potentially result in the sudden flow of tailings into the Attenuation Pond area. This in turn could potentially result in the development of a wave which overtops the Saddle Dam at the northwest end, releasing tailings and reclaim water to Third Portage Lake.

<u>Potential Effect</u>

A breach or failure of the Stormwater Dike may cause a wave-induced overtopping of the Saddle Dam at the northwest end. The Saddle Dam would not be expected to fail due to a single overtopping wave event.

This failure mode is not expected to release water to Third Portage Lake. The distance between the toe of the Saddle Dam and Third Portage Lake is on the order of 150 m, so tailings would likely settle out. The potential impacts on Third Portage Lake water quality, fish and fish habitat would likely be minor, localized and short-lived.

<u>Mitigation, Management, and Monitoring</u>

The Stormwater Dike was designed to meet Dam Safety Guidelines (CDA, 1999). The upstream side slopes were designed to allow machine traffic, and are therefore highly conservative with respect to slope stability. The dike was constructed in the dry under controlled conditions. During the construction of the dike a comprehensive quality control and quality assurance program was undertaken to confirm foundation conditions, material type and quality, and to adjust designs as necessary to reflect actual conditions found at site. The dike will eventually freeze, which will enhance stability. Therefore, failure of the dike due to overtopping is not considered to be credible.

3.2 Failure Scenario during Closure

The Stormwater Dike will be covered by tailing on both upstream and downstream side, to equal out the different elevations. At closure Reclaim Pond water will be pumped to an Attenuation Pond, the basin behind the Saddle Dams and Stormwater Dike will be drained and filled with run-of-mine, acid-buffering ultramafic waste rock (NPAG). The rock is expected to freeze over time. Failure of the Stormwater Dike following closure is not considered to be credible. Further, the lack of water will reduce mobility of tailings if failure occurs.

Potential Effect

No effects to water quality, fish or fish habitat is expected.

Mitigation, Management, and Monitoring

The Stormwater Dike was designed to meet Dam Safety Guidelines (CDA, 1999). The dike was constructed under controlled conditions. During the construction of the dike a comprehensive quality control and quality assurance program was undertaken to confirm foundation conditions, material type and quality, and to adjust designs as necessary to reflect actual or unexpected conditions found at site. Monitoring during operations ensure the Stormwater Dike performs as intended. The dike will eventually freeze, which will enhance stability. Therefore, post-closure failure of the Stormwater Dike by full breaching or foundation and slope failure is not considered to be credible.

AGNICO EAGLE

MEADOWBANK GOLD PROJECT

DEWATERING DIKES

Operation, Maintenance and Surveillance Manual

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

Version 6
February 2017

DEWATERING DIKES

OPERATION, MAINTENANCE AND

SURVEILLANCE MANUAL

MEADOWBANK GOLD PROJECT

AGNICO EAGLE MINES LIMITED

IMPLEMENTATION SCHEDULE

This Plan is immediately implemented.

DISTRIBUTION LIST

AEM- General Mine Manager

AEM- Environment Superintendent

AEM- Mine Operations Superintendent

AEM- Engineering Superintendent

AEM- General Services Manager

AEM- Site Services Superintendent

AEM- Corporate Environment Director

AEM- Health and Safety Superintendent

Golder- Dike Design Engineer

SNC- Dike Design Engineer

DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
(first revision)	February 2012	All	All	
V2	August 27, 2013	All	All	
V3	September 15, 2013	All	All	Updated items mentioned by MDRB and the Mine Inspector in the Annual Geotechnical Inspection in September 2013
V4	January 2015	All	All	
V5	January 2016	All	All	
V6	February 2017	All	All	

Approved by:

Pierre McMullen
Engineering Assistant - Superintendent

Jamie Quesnel
Environment Superintendent

TABLE OF CONTENTS

DISTRIBUTION LIST ..... **I**

DOCUMENT CONTROL ..... **II**

LIST OF TABLES ..... **V**

LIST OF FIGURES ..... **VI**

LIST OF APPENDICES ..... **VI**

SECTION 1 • INTRODUCTION **1-1**

1.1 Purpose 1-1
1.2 Regulatory Requirements 1-1
1.3 Consequences of Failure 1-2
1.4 Registered Manual Holders and Revisions 1-2
1.5 Annual Review of Manual 1-2
1.6 Reference Documents and Drawings 1-3

SECTION 2 • ROLES AND RESPONSIBILITIES **2-1**

2.1 Responsibilities 2-1
2.2 Required Levels of Knowledge 2-5

SECTION 3 • DESCRIPTION OF DEWATERING DIKES **3-1**

3.1 East Dike 3-3
3.1.1 East Dike - Design and Construction 3-3
3.1.2 East Dike - Instrumentation 3-8
3.1.3 East Dike - Dewatering 3-16
3.1.4 East Dike - Seepage Collection System 3-16
3.1.5 East Dike - Access 3-17
3.2 Bay-Goose Dike 3-17
3.2.1 Bay-Goose Dike – Design and Construction 3-18
3.2.2 Bay-Goose Dike – Instrumentation 3-26
3.2.3 Bay-Goose Dike - Seepage Collection System 3-36
3.2.4 Bay-Goose Dike - Access 3-36
3.3 South Camp Dike 3-37
3.3.1 South Camp Dike – Design and Construction 3-37
3.3.2 South Camp Dike - Instrumentation 3-37
3.3.3 Seepage Collection System 3-38
3.3.4 South Camp Dike - Access 3-38

3.4 Vault Dike 3-40
3.4.1 Vault Dike – Design and Construction 3-40
3.4.2 Vault Dike – Dewatering 3-40
3.4.3 Vault Dike - Instrumentation 3-42
3.4.4 Vault Dike - Seepage Collection System 3-43
3.4.5 Vault Dike - Access 3-43

SECTION 4 • DEWATERING 4-1

4.1 Freeboard 4-1
4.2 Water Management and Quality 4-1
4.3 Surveillance and Monitoring Requirements 4-2
4.4 Safety and Security 4-2

SECTION 5 • OPERATIONS 5-1

5.1 Freeboard 5-1
5.2 Water Management 5-1
5.3 Water Quality 5-2

SECTION 6 • MAINTENANCE PROCEDURES 6-1

6.1 Planned and Un-Planned Maintenance 6-1
6.2 Embankment Erosion 6-1
6.3 Seepage Collection System 6-1
6.4 Instrumentation 6-2
6.5 Access 6-2

SECTION 7 • SURVEILLANCE 7-1

7.1 Surveillance Requirements 7-1
7.2 Surveillance Protocols 7-1
7.3 Responsibilities and Frequency 7-1
7.3.1 Dewatering Inspections (Daily and Weekly) 7-2
7.3.2 Daily and Weekly Routine Inspections 7-5
7.3.3 Monthly Routine Inspections 7-8
7.3.4 Engineering Inspection 7-8
7.3.5 Dam Safety Review 7-9

SECTION 8 • MONITORING AND INSTRUMENTATION 8-10

8.1 Dewatering – Drawdown Rate and Water Quality 8-10
8.2 Geotechnical Monitoring 8-10
8.2.1 Data Collection Protocols and Schedule 8-10
8.2.1.1 Thermistors 8-12
8.2.1.2 Survey Monuments and Prisms 8-12
8.2.1.3 Slope Inclinometer Casings 8-12
8.2.1.4 Vibrating Wire Piezometers 8-13

8.2.1.5 Seismographs 8-13
8.2.2 Anomalous Instrumentation Data 8-13
8.3 Seepage Monitoring - Operations 8-14
8.3.1 Data Collection Protocols and Schedule 8-14
8.3.2 Anomalous Measurements 8-15

SECTION 9 • REPORTING PROCEDURES AND DATA MANAGEMENT 9-1

9.1 Reporting Protocols 9-1
9.1.1 Inspection Documents 9-1
9.1.2 Instrumentation Measurements 9-1
9.1.3 Emergencies 9-1
9.2 Data Management 9-1

SECTION 10 • DECOMMISSIONING 10-1

10.1 General 10-1
10.2 East Dike Embankments 10-1
10.3 Seepage Collection System 10-1
10.4 Instrumentation and Monitoring 10-1

SECTION 11 • EMERGENCY PREPAREDNESS PLAN 11-1

11.1 Emergency Procedures 11-1
11.1.1 Operation 11-1
11.2 Emergency Details 11-2
11.3 Medical and First Aid Services 11-4
11.4 On Site Equipment and material 11-4

SECTION 12 • EMERGENCY RESPONSE REFERENCE DOCUMENTS 12-1

SECTION 13 • REFERENCES 13-1

LIST OF TABLES

Table 1.1 Regulatory Requirements 1-1
Table 1.2 Classification of Dams in Terms of Consequences of Failure (CDA 2007) 1-1
Table 1.3 List of Registered OMS Manual Holders 1-2
Table 1.4 Record of Revisions/Addenda 1-2
Table 1.5 Summary of key reference documents for the Dewatering Dikes 1-3
Table 2.1 Responsibilities during Dewatering 2-2
Table 2.2 Responsibilities during Operation 2-4
Table 2.3 Recommended Minimum Knowledge and Training Requirements 2-6
Table 3.1 Existing Instrumentation Summary 3-9
Table 3.2 Existing Instrumentation Summary 3-27

Table 3.3 South Camp Dike Existing Instrumentation Summary ... 3-38
Table 3.4 Vault Dike Existing Instrumentation Summary ... 3-42
Table 4.1 Design Minimum Freeboard ... 4-1
Table 5.1 Freeboard ... 5-1
Table 5.2 Sump Design Criteria ... 5-2
Table 7.1 Summary of Consequences and Proposed Monitoring/Action for Rare Events Based on Water Retaining Embankment Failure Modes Identified in ICOLD (1998) ... 7-2
Table 7.2 Inspection, Monitoring and Review Requirements ... 7-2
Table 8.1 Geotechnical Instrumentation Monitoring Program ... 8-11
Table 12.1 Emergency Response Reference Documents ... 12-1
Table 12.2 Potential Effects or Causes of Failure Mechanisms ... 12-1
Table 12.3 Threshold Criteria during Operation for East Dike ... 12-3
Table 12.4 Threshold Criteria during Operation for Bay-Goose Dike ... 12-4
Table 12.5 Threshold Criteria during Operation for South Camp Dike ... 12-5
Table 12.6 Threshold Criteria during Operation for Vault Dike ... 12-6
Table 12.7 Communication Charts for Each Emergency Level ... 12-7
Table 12.9 Names and Contact Details ... 12-8
Table 12.10 Emergency Response Summary for East Dike and Bay-Goose Dike ... 12-10
Table 12.11 Risk Matrix ... 12-13
Table 12.12 Risk assessment for East Dike, Bay-Goose Dike, South Camp Dike and Vault Dike 12-14
Table 13.1 References ... 13-1

LIST OF FIGURES

Figure 1 Organizational Structure ... 2-1
Figure 2 Site Plan ... 3-2
Figure 3 East Dike Plan and Profile ... 3-5
Figure 4 East Dike Typical Section ... 3-6
Figure 5 East Dike and Access Roads ... 3-7
Figure 6 Bay-Goose Dike Instrumentation Plan ... 3-22
Figure 7 Bay-Goose Dike – Profile View of SB and CSB Placement Zones and Instrumentation profile ... 3-23
Figure 8 BFigure 8ay-Goose Dike – Typical Sections ... 3-24

LIST OF APPENDICES

Appendix A: Inspection Forms
Appendix B: Dike Failure Scenario Appendices from the ERP

SECTION 1 • INTRODUCTION

1.1 PURPOSE

This document includes procedures for the operation, maintenance and surveillance (OMS) of the Dewatering Dikes at the Meadowbank Gold Project, Nunavut, operated by Agnico Eagle Mines Limited (AEM), Meadowbank Division. The Dewatering Dikes are comprised of the following structures: East Dike, Bay-Goose Dike, South Camp Dike, and Vault Dike. The dewatering dikes isolate the open pit mining activities from Second Portage Lake and Third Portage Lake.

The responsibilities of AEM staff have been allocated based on the current management structure. As the management structure changes the OMS Manual should be revised and distributed accordingly.

This OMS Manual refers to the dewatering, operations, and decommissioning phases of the Dewatering Dikes.

1.2 REGULATORY REQUIREMENTS

This manual addresses specific requirements from regulatory agencies and provides procedures to maintain compliance. Regulatory requirements are presented in the documents summarized in Table 1.1.

Table 1.1 Regulatory Requirements

Document	Document Reference No.	Review Date
Territorial Lands Act - Land Lease	Production Lease KVPL08D280	Expires December 27, 2027
Environmental Impact Assessment	NIRB project certificate No. 004	n/a – Only if substantial modifications to original application are to be carried out
Water Licence Type A	Nunavut Water Board Water License 2AM-MEA0815	Expires July 22, 2025

The operating, maintenance, surveillance and emergency procedures recommended by the Canadian Dam Association (CDA) “Dam Safety Guidelines” (CDA 2007) and the Mining Association of Canada (MAC) “Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities” (MAC, 2005) have been incorporated into this manual.

The CDA Dam Safety Guidelines (CDA, 2007) states: “dam operation, maintenance and surveillance shall be provided so that an acceptable level of dam safety is ensured.” This manual contains protocols and information that will assist AEM to operate, maintain, and monitor the Dewatering Dikes in a safe manner and identify early signs of distress. Qualified personnel shall operate, maintain and monitor the structures and adequate records shall be maintained for general and reference purposes.

1.3 CONSEQUENCES OF FAILURE

The Dewatering Dikes consequence of failure classification is based on the guidelines provided in the CDA Dam Safety Guidelines (CDA 2007) and is presented in Table 1.2. The East Dike and Bay-Goose Dike are rated as “High” consequence of failure structures based on the potential for loss of life and “High” economic loss. The South Camp Dike and Vault Dike are rated as a “Significant” consequence of failure structure based on a temporary risk to workers, and classified as “Low” due to economic loss.

No flooding or inundation mapping has been completed. It is assumed that failure of the East Dike could flood the Portage Pit, resulting in associated threat to the safety of mine personnel, equipment, and other workings within the dewatered area. Similarly, it is assumed that failure of the Bay-Goose Dike could flood the Goose Island Pit and Portage Pit, resulting in associated threat to the safety of mine personnel, equipment, and other workings within the dewatered area. Flooding would likely cause cessation of mining operations within one or both pits, either temporarily or permanently. It is assumed that failure of South Camp Dike could not flood the Bay-Goose Pit as the Third Portage Lake water level at South Camp Dike is too low. It is assumed that once the dewatering of Vault Lake will be complete, a failure of Vault Dike could flood Vault Pit resulting in associated threat to the safety of mine personnel, equipment, and other workings within the dewatered area. Flooding would likely cause cessation of mining operations within one or both pits, either temporarily or permanently.

Table 1.2 Classification of Dams in Terms of Consequences of Failure (CDA 2007)

Dam Class	Population at Risk [Note 1]	Incremental losses		
		Loss of Life [Note 2]	**Environmental and Cultural Values**	**Infrastructure and Economics**
Low	None	0	Minimal short-term loss No long-term loss	Low economic losses; area contains limited infrastructure or services
Significant	Temporary only	Unspecified	No significant loss or deterioration of fish or wildlife habitat Loss of marginal habitat only Restoration or compensation in kind highly possible	Losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes
High	Permanent	10 or fewer	Significant loss or deterioration of *important* fish or wildlife habitat Restoration or compensation in kind highly possible	High economic losses affecting infrastructure, public transportation, and commercial facilities
Very High	Permanent	100 or fewer	Significant loss or deterioration of *critical* fish or wildlife habitat Restoration or compensation in kind possible but impractical	Very high economic losses affection important infrastructure or services *(e.g., highway, industrial facility, storage facilities for dangerous substances)*
Extreme	Permanent	More than 100	Major loss of *critical* fish or wildlife habitat Restoration or compensation in kind impossible	Extreme losses affecting critical infrastructure or services *(e.g., hospital, major industrial complex, major storage facilities for dangerous substances)*

Note 1. *Definitions for population risk:*

None – *There is no identifiable population at risk, so there is no possibility of loss of life other than through unforeseeable misadventure.*

Temporary – *People are only temporarily in the dam-breach inundation zone (e.g., seasonal cottage use, passing through on transportation routes, participating in recreational activities).*

Permanent – *The population at risk is ordinarily located in the dam-breach inundation zone (e.g., as permanent residents); three consequence classes (high, very high, extreme) are proposed to allow for more detailed estimates of potential loss of life (to assist in decision-making if the appropriate analysis is carried out).*

Note 2. *Implications for loss of life:*

Unspecified – *The appropriate level of safety required at a dam where people are temporarily at risk depends on the number of people, the exposure time, the nature of their activity, and other conditions. A higher class could be appropriate, depending on the requirements. However, the design flood requirement, for example, might not be higher if the temporary population is not likely to be present during the flood season.*

1.4 REGISTERED MANUAL HOLDERS AND REVISIONS

The Engineering Superintendent is responsible for maintaining an up-to-date list of the registered holders of this OMS Manual in Table 1.3.

The Engineering Superintendent is also responsible for the issue of all revisions and addenda to the registered holders of this Manual. Revisions will be made, as and when required, by re-issuing a complete section, table or appendix so that the old section, table or appendix can be removed and replaced. Each registered holder is responsible for placing the revisions and addenda in his or her manual and for recording receipt of the same in Table 1.3.

Each copy of this manual is assigned a unique identification number.

Table 1.3 List of Registered OMS Manual Holders

Position / Name / Address or Location	OMS Manual Copy No.
General Mine Manager / Bertin Paradis, Luc Chouinard (asst.) / OFFICE	1
Environment Superintendent / Jamie Quesnel / OFFICE	2
Mine Operations Superintendent / Yan Côté, Eric Steinmetzer (asst.) / OFFICE	3
Engineering Superintendent / Julie Belanger, Pierre McMullen (asst.) / OFFICE	4
Logistics Coordinator / Mathieu Grenier / OFFICE	5
Energy & Infrastructures Superintendent / Christian Soucy / OFFICE	6
Vice President, Environment / Michel Julien / AEM Toronto Office	7
Health and Safety Superintendent / Norman Ladouceur, Yves Levesque (asst.) / OFFICE	8
Dike Design Engineer / Golder Associates Ltd./ 500 – 4260 Still Creek Drive, Burnaby, BC, V5C 6C6	9
Dike Design Engineer / SNC-Lavalin Inc./ 5500, Boulevard des Galeries, Bureau 200, Quebec, Quebec, G2K 2E2	10
Update as Required	

Table 1.4 Record of Revisions/Addenda

Revision No.	Section	Table	Appendix	Addenda No.	Date of Revision
1	All	All	All	-	February 2012
2	All	All	All	-	August 2013
3	All	All	All	-	September 2013
4	All	All	All	-	January 2016
5	All	All	All	-	February 2017

1.5 ANNUAL REVIEW OF MANUAL

This manual will be reviewed by AEM on at least an annual basis and revised as necessary to accommodate changes in the condition and operation of the facilities. The registered users of the manual are encouraged to provide comments and suggestions for improvement of the manual and the procedures specified in it to the Engineering Superintendent. The comments and suggestions communicated will be considered in the subsequent review.

1.6 REFERENCE DOCUMENTS AND DRAWINGS

The following Table 1.5 is a summary of key reference documents for the Dewatering Dikes. All design and as-built documents can be found in hard copy onsite in the engineering department, as well as in electronic copies on the dikes server.

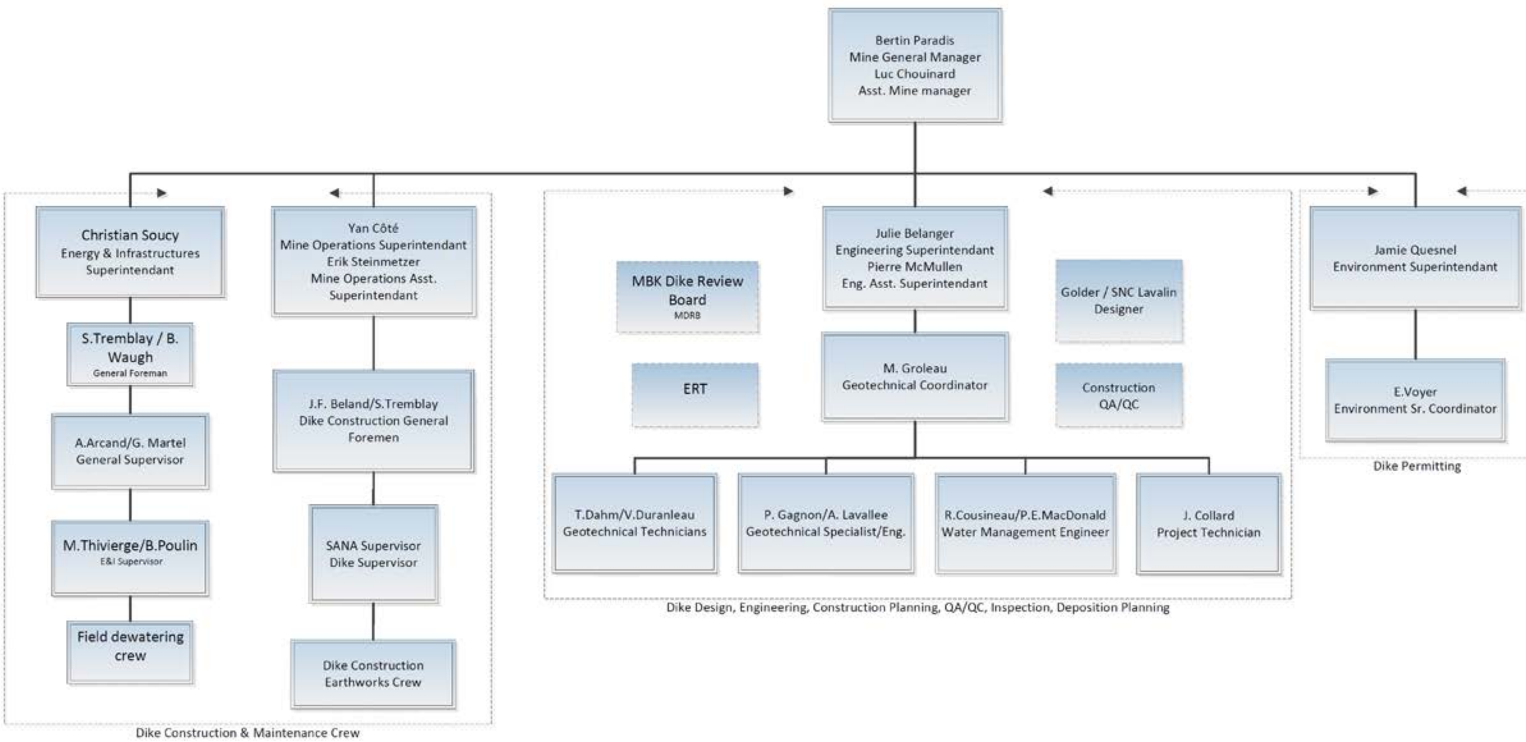
Table 1.5 Summary of key reference documents for the Dewatering Dikes

Dewatering Dike	Type of Information	Document Number	Document Title
East Dike	Design	Doc. 572	East Dike Design Meadowbank Gold Project (Golder 2008b)
	As-built	Doc. 900	East Dike Construction As-Built Report Meadowbank Gold Project (Golder 2009d)
	Remediation	Doc. 916	Meadowbank East Dike Grouting Response Plan (Golder 2009b)
		Doc. 953	East Dike CPT Investigation Meadowbank Gold Project" (Golder 2010b)
		Doc. 986	East Dike Sinkhole Investigation Program Meadowbank Gold Project (Golder 2010a)
Bay-Goose Dike	Design	Doc. 802	Bay-Goose Dike and South Camp Dike Designs (Golder 2009a)
	As-built	Doc. 1328	Bay Goose Dike Construction As-Built Report Meadowbank Gold Project (Golder 2013)
South Camp Dike	Design	Doc. 802	Bay-Goose Dike and South Camp Dike Designs (Golder 2009a)
	As-built	NA	South Camp Dike Construction Summary Report, Meadowbank Gold Project (AEM 2012)
Vault Dike	Design	610548-2020-4GER-0001	Detailed Engineering of Vault Dike (SNC, 2013a)
	Technical Specifications	610548-2020-4GEF-0001	Construction of Vault Dike – Technical Specifications (SNC, 2013b)
	As-built	NA	Construction Summary Report Vault Dike (AEM, 2013)

SECTION 2 • ROLES AND RESPONSIBILITIES

An organizational chart of the current management structure is shown in Figure 1. This chart shall be updated to reflect changes in management structure, as necessary, such that it is maintained up-to-date.

Figure 1 Organizational Structure



2.1 RESPONSIBILITIES

The responsibilities for each management position during dewatering and during operations of the Dewatering Dikes are shown in Table 2.1 and Table 2.2, respectively. For the purpose of this manual, dewatering is defined as completed, and operation begins when the downstream toe of the dike is exposed.

Table 2.1 Responsibilities during Dewatering

Position	Responsibilities
Manager of Regulatory Affairs	Liaise with external stakeholders during an emergency event including NIRB, Nunavut Water Board, NGO's, government agencies.
General Mine Manager	Initiate and oversee emergency or contingency protocols during emergency events.
	Liaise/direct/coordinate the Meadowbank Dike Review Board (MDRB).
	Oversight of Mine, Engineering, and Environment Superintendents tasks and responsibilities as laid out in the OMS Manual.
Assistant Mine Manager	Initiate and oversee emergency or contingency protocols during emergency events, if General Manager is not on site.
	Oversight of Mine, Engineering, and Environment Superintendents tasks and responsibilities as laid out in the OMS Manual.
Mine Operations Superintendent	Maintain access to the Dewatering Dikes, including making road repairs, controlling dust and removing snow. Maintain stockpiles of construction material.
	Carry out field maintenance on the dikes as required, including material placement, electrical and mechanical repairs.
Engineering Superintendent/Geotechnical Coordinator/ Geotechnical Engineer/Specialist	Construction of seepage collection works.
	Carry out inspections of the dikes as required in the OMS Manual.
	Monitor Dewatering Dike instrumentation as required in the OMS Manual.
	Monitor pumping rates for dewatering, upstream and downstream water levels, and freeboard.
	Liaise with Design Engineer during dewatering regarding dike performance, pumping rates, water quality, instrumentation measurements, etc.
	Review geotechnical and environmental monitoring data for compliance with Water License regulations and to evaluate dike performance with respect to design parameters.
	Prepare reports including description of activities on dikes, pumping rates, instrumentation readings, water quality data, dike performance, visual observations, etc. as required in the OMS Manual.
	Determine dewatering pumping schedule based on the water quality monitoring.
	Maintain instrumentation, readout units, data acquisition system and cabins.
	Coordinate work force as required for monitoring and maintenance.

Position	Responsibilities
	Coordinate equipment, labour, materials and maintenance activities required for pumps and pipelines during dewatering.
	Revise and update the OMS Manual to reflect as-built conditions and any other changes.
	Maintain up to date list of registered holders of the OMS Manual.
	Issue all revisions and addenda to registered OMS Manual holders.
	Carry out field operations including pumping.
Environment Superintendent	Monitor water quality.
	Monitor total suspended solids at pump intake.
	Review environmental monitoring data for compliance with Water License and regulations and to evaluate dike performance with respect to design parameters.
	Liaise with external stakeholders including NIRB, Nunavut Water Board, NGO's, government agencies.
Energy & Infrastructures Superintendent	Maintain and service pumps and pipelines for dewatering.
	Coordinate equipment, labour and materials for maintenance during dewatering.
	Carry out field maintenance on material placement, electrical and mechanical repairs.
	Coordinate labour as required for monitoring.
Design Engineer	Communicate with Engineering Superintendent/ Dike Advisor on frequent basis regarding performance of dewatering dikes.
	Review instrumentation package (to be provided by Engineering Superintendent/Dike Advisor) on a frequent basis.
Meadowbank Dike Review Board (MDRB)	Be updated on the performance of the dewatering dikes behaviour during their operation.
Emergency Response Team	Follow the guidance written in the Emergency Response Plan in an emergency situation

Table 2.2 Responsibilities during Operation

Position	Responsibilities
Manager of Regulatory Affairs	Liaise with external stakeholders during an emergency event including NIRB, Nunavut Water Board, NGO's, government agencies.
General Mine Manager	Liaise with external stakeholders including NIRB, Nunavut Water Board, NGO's, government agencies.
	Liaise / coordinate / direct the MDRB.
	Initiate and oversee emergency or contingency protocols during emergency events.
	Oversight of Mine, Engineering, and Environment Superintendents tasks and responsibilities as laid out in the OMS Manual.
	Coordination of mine staff and equipment during an emergency.
Assistant Mine Manager	Oversight of Mine, Engineering, and Environment Superintendents tasks and responsibilities as laid out in the OMS Manual.
	Coordination of mine staff and equipment during an emergency if General Manager is not on site.
Mine Operations Superintendent	Maintain access to the Dewatering Dikes and seepage collection systems, including making road repairs, controlling dust and removing snow.
	Carry out field maintenance on the dikes as required, including material placement, electrical and mechanical repairs.
Engineering Superintendent/Geotechnical Coordinator/ Geotechnical Spec. or Eng	Carry out inspections of the dikes, ditches and sumps as required in the OMS Manual.
	Monitor seepage pumping rates.
	Monitor Dewatering Dike instrumentation as required in the OMS Manual.
	Review geotechnical instrumentation and environmental monitoring data to evaluate dike performance with respect to design parameters and for compliance with Water License and regulations.
	Prepare reports including description of activities on dikes, pumping rates, instrumentation readings, water quality data, dike performance, visual observations, etc. as required in the OMS Manual.
	Liaise with Design Engineer regarding dike performance, pumping rates, water quality, instrumentation measurements, etc.
	Maintain instrumentation, readout units, data acquisition system and cabins.
	Coordinate work force as required for monitoring and maintenance.
	Coordinate equipment, labour, materials and maintenance activities required for pumps and pipelines associated with the seepage collection systems and any runoff diversions.
	Revise and update the OMS Manual to reflect as-built conditions of seepage collection system and future modifications.
	Maintain up to date list of registered holders of the OMS Manual.
	Issue all revisions and addenda to the registered OMS Manual holders.
	Liaise with MDRB as required.

Position	Responsibilities
	Carry out field operations.
Environment Superintendent	Monitor water quality of seepage and runoff collected in sumps and ditches.
	Review environmental monitoring data for compliance with Water License and regulations and to determine dike performance with respect to design parameters.
	Liaise with external stakeholders including NIRB, Nunavut Water Board, NGO's, government agencies.
Energy & Infrastructures Superintendent	Maintain and service pumps and pipelines for seepage and runoff.
	Coordinate equipment, labour and materials for maintenance during dewatering.
	Carry out field maintenance on material placement, electrical and mechanical repairs
	Coordinate labour as required for monitoring and maintenance.
	Purchase equipment as required.
Design Engineer	Communicate with Engineering Superintendent/ Dike Advisor on a frequent basis regarding performance of dewatering dikes. Frequency to be determined by Engineering Superintendent/ Dike Advisor.
	Review instrumentation package (to be provided by Superintendent/Dike Advisor) on a frequent basis, frequency to be determined by Engineering Superintendent/ Dike Advisor.
	Carry out annual inspection and reporting.
Meadowbank Dike Review Board (MDRB)	Be updated on the performance of the dewatering dikes behaviour during operation.
Emergency Response Team	Follow the guidance written in the Emergency Response Plan in an emergency situation

All site personnel are responsible for informing their Managers of any indications of abnormal situations or conditions that may be observed.

The responsibilities and authorities of each position in the OMS Manual should be updated to reflect any changes to the overall management structure as they occur.

2.2 REQUIRED LEVELS OF KNOWLEDGE

A minimum level of knowledge and training are required for personnel to adequately carry out their responsibilities and to appropriately realize their level of authority. Personnel should understand consequences of non-compliance for their area and have an understanding of emergency procedures. The recommended minimum levels of knowledge for the anticipated positions are as summarized in Table 2.3.

Table 2.3 Recommended Minimum Knowledge and Training Requirements

Position	Recommended Minimum Knowledge and Training
Manager of Regulatory Affairs	Review of the OMS Manual, with an understanding of the operational requirements.
	Detailed knowledge of emergency response procedures.
General Mine Manager	Detailed understanding of the OMS Manual, with a complete understanding of the design, dewatering and operational requirements, particularly monitoring, inspection and dam safety review requirements.
	Complete understanding of environmental compliance issues and monitoring requirements.
	Understanding of all related technical documents for design and construction.
	Detailed knowledge of emergency response procedures.
Assistant Mine Manager	Detailed understanding of the OMS Manual, with a complete understanding of the design, dewatering and operational requirements, particularly monitoring, inspection and dam safety review requirements.
	Complete understanding of environmental compliance issues and monitoring requirements.
	Understanding of all related technical documents for design and construction.
	Detailed knowledge of emergency response procedures.
Environment Superintendent	Detailed understanding of the OMS Manual, with a complete understanding of the design, dewatering and operational requirements.
	Detailed and ongoing review of all monitoring, inspections and dam safety reviews.
	Complete understanding of environmental compliance issues and monitoring requirements.
	Knowledge of emergency response procedures.
Mine Operations Superintendent	Basic knowledge of the OMS Manual, with an understanding of the design requirements.
	Detailed knowledge of emergency response procedures.
Engineering Superintendent/Geotechnical Coordinator/ Geotechnical Spec. or Eng	Detailed understanding of the OMS Manual, with a complete understanding of the design, dewatering and operational requirements.
	Detailed knowledge of monitoring protocols and requirements.
	Detailed and ongoing review of all monitoring, inspections and dam safety reviews.
	Complete understanding of all related technical documents for design, dewatering, operation, risk assessment and emergency response.
	Detailed understanding of all operational elements within the facility and their operational and maintenance requirements.
	Detailed knowledge of emergency response procedures.
Environment Personnel	Knowledge of the OMS Manual, with an understanding of the dewatering and operational requirements set out in this OMS

Position	Recommended Minimum Knowledge and Training
	Manual.
	OMS Manual should be reviewed with the Environmental Superintendent.
	Detailed knowledge of environmental monitoring protocols and requirements.
	Knowledge of emergency procedures.
Mine Personnel	Knowledge of the OMS Manual, with an understanding of the dewatering and operational requirements set out in this OMS Manual.
	Knowledge of emergency response procedures.
Geotechnical Engineering Personnel	Knowledge of the OMS Manual, with an understanding of the design, dewatering, and operational requirements set out in this OMS Manual.
	Detailed knowledge of monitoring protocols and requirements.
	Knowledge of emergency procedures.
Energy & Infrastructures Superintendent	Basic understanding of the OMS Manual, including the design, dewatering and operational requirements set out in the OMS Manual.
	Detailed knowledge of all operational elements set out in the OMS and required for an event of emergency, such as available materials quantity and locations, equipment inventory and locations and available labour.
	Knowledge of emergency response procedures.
External Personnel (Design Engineer and MDRB)	Varied levels of knowledge and understanding depending on involvement.
	General Manager shall determine levels of knowledge and instruct personnel.
Emergency Response Team	Knowledge of emergency response procedures.

The OMS Manual should be updated to reflect any changes in responsibilities or management structure as they occur.

SECTION 3 • DESCRIPTION OF DEWATERING DIKES

The Meadowbank Gold Project site is located approximately 80 km north of Baker Lake, Nunavut. The gold ore deposits are situated adjacent to and beneath Second Portage Lake, Third Portage Lake and Vault Lake. The mine plan includes the construction and operation of a series of dewatering dikes to isolate the open pit mining activities from the lakes. Figure 2 presents the site plan. The Dewatering Dikes consist of the following structures:

- East Dike;
- Bay-Goose Dike;
- South Camp Dike; and
- Vault Dike.

A description of the physical conditions of the site, as well as a description of the climate, geological and geotechnical conditions can be found in various documents including the design documents for the East Dike and Bay-Goose Dike Doc. 572 Sections 3.0 and 4.0 (Golder 2008b) and Doc. 802 Section 2.0 (Golder 2009a), respectively.

In 2008 the East Dike and West Channel Dikes were constructed to isolate the northwest arm of Second Portage Lake to permit mining of Portage Pit and also to provide an area for the storage of tailings. Dewatering of the northwest arm of Second Portage Lake began in the spring of 2009 and was halted during the summer of 2009. Dewatering recommenced in the fall of 2009. The downstream toe of the East Dike has been exposed continuously since July 2010 although was mostly exposed by July 2009. Dewatering of the basin continued intermittently as other construction and site water was transferred to the basin as part of the operations.

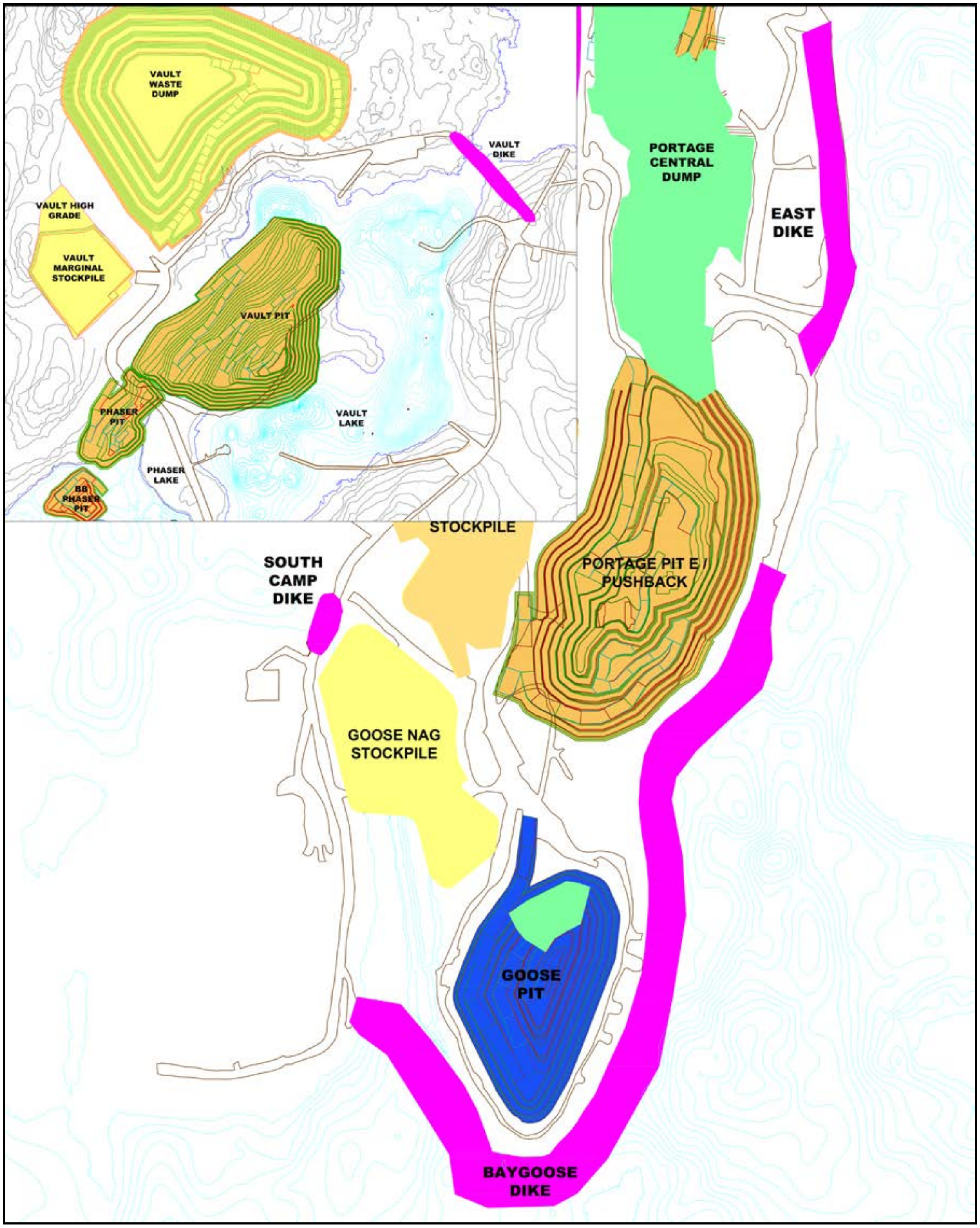
In 2009 the South Camp Dike was constructed. The earthworks component of the Bay-Goose Dike construction occurred over two summer construction seasons. The north portion of the Bay-Goose Dike was constructed in 2009 and the south portion in 2010. Grouting and jet grouting works commenced in 2010 and were completed by mid-July 2011.

Dewatering of the Bay-Goose Basin occurred between July 25 and November 14, 2011 following completion of the Bay-Goose Dike construction and instrumentation installation. In March 2012, the pre-stripping of Goose Pit started. Goose Pit mining operations were completed in 2015. Pit waste rock infilling has been completed and is planned for 2017-2019.

The construction of Vault Dike at Meadowbank was conducted from February 2013 to March 2013. Vault Dike is located across a shallow creek which connects Wally Lake and Vault Lake, at the Vault Pit area. Vault Dike is essential to allow the dewatering of Vault Lake and to isolate Vault Pit during mining activities from Wally Lake. The dewatering of Vault Lake started on June 27th, 2013 and was completed in the summer of 2014.

The following subsections provide additional details for each of the Dewatering Dikes.

Figure 2 Site Plan



3.1 EAST DIKE

The East Dike together with the West Channel Dike isolates the northwest arm of Second Portage Lake. During the operational phase of the mine, the East Dike isolates the Portage Pit from Second Portage Lake. In closure, as the plan will include breaching of the Bay-Goose Dike thereby flooding both Goose and Portage Pits, then the East Dike will separate Third Portage Lake from Second Portage Lake. There are no spillways or water diversion works associated with the East Dike. The East Dike also used to serve as a haul road to connect the North Portage Pit to the ore stockpiles and to the crushing facility within the plant site. The West Channel Dike used to cover a narrow channel and prevent flow from Third Portage Lake to Second Portage Lake. The West Channel Dike together with the East Dike isolated the northwest arm of Second Portage Lake. The West Channel Dike was no longer required and was removed as part of mining operations in the Portage Pit in 2012.

The East Dike was constructed in the summer of 2008 and grouting of the foundation and bedrock occurred in 2008 and during the first quarter of 2009. It is approximately 800 m in length, and was constructed within Second Portage Lake prior to dewatering. The dike consists of a wide rockfill shell, with downstream filters and a soil-bentonite cutoff wall that extends to bedrock. The cutoff wall extends up to 8 m below lake level.

3.1.1 East Dike - Design and Construction

The East Dike design is contained within Doc. 572 (Golder 2008b). A plan view and profile of the constructed dike is presented on Figure 3 and includes the locations of instrumentation installations used for monitoring. A typical cross section through the dike and is shown on Figure 4. Additional as-built information and as-built drawings for the East Dike are provided in Doc. 900 (Golder 2009e).

Dike construction occurred in the following general manner:

<u>Rockfill Embankment:</u>

- A rockfill platform approximately 50 m wide was advanced from the south abutment to the north. The rockfill platform provided construction access and support for the core materials.

- The width of the rockfill platform (embankment) was subsequently increased by placement of additional rockfill on the downstream side, to provide an adequate road width to accommodate two-way haul traffic.

<u>Initial Trench Excavation:</u>

- Rockfill and lakebed soils were excavated from the crest of the rockfill platform to expose bedrock along the cutoff centreline. Loose blocks or slabs from the bedrock surface were removed, as practical.

Backfilling of the Initial Trench:

- A coarse granular filter (150 mm minus) was placed using the bucket of the excavator on the downstream slope of excavation.
- Then the remaining portion of the excavation was backfilled with Core Backfill (19 mm minus) material in the central portion along the cutoff wall centreline and Coarse Filter (150 mm minus) material on the upstream and downstream sides of the Core Backfill. Backfilling of the trench with the Core Backfill and Coarse Filter materials was a simultaneous activity and occurred progressively as the initial trench was the excavation front advanced.
- At the bedrock surface, a minimum of 5 m of Core Backfill material was to be placed.

Compaction of Core Backfill:

- Core Backfill and Coarse Filter were placed to an elevation 2 m above the water level to form a platform from which densification could occur.
- The Core Backfill was densified using multiple passes of dynamic compaction. Craters produced by the dropped weight were backfilled to level the working platform between passes.

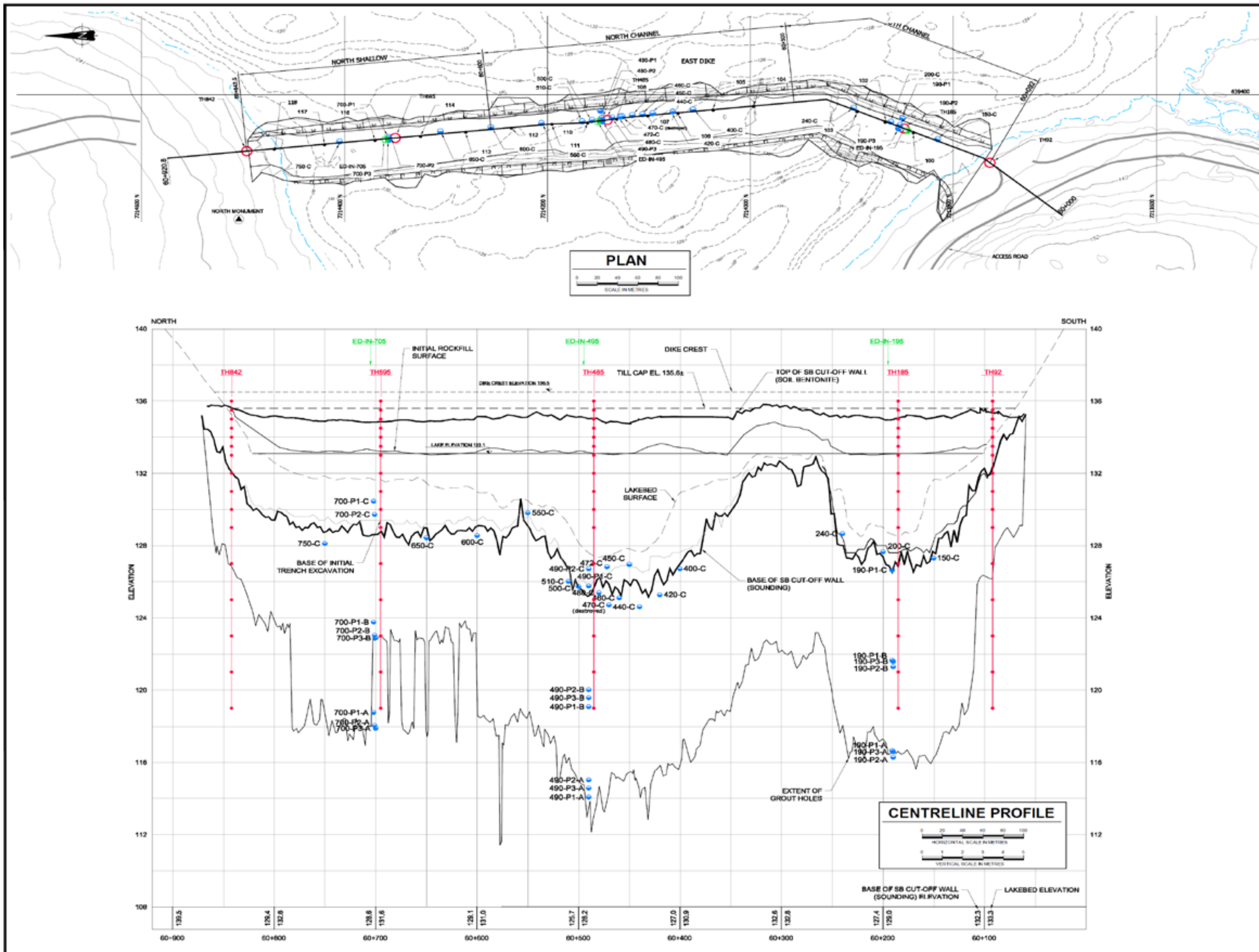
Cutoff:

- A 1 m wide trench was excavated through the Core Backfill material and extended to the bedrock surface along the cutoff wall centreline. Bentonite slurry was used to support the trench.
- The trench was backfilled with soil-bentonite.

Grouting:

- Grouting of the bedrock foundation and “contact area” identified as the zone between the base of the cutoff wall and bedrock surface was performed through the centerline of the cutoff wall.

Figure 3 East Dike Plan and Profile



LEGEND:

LAND-BASED TOPOGRAPHIC MAJOR CONTOURS INTERVAL 10m
LAND-BASED TOPOGRAPHIC MINOR CONTOURS INTERVAL 2m
BATHYMETRIC MAJOR CONTOURS INTERVAL 2m
SHORE LINE
CUTOFF WALL CENTRELINE
EXISTING THERMISTOR
SURVEY MONUMENT LOCATION
PIEZOMETER
INCLINOMETER
SURVEY CONTROL MONUMENT

NOTES:

1) ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2) ALL ELEVATIONS ARE IN METRES ABOVE SEA LEVEL (MASL) UNLESS OTHERWISE NOTED.
3) GRID REFERENCE: NAD 83, UTM ZONE 14.
4) CONTOUR INFORMATION ON LAND SUPPLIED BY AGNICO-EAGLE MINES LIMITED (AEM), MEADOWBANK DIVISION.
5) LAKEBED SURFACE INTERPOLATED FROM 2006 BATHYMETRY DATA. DETAILED BATHYMETRY (0.5m INTERVAL) BASED ON 2008 SURVEY.
6) LAKE CONTOURS ARE BASED ON SURVEYED LAKE SURFACE ELEVATION: SECOND PORTAGE LAKE = 133.1m.

PIEZOMETER LOCATION TABLE

NAME	STATION	EASTING	NORTHING
150-C	60+149.94	639347.4	7213816.4
190-P1	60+190.54	639355.8	7213857.4
190-P2	60+190.15	639363.0	7213853.9
190-P3	60+189.86	639368.8	7213852.1
200-C	60+200.00	639370.5	7213861.5
240-C	60+239.86	639382.3	7213899.7
400-C	60+400.00	639379.7	7214056.0
420-C	60+420.00	639381.9	7214076.4
440-C	60+440.00	639379.9	7214096.3
450-C	60+450.14	639375.0	7214106.0
460-C	60+460.00	639377.8	7214116.2
470-C	60+470.00	639376.5	7214126.2
472-C	60+472.00	639376.2*	7214128.2*
480-C	60+480.00	639375.1	7214136.2
490-P1	60+489.91	639361.9	7214144.6
490-P2	60+490.21	639369.8	7214145.7
490-P3	60+490.40	639373.8	7214146.3
500-C	60+500.00	639372.3	7214155.8
510-C	60+510.00	639370.9	7214165.6
550-C	60+550.24	639365.0	7214205.60
600-C	60+600.06	639360.0	7214255.1
650-C	60+650.13	639355.0	7214304.9
700-P1	60+701.54	639342.0	7214355.3
700-P2	60+700.53	639350.0	7214355.1
700-P3	60+700.14	639353.9	7214355.1
750-C	60+750.06	639345.5	7214404.4

THERMISTOR LOCATION TABLE

NAME	STATION	EASTING	NORTHING
TH92	60+092	639325.0	7213763.8
TH185	60+185	639362.9	7213848.4
TH485	60+485	639372.4	7214140.7
TH695	60+695	639352.5	7214349.8
TH842	60+842	639337.9	7214496.1

INCLINOMETER LOCATION TABLE

NAME	STATION	EASTING	NORTHING
ED-IN-705	60+704.80	639351.5	7214359.6
ED-IN-495	60+495	639371*	7214151*
ED-IN-195	60+194.69	639366.6	7213857.3

* COORDINATE ASSUMED, TO BE CONFIRMED BY SURVEY

PROJECT
AEM
AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT
NUNAVUT

TITLE
EAST DIKE INSTRUMENTATION PLAN AND PROFILE

Golder Associates

PROJECT No. 09-1428-5007			PHASE No. 3000	
DESIGN	FE	10NOV10	SCALE AS SHOWN	REV.
CADD	GG	10NOV10	FIGURE C1-1	
CHECK				
REVIEW				

Figure 4 East Dike Typical Section

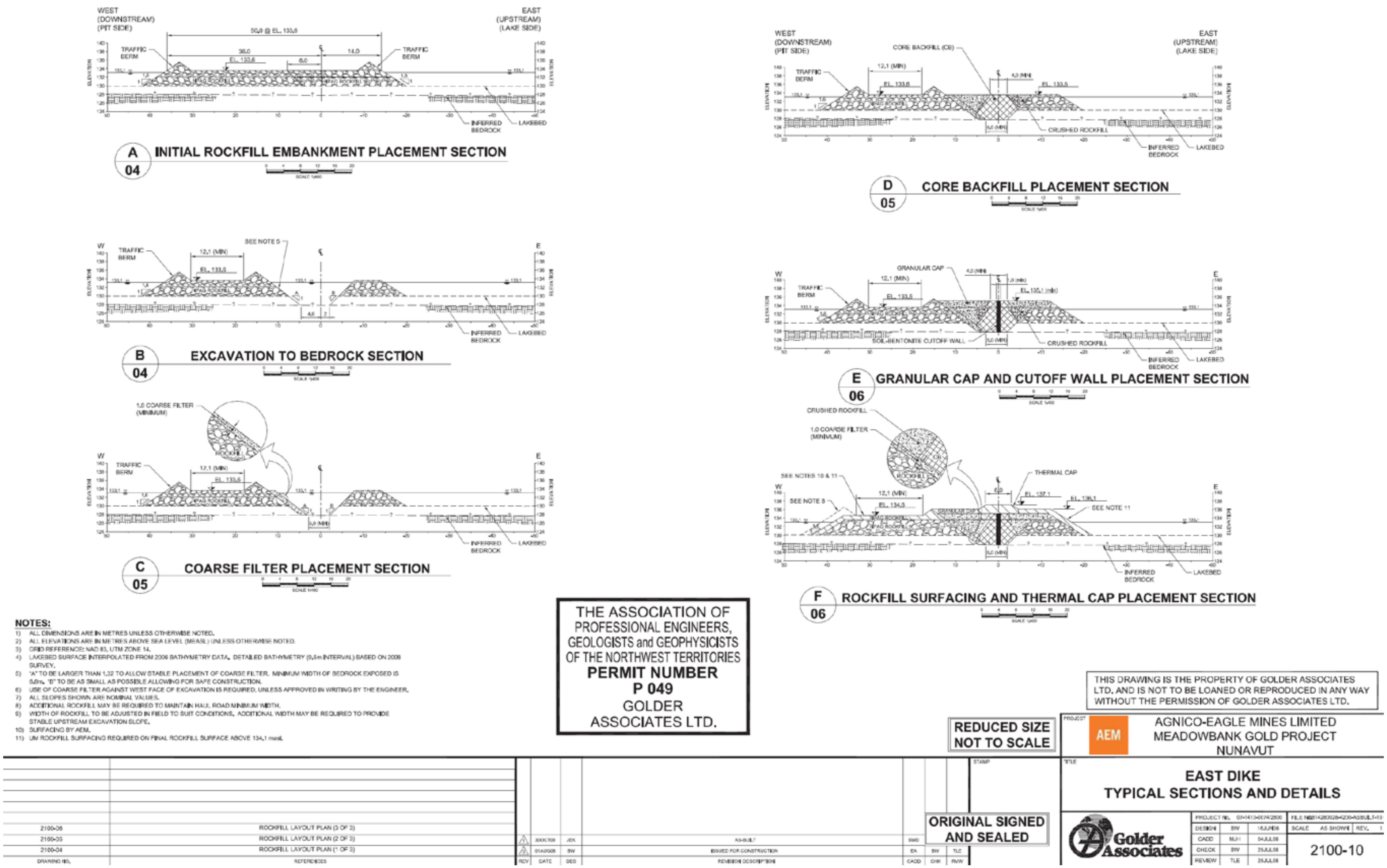
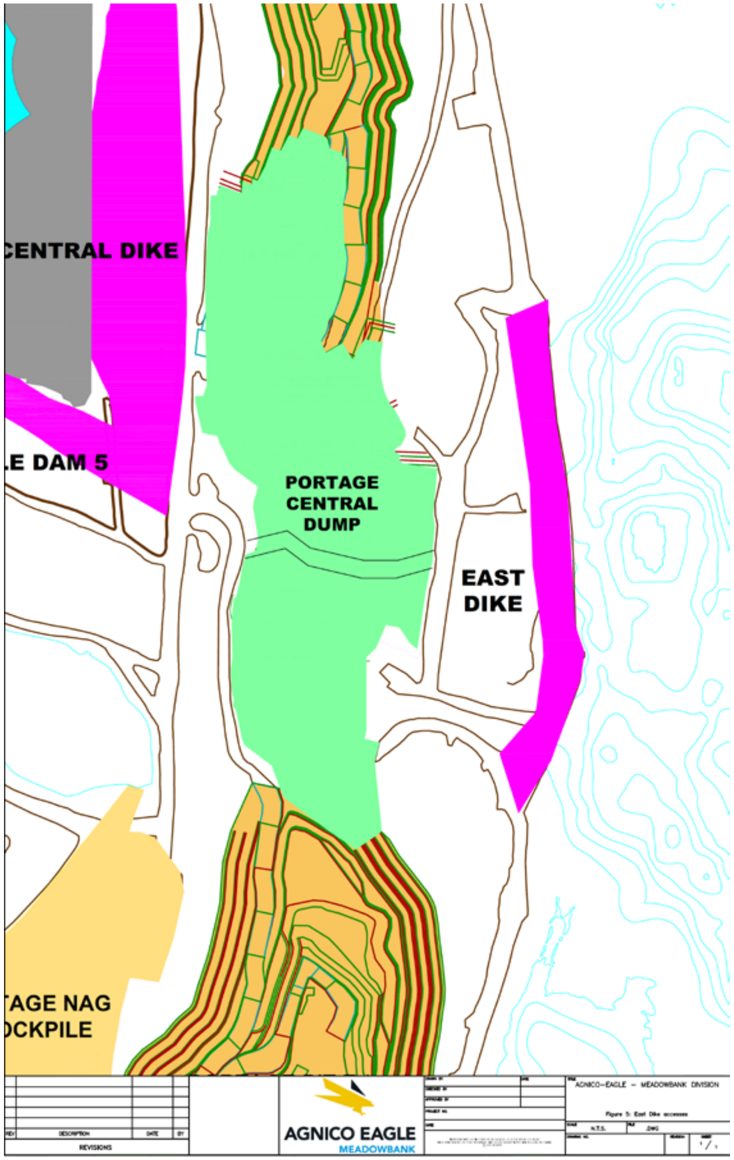


Figure 5 East Dike and Access Roads



3.1.2 East Dike - Instrumentation

Instrumentation was installed prior to dewatering to monitor the behaviour of the dike and dike foundation during dewatering and operation. Instrumentation consisted of:

- Single vibrating wire piezometers located downstream of the cutoff wall;
- Arrays of vibrating wire piezometers, installed at various levels, upstream, immediately downstream of the cutoff wall and further downstream;
- Thermistor strings installed through the centreline of the cutoff wall;
- Inclinometers installed through the centreline of the cutoff wall; and
- Survey monuments along the centreline of the cutoff wall.

The monitoring network was expanded through the installation of additional instruments. Table 3.1 summarizes existing instrumentation.

Table 3.1 Existing Instrumentation Summary

Instrumentation Type	Station Location	Label / Identification	Offset from Centreline + is d/s; - is u/s	Elevation (masl)	Details
Vibrating Wire Piezometer Array	60+190	190-P1-A	10	116.7	190-P1 Top of steel casing: El. 136.39
		190-P1-B	10	121.7	
		190-P1-C	10	126.7	
		190-P2-A	2	116.34	190-P2 Top of steel casing: El. 136.54
		190-P2-B	2	121.34	
		190-P2-C	2	126.34	
		190-P3-A	-2	116.63	190-P3 Top of steel casing: El. 136.54
		190-P3-B	-2	121.63	
Vibrating Wire Piezometer Array	60+490	490-P1-A	11	114.12	490-P1 Top of steel casing: El. 136.20
		490-P1-B	11	119.12	
		490-P1-C	11	125.81	
		490-P2-A	3.1	115.07	490-P2 Top of steel casing: El. 136.15
		490-P2-B	3.1	120.07	
		490-P2-C	3.1	126.76	
		490-P3-A	-0.9	114.62	490-P3 Top of steel casing: El. 136.02
		490-P3-B	-0.9	119.62	
Vibrating Wire Piezometer Array	60+700	700-P1-A	9.9	118.81	700-P1 Top of steel casing: El. 136.27
		700-P1-B	9.9	123.81	
		700-P1-C	9.9	130.5	
		700-P2-A	2	118.08	700-P2 Top of steel casing: El. 136.48
		700-P2-B	2	123.08	
		700-P2-C	2	129.77	
		700-P3-A	-1.9	117.93	700-P3 Top of steel casing: El. 136.40
		700-P3-B	-1.9	122.92	

Instrumentation Type	Station Location	Label / Identification	Offset from Centreline + is d/s; - is u/s	Elevation (masl)	Details
Individual Vibrating Wire Piezometers	60+150	150-C	2.1	127.35	Top of steel casing: El. 136.33
	60+200	200-C	2	127.71	Top of steel casing: El. 136.29
	60+240	240-C	2	128.71	Top of steel casing: El. 136.26
	60+400	400-C	2.2	126.76	Top of steel casing: El. 136.27
	60+420	420-C	2	125.32	Top of steel casing: El. 137.10
	60+440	440-C	2	124.66	Top of steel casing: El. 137.14
	60+450	450-C	1.9	127	Top of steel casing: El. 136.22
	60+460	460-C	2	125.15	Top of steel casing: El. 137.60
	60+470	470-C	2	124.76	Top of steel casing: El. 137.43
	60+480	480-C	2	125.44	Top of steel casing: El. 137.65
	60+500	500-C	2	125.78	Top of steel casing: El. 137.34
	60+510	510-C	2	126.06	Top of steel casing: El. 137.10
	60+550	500-C	2	129.85	Top of steel casing: El. 136.24
	60+600	600-C	1.9	128.6	Top of steel casing: El. 136.53
	60+650	650-C	2	128.48	Top of steel casing: El. 136.59
	60+750	750-C	1.5	128.16	Top of steel casing: El. 136.93

Instrumentation Type	Station Location	Label / Identification	Offset from Centreline + is d/s; - is u/s	Elevation (masl)	Details
Thermistor Strings	60+092	TH92	0	136 (1st Bead)	Beads at Elev. 136, 135.5, 135, 134.5, 134, 133.5, 133, 132, 131, 130, 129, 127, 125, 123, 121 and 119 masl.
	60+185	TH185	0	136 (1st Bead)	Beads at Elev. 136, 135.5, 135, 134.5, 134, 133.5, 133, 132, 131, 130, 129, 127, 125, 123, 121 and 119 masl.
	60+485	TH485	0	136 (1st Bead)	Beads at Elev. 136, 135.5, 135, 134.5, 134, 133.5, 133, 132, 131, 130, 129, 127, 125, 123, 121 and 119 masl.
	60+440	P440	0	136 (1stBead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+443	S443	0	136.5 (1stBead)	Beads at Elev. 136.50, 136.45, 136.40, 136.35, 136.30, 136.25, 136.20, 136.15, 136.10, 136.05, 136.00, 134.00, 132.00, 130.00, 128.00 and 126.00 masl.
	60+446	P446	0	136 (1stBead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+449	S449	0	136 (1stBead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+452	P452	0	136 (1stBead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+455	S455	0	136 (1stBead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.

Instrumentation Type	Station Location	Label / Identification	Offset from Centreline + is d/s; - is u/s	Elevation (masl)	Details
	60+458	P458	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+461	S461	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+464	P464	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+467	S467	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+479	S479	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+482	P482	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+483	T483	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+486	T486	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+488	P488	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.

Instrumentation Type	Station Location	Label / Identification	Offset from Centreline + is d/s; - is u/s	Elevation (masl)	Details
	60+491	S491	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+494	P494	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+497	S497	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+500	P500	0	136.5 (1st Bead)	Beads at Elev. 136.50, 136.25, 136.00, 135.00, 134.00, 133.00, 132.00, 131.00, 129.00, 127.00, 125.00, 123.00, 121.00, 119.00, 117.00 and 115.00 masl.
	60+503	S503	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+506	P506	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+509	S509	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+512	P512	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+515	S515	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.

Instrumentation Type	**Station Location**	**Label / Identification**	**Offset from Centreline + is d/s; - is u/s**	**Elevation (masl)**	**Details**
	60+518	P518	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+521	S521	0	136 (1st Bead)	Beads at Elev. 136, 135, 134, 133, 132, 131, 130, 129, 127, 125, 123, 121, 119, 117, 115 and 113 masl.
	60+695	TH695	0	136 (1st Bead)	Beads at Elev. 136, 135.5, 135, 134.5, 134, 133.5, 133, 132, 131, 130, 129, 127, 125, 123, 121 and 119 masl.
	60+842	TH842	0	136 (1st Bead)	Beads at Elev. 136, 135.5, 135, 134.5, 134, 133.5, 133, 132, 131, 130, 129, 127, 125, 123, 121 and 119 masl.

Instrumentation Type	Station Location	Label / Identification	Offset from Centreline + is d/s; - is u/s	Elevation (masl)	Details
Inclinometer	60+195	ED-IN-195 (A and B Axis)	0.05	137.6 (Collar Elevation)	Azimuth 51.2 degree Destroyed in 2010
	60+495	ED-IN-495 (A and B Axis)	0.05	137.6 (Collar Elevation)	Azimuth 347.9
	60+705	ED-IN-705 (A and B Axis)	0.09	137.6 (Collar Elevation)	Azimuth 20.4 degree
Initial Crest Survey Monuments		100	0	136.9	Most have been destroyed since installation.
		101		136.8	
		102		136.7	
		103		136.6	
		104		136.9	
		105		136.8	
		106		136.9	
		107		136.7	
		108		136.6	
		109		136.5	
		110		136.6	
		111		136.3	
		112		136.5	
		113		136.7	
		114		136.8	
		115		136.7	
		116		136.8	
		117		136.7	
		118		136.7	

As installation of additional instrumentation occurs to broaden the existing monitoring network or to replace damaged instruments, the summary table and figures shall be updated.

Blast monitoring is carried out using portable blast monitoring seismographs that measure both blast induced velocities and accelerations at the point of monitoring (i.e. crest and/or the toe of the dike).

- Instrumentation locations are shown both in plan and profile on Figure 5.
- Records of all instrument installation details, data sheets, and calibration sheets shall be maintained and stored in a central location, such that they are readily available to AEM personnel and external reviewers.

3.1.3 East Dike - Dewatering

During dewatering of the northwest arm of Second Portage Lake, an apparent leak through the East Dike of up to 0.5 m^3/s occurred over several days near Sta. 60+490. The leak then appeared to self-heal following drilling works for the additional grouting carried out in this sector. A sinkhole cavity of about 18 m^3 in the general vicinity of the leak (Sta. 60+472) also appeared in July 2009. The sinkhole was located immediately upstream of the cutoff wall and extended at least partially through the cutoff wall. A Technical Memorandum entitled "Meadowbank East Dike Grouting Response Plan – Completed Works" (Golder 2009b) provides additional information regarding the remedial grouting work and Golder Doc. No. 961 (Golder, 2009d) "East Dike Sinkhole Summary Report" provides more details about the sinkhole.

Following the appearance of the sinkhole, a cone penetration test (CPT) investigation was conducted, and three diamond drill holes and a surface geophysical survey were advanced in the area to obtain additional information. Based on the CPT results, there appeared to be a zone of coarser grained material (area with lower fines content) in the apparent leak area. The drilling investigation indicated that there may be soil between the base of the cut-off wall and underlying bedrock that was not completely excavated and/or grouted. An additional investigation of the sinkhole and apparent leakage area consisting of the temporary installation of thermistor strings and monitoring of the thermal condition was initially conducted in 2010 and repeated in 2011. Based on the thermal results, it appeared that a pervious zone existed within the cut-off wall and shallow bedrock between approximately Sta. 60+440 and 60+504. In the past, AEM considered potential mitigation options to reduce seepage through the dike and to provide contingency protection for the Portage Pit. Based on the stability of the dike and the seepage rate, remediation or implementation of contingency control measures is not considered necessary. The condition of the dike will continually be monitored and if the condition of the dike is judged to be deteriorating then remediation would be reassessed. Details regarding these investigations are provided in East Dike CPT Investigation Report (Golder, 2010b) and East Dike Sinkhole Investigation Program October-November 2009 (Golder 2010a).

The seepage is currently controlled by a seepage collection system and is not impacting the mining operation. The seepage is regularly monitored and appears to have stabilized and does not have a negative effect on the dike stability.

3.1.4 East Dike - Seepage Collection System

The purpose of the seepage collection system is to:

- Collect and convey seepage and runoff away from the downstream toe area; and
- Allow measurement of seepage through the dike.

The downstream toe of the East Dike was mostly exposed by July 2009 and then entirely by July 2010. Three seepage zones have been identified along the toe of the East Dike at approximately Sta. 60+480, Sta. 60+225 and Sta. 60+550. A temporary rectangular weir was installed in 2009 to monitor the seepage observed at approximately Sta. 60+480. Monitoring of the seepage from this location has occurred during the open water season (approximately mid-July through early October) in 2009 and 2010. During 2010, a temporary v-notch weir was installed to measure a second zone of seepage exposed near Sta. 60+225 following dewatering. This portion of the dike was not exposed for visual inspection in 2009 due to the downstream water elevation. No monitoring system has been installed in the area around Sta. 60+550. Seepage flows have been measured to be between 7 L/s and 11 L/s at Sta. 60+480 and around 4 L/s at Sta. 60+225 and estimated to be about 1 L/s at Sta. 60+550.

The installation of a seepage collection system downstream of East Dike to capture and pump the seepage water started in September 2011 and was completed in 2012. After the system installation, 3 zones of seepage were identified near the downstream toe. The zones at about Sta. 60+247 and Sta. 60+498 each had a collection sump with pump connected to a year round pumping and piping system.

In 2011, the downstream seepage at Sta. 60+498 had been stable at a rate of about 864 m^3/day (10 L/s) with no visual signs of turbidity, which was consistent with rates recorded during previous years. In 2011, the seepage downstream at Sta.60+247 appeared stable at around 345.6 m^3/day (4L/s) with no visual signs of turbidity noted, which was consistent with previous rates. Since the installation of the seepage collection system, all seepage is being captured within the sumps and no sign of additional seepage on the ground surface or downstream in the Portage Pit was observed. No active monitoring of the seepage rate at these locations occurred in 2012 but AEM has been visually inspecting the flow in the sumps and no turbidity was noted. AEM performed a pump test after the installation of the sumps, it was noted that the measured flow were consistent with 2010 and 2011 data. Flow meters have been installed in 2013 at the exit of each pump. Since then, the observed flow has been reducing to an average of 492 m^3/day in 2016 with a maximum flow of 596 m^3/day in August and minimum flow of 411 m^3/day in March 2016.

3.1.5 East Dike - Access

Access to the East Dike is from the north and south abutments, shown on Figure 2 and Figure 5. In 2010, the East Dike was used as a haul road connecting the North Portage Pit to the Plant Site. East Road was built downstream and used to function as haul road to get access from the east to Portage Pit. No haul trucks use the East Dike or East Road anymore during normal operations. A shortcut access is possible from the Pit E Ramp through the Central Dump, as seen on Figure 5.

3.2 BAY-GOOSE DIKE

The Bay-Goose Dike together with the South Camp Dike isolates the Bay-Goose Basin from Third Portage Lake, which permits mining of the Goose Pit and the southern portion of Portage Pit. No spillways or water diversion works are associated with the Bay-Goose Dike. Figure 2 shows the location of Bay-Goose Dike.

The Bay-Goose Dike is approximately 2,200 m in length and was constructed “in the wet”, prior to dewatering. The dike consists of a wide rockfill shell, with downstream filters and a cutoff wall constructed of a mixture of materials dependent on the location along the dike:

- Soil-bentontie (SB);
- Cement soil-bentonite (CSB);

- Jet grouted columns;
- A combination of soil-bentonite and cement soil-bentonite;
- A combination of soil-bentonite and/or cement soil-bentonite and jet grouted columns; and
- With the exception of the south abutment, the cutoff system (including the jet grouted columns) extends to bedrock and is up to 20 m below lake level.

The earthworks component of the Bay-Goose Dike construction occurred over two summer construction seasons. The north portion of the Bay-Goose Dike was constructed in 2009 and the south portion in 2010. Grouting and jet grouting works commenced in 2010 and were completed by mid-July 2011.

Further details regarding the dike are provided in the following subsections.

3.2.1 Bay-Goose Dike – Design and Construction

The dike design is provided within Doc. 802 (Golder 2009a). A plan view of the dike along with the instrument locations is shown on Figure 6. Figure 7 provides the profile view along the cutoff wall centreline. Figure 8 provides the profile view of instrumentation details. Typical cross sections are shown on Figure 9. As-built drawings of the dike can be found in Golder 2009a.

Dike construction occurred in the following general manner:

<u>Rockfill Platform / Embankment:</u>

- A rockfill platform of varying width (approximately 60 to 90 m) was advanced from the north abutment to Goose Island, between July and September 2009 to an elevation of about 134 m.
- A rockfill causeway about 25 m wide was advanced from Goose Island to the south abutment between February and June 2010 while ice cover existed on Third Portage Lake. Ice was broken and removed, as practical, in front of the advancing rockfill platform.
- Following ice breakup from the lake in July 2010, additional rockfill was placed to widen the causeway to the full design width of the rockfill platform (approximately 55 to 100 m).
- The rockfill platforms surface elevation was about 134 m and was used to provide a working surface for the subsequent construction activities. The rockfill also provides lateral support for the granular core materials.

<u>Initial Trench Excavation:</u>

- Rockfill and lakebed soils were excavated from the rockfill platform surface to bedrock or competent lakebed soils along the cutoff centreline. As much as practical, loose blocks or slabs from the bedrock surface were removed.

- Ice rich soils beneath the cutoff wall were removed with the exception of at the south abutment where beyond Sta. 32+112 some ice-rich soils remain beneath the base of the initial trench excavation and cutoff wall.

- The required bottom width of the excavation varied based on its depth and varied between 8 and 11 m.

<u>Backfilling of the Initial Trench:</u>

North Portion of Dike

- A layer of Core Backfill (19 mm minus) material was placed along the downstream slope of the excavation such that Core Backfill material would be in contact with the lakebed soils.

- Then the remaining portion of the excavation was backfilled with Core Backfill (19 mm minus) material in the central portion along the cutoff wall centerline, with Coarse Filter (150 mm minus) material simultaneously placed on either side of the Core Backfill. Backfilling of the excavated trench occurred progressively as the excavation front advanced.

South Portion of Dike

- In very limited areas along the alignment, a layer of Core Backfill (19 mm minus) material was placed along the downstream slope of the excavation prior to the primary backfilling of the trench.

- The excavation was backfilled with Core Backfill (19 mm minus) material in the central portion along the cutoff wall centerline, with Coarse Filter (150 mm minus) material simultaneously placed on the downstream side of the Core Backfill and a “Fine Rockfill” material placed on the upstream side. Backfilling of the excavated trench occurred progressively as the excavation front advanced.

- In areas to be compacted using the vibratory-densification method, the width of Core Backfill material was required to be 8 m. Therefore, once the initial backfilling had been completed relatively small V-shaped excavations were made at the surface on either side of the initially placed Core Backfill. These excavations were then refilled with Core Backfill material to provide the required 8 m width of Core Backfill.

<u>Compaction of Core Backfill:</u>

- For all of the North Portion of the dike and a majority of the South Portion of the dike, a 2 m layer of Core Backfill, Coarse Filter, and Rockfill was placed to increase the elevation of the platform to provide a working surface for the dynamic compaction.

- The Core Backfill was densified using multiple passes of dynamic compaction. Craters produced by the dropped weight were backfilled to the level of the working platform between passes.

- For the South Portion of the dike, in zones where the initial excavation was not extended to bedrock, termed "partial cutoff" zones, compaction of the Core Backfill material was done using two methods: vibratory-densification and dynamic-compaction. Vibratory-densification of the Core Backfill material was conducted from the initial rockfill platform working surface (134 m). Vibro-densification was utilized to treat the Core Backfill material at the base of the excavation up to an elevation of about.128 m (i.e. 6 m below the water level). Then the 2 m of additional Core Backfill, Coarse Filter, and Rockfill materials were placed to increase the elevation of the platform to about 136 m creating the working surface for the dynamic compaction. The upper portion of the Core Backfill material was then treated using multiple passes of dynamic compaction. Craters produced by the dropped weight were backfilled to the level of the working platform between passes.

<u>Cutoff:</u>

- A 1 m wide trench was excavated through the Core Backfill material and extended to bedrock or competent till surface along the cutoff wall centreline. Bentonite slurry was used to support the trench.

- The trench was backfilled with:

  - Soil-bentonite (SB);

  - Cement Soil-bentonite (CSB); or

  - A combination of SB and CSB.

- Then a capping layer about 0.5 m thick of SB was placed above the trench to an approximate elevation of 136.5 m.

<u>Jet Grouted Wall</u>

- Jet grouting has been used to extend the low permeability element (cutoff wall) of the dike to the bedrock surface. A double jet system was used with a cement water ratio of 1:1 to construct the jet grouted columns. Jet grouting was completed from a working platform elevation of approximately 137 m.

- Jet grouting beneath the cutoff wall to the bedrock surface was conducted in the "partial cutoff" areas where the cutoff wall was not excavated to bedrock. This occurred in Channel 1 (Sta. 32+007 to 32+110), Channel 2 (Sta. 31+820 to 31+928), and Channel 3 (Sta. 31+575 to 31+611). Jet grouted columns were constructed with a centre to centre spacing of 1.2 m with an overlap with the cutoff wall and extended into the bedrock surface. Columns were constructed in two passes, primary columns at a spacing of 2.4 m with secondary columns subsequently constructed between the primary columns.

- Jet grouting was also conducted in two additional areas of the dike where significant silt accumulated at the base of the initial excavation and prevented the cutoff wall from being successfully constructed to bedrock. These two areas the North Channel (Sta. 30+361 to 30+435) and between Channel 1 and Channel 2 (Sta. 31+928 to 32+007). Jet grouted columns were constructed with a centre to centre spacing generally of 1.5 m, with the exception of the portion between Sta. 31+928 and Sta. 31+966.4 where a spacing of 1.2 m was utilized, following a primary and secondary sequence for installation.

<u>Grouting:</u>

- The working platform along the cutoff wall centerline was raised with Coarse Filter material to an elevation of 137 m, from which grouting work was conducted.

- Grouting of the bedrock foundation and "contact area" identified as the zone between the base of the cutoff wall or jet grout columns and bedrock surface was performed through the centerline of the cutoff wall.

Figure 6 Bay-Goose Dike Instrumentation Plan

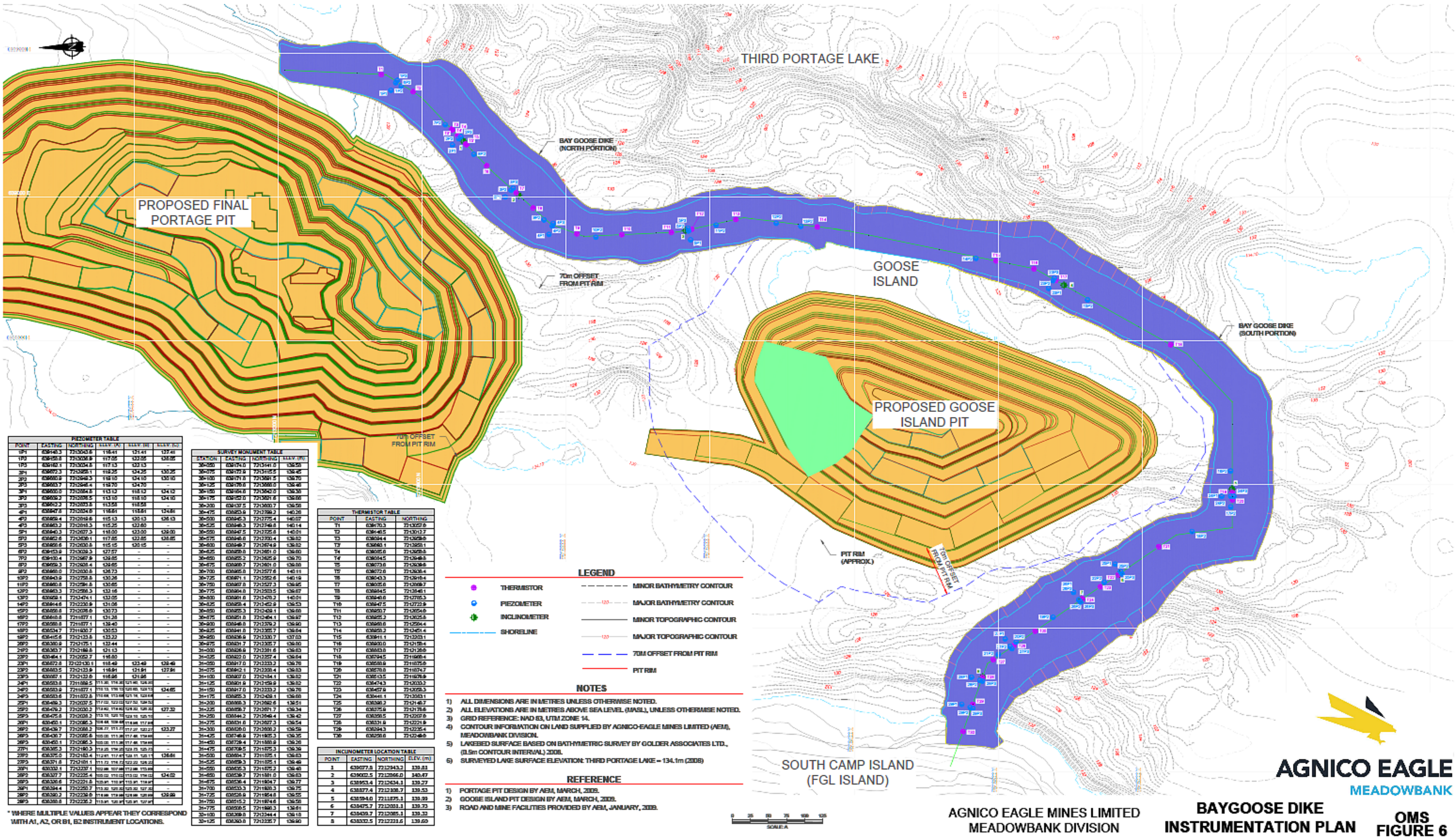


Figure 7 Bay-Goose Dike – Profile View of SB and CSB Placement Zones and Instrumentation profile

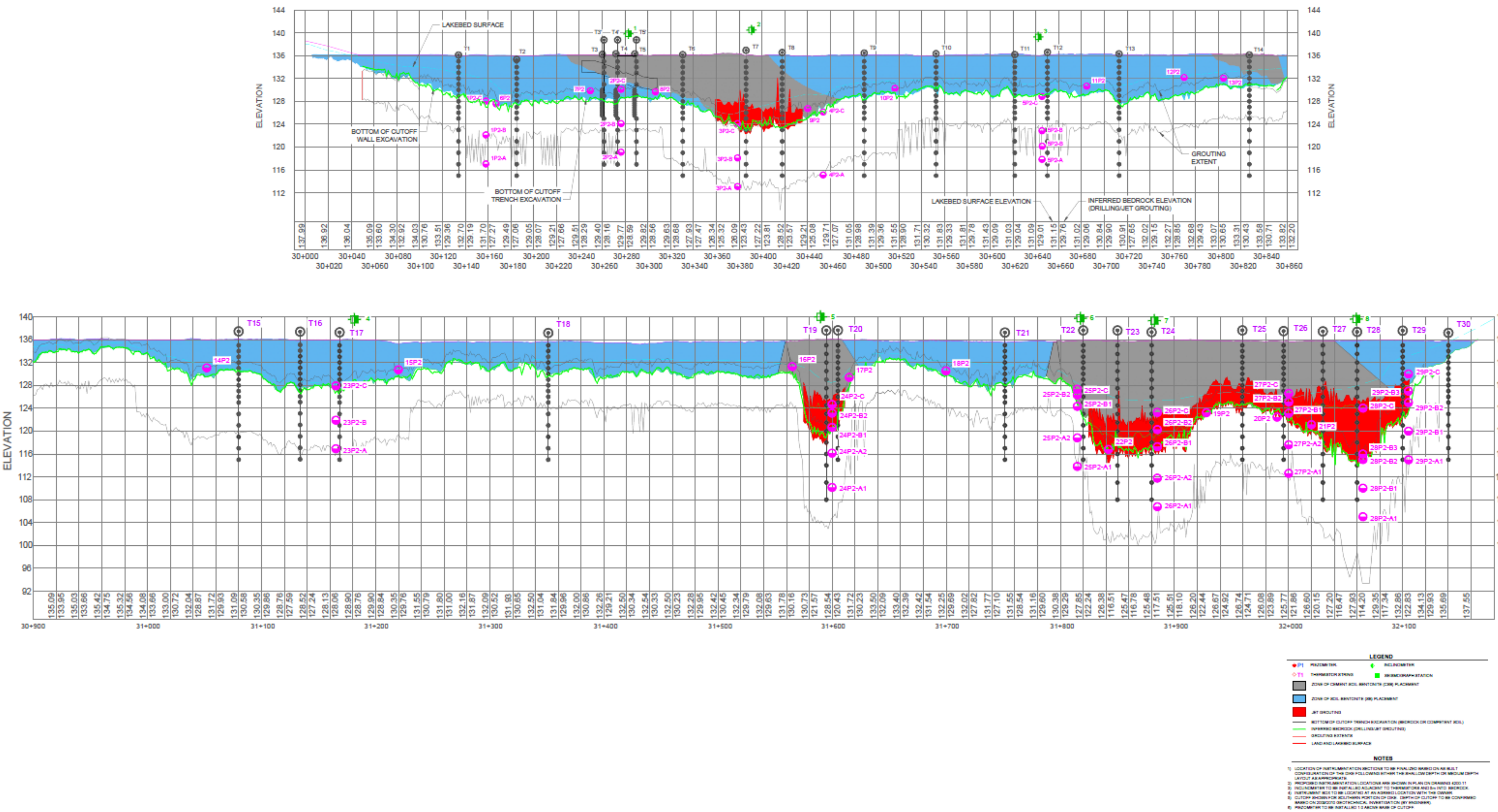
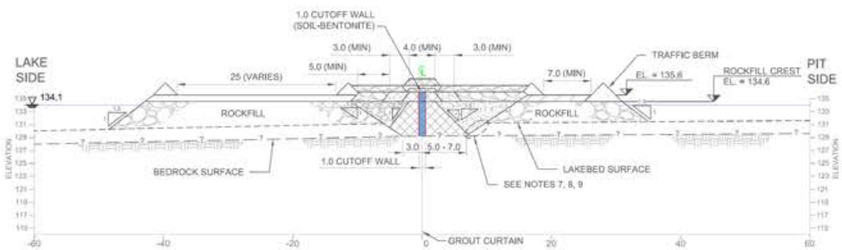
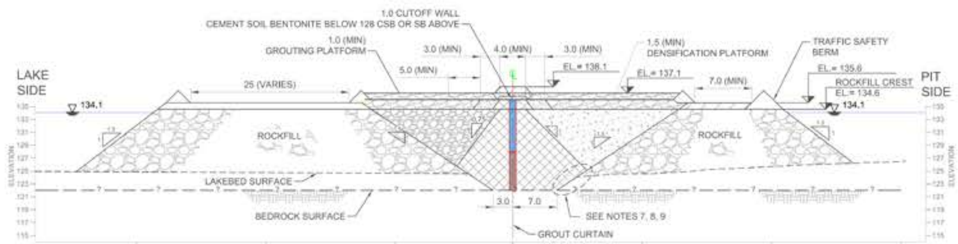


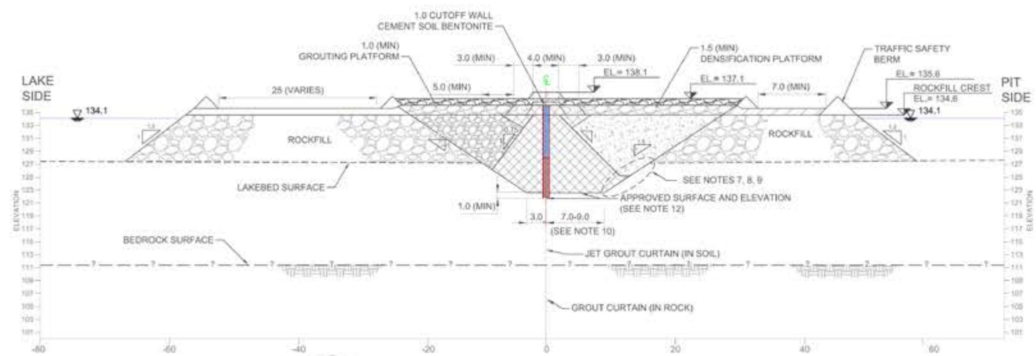
Figure 8 BFigure 8ay-Goose Dike – Typical Sections



A TYPICAL SECTION - BEDROCK ELEVATION ABOVE 128.0
4300-13 SCALE: A



B TYPICAL SECTION - BEDROCK ELEVATION BELOW 128.0
4300-13 SCALE: A



C TYPICAL SECTION- PARTIAL CUTOFF WALL
4300-13 SCALE: A

NOTES

1) ALL DIMENSIONS IN METERS UNLESS OTHERWISE NOTED
2) ALL ELEVATIONS IN METERS ABOVE SEA LEVEL (MASL) UNLESS OTHERWISE NOTED
3) ALL SLOPES SHOWN ARE NOMINAL VALUES.
4) GEOCHEMICAL CLASSIFICATION OF NPAG IS RESPONSIBILITY OF AEM. ALL MATERIALS USED IN CONSTRUCTION ARE TO BE NPAG.
5) ALL ICE RICH MATERIAL BENEATH THE CUTOFF WALL WAS EXCAVATED, EXCEPT BETWEEN STA 32+112 AND 32+166.
6) BEDROCK AND LAKEBED SURFACES ARE SHOWN AS SMOOTH LINES FOR ILLUSTRATIVE PURPOSES. UNDULATING AND UNEVEN SURFACES EXIST.
7) CORE BACKFILL WITHIN THE DOWNSTREAM SIDE OF THE TRENCH WAS PLACED WITHIN 2m OF THE LAKEBED SEDIMENT ELEVATION.
8) MATERIAL PLACEMENT ANGLES FOR THE CORE BACKFILL AND COARSE FILTER ARE APPROXIMATE. DOWNSTREAM CORE BACKFILL SLOPE WAS MONITORED TO ENSURE THE 2m LIMIT (SEE NOTE 7) WAS ACHIEVED.
9) ALONG PORTIONS OF THE ALIGNMENT, LATERAL PLACEMENT OF CORE BACKFILL ON THE DOWNSTREAM SIDE OF THE EXCAVATION WAS REQUIRED IN ADVANCE OF THE PROGRESSIVE BACKFILLING OF CORE BACKFILL AND COARSE FILTER/FINE ROCKFILL. THE ENGINEER DETERMINED WHERE LATERAL PLACEMENT WAS REQUIRED.
10) IN PARTIAL CUTOFF WALL SECTIONS, WHERE DEPTH OF SOIL LEFT IN PLACE IS LESS THAN 4m BELOW BASE OF INITIAL EXCAVATION THEN DIMENSION IS 7.0m OTHERWISE 9.0m. IN CHANNEL 1 DIMENSIONS WAS APPROXIMATELY 7m.
11) BASE WIDTH OF EXCAVATION ON UPSTREAM SIDE OF CENTRELINE WAS INCREASED LOCALLY TO 6m TO ACCOMMODATE CORNER CONSTRUCTION OF CUTOFF WALL.
12) IN PARTIAL CUTOFF SECTIONS THE INITIAL EXCAVATION WAS EXCAVATED UNTIL COMPETENT SOILS ENCOUNTERED, AND CUTOFF TRENCH EXTENDED GENERALLY 1.0m INTO COMPETENT MATERIAL BELOW INITIAL TRENCH EXCAVATION. AS APPROVED BY ENGINEER.

LEGEND

INFERRED BEDROCK
COARSE FILTER
CORE BACKFILL
ROCKFILL SURFACING AND THERMAL CAP
ROCKFILL
FINE ROCKFILL
SOIL BENTONITE (SB)
CEMENT SOIL BENTONITE (CSB)

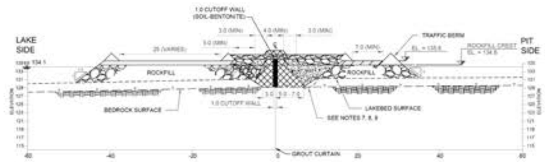
SCALE: A

AGNICO EAGLE
MEADOWBANK

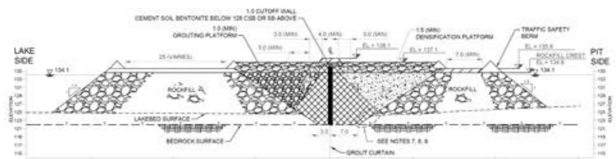
AGNICO EAGLE MINES
MEADOWBANK DIVISION

BAYGOOSE DIKE
TYPICAL SECTION

FIGURE 9



A TYPICAL SECTION - BEDROCK ELEVATION ABOVE 128.0



B TYPICAL SECTION - BEDROCK ELEVATION BELOW 128.0

3.2.2 Bay-Goose Dike – Instrumentation

Instrumentation was installed prior to dewatering to monitor the performance of the dike and dike foundation during dewatering and throughout the operational life of the structure.

Instrumentation provides information on the performance of the structure and its foundation and allows comparison with predictions of performance made during the design studies for deformation, seepage and thermal behaviour. Instrumentation may also provide early warnings regarding the development of unexpected pore water pressure responses to dewatering, pit blasting, increasing seepage and increasing deformation.

Several types of instruments have been installed to collect the required information, including the following:

- Single vibrating wire piezometers located downstream of the cutoff wall;
- Arrays of vibrating wire piezometers, installed at various levels, upstream, immediately downstream of the cutoff wall and further downstream;
- Thermistor strings installed through the centreline of the cutoff wall;
- Inclinometers installed through the centreline of the cutoff wall; and
- Survey monuments along the centreline of the cutoff wall.

Table 3.2 summarizes existing instrumentation. The instrumentation locations are shown in plan and section on Figure 6 and Figure 8, respectively.

Table 3.2 Existing Instrumentation Summary

Instrumentation Type	Station Location	Label / Identification	Offset from Centreline (+ is d/s – is u/s)	Elevation (masl)	Details
Vibrating Wire Piezometer Array	30+158	1P1-A	14.43	116.41	1P1 Top of steel casing: El. 137.04 m
		1P1-B	14.43	121.41	
		1P1-C	14.43	127.41	
		1P2-A	1.97	117.05	1P2 Top of steel casing: El. 136.88 m
		1P2-B	1.97	122.05	
		1P2-C	1.97	128.05	
		1P3-A	1.94	117.13	1P3 Top of steel casing: El. 136.53 m
		1P3-B	1.94	122.13	
Vibrating Wire Piezometer Array	30+276.5	2P1-A	14.4	119.25	2P1 Top of steel casing: El. 136.99 m
		2P1-B	14.4	124.25	
		2P1-C	14.4	130.25	
		2P2-A	2.1	119.10	2P2 Top of steel casing: El. 137.52 m
		2P2-B	2.1	124.10	
		2P2-C	2.1	130.10	
		2P3-A	1.93	119.70	2P3 Top of steel casing: El. 137.18 m
		2P3-B	1.93	124.70	
Vibrating Wire Piezometer Array	30+378.5	3P1-A	14.42	113.12	3P1 Top of steel casing: El. 137.24 m
		3P1-B	14.42	118.12	
		3P1-C	14.42	124.12	
		3P2-A	2.03	113.10	3P2 Top of steel casing: El. 138.01 m
		3P2-B	2.03	118.10	
		3P2-C	2.03	124.10	
		3P3-A	2.01	113.58	3P3 Top of steel casing: El. 138.01 m
		3P3-B	2.01	118.58	
Vibrating Wire Piezometer Array	30+453.5	4P1-A	14.44	116.61	4P1 Top of steel casing: El. 137.14 m
		4P1-B	14.44	118.61	
		4P1-C	14.44	124.61	
		4P2-A	2.03	115.13	4P2 Top of steel casing: El. 137.40 m
		4P2-B	2.03	120.13	
		4P2-C	2.03	126.13	
		4P3-A	1.98	115.25	4P3 Top of steel casing: El. 137.68 m
		4P3-B	1.98	120.25	
Vibrating Wire Piezometer Array	30+645.5	5P1-A	14.58	118.00	5P1 Top of steel casing: El. 137.04 m
		5P1-B	14.58	123.00	
		5P1-C	14.58	129.00	
		5P2-A	1.97	117.85	5P2 Top of steel casing: El. 137.03 m
		5P2-B	1.97	122.85	
		5P2-C	1.97	128.85	
		5P3-A	2.09	115.15	5P3 Top of steel casing: El. 137.05 m
		5P3-B	2.09	122.60	
Vibrating Wire Piezometer Array	31+165	23P1-A	14.51	118.49	23P1 Top of steel casing: El. 137.62 m
		23P1-B	14.51	123.49	
		23P1-C	14.51	129.49	
		23P2-A	2.15	116.91	23P2 Top of steel casing: El. 137.86 m
		23P2-B	2.15	121.91	
		23P2-C	2.15	127.91	
		23P3-A	1.92	116.96	23P3 Top of steel casing: El. 136.59 m
		23P3-B	1.92	121.96	

Instrumentation Type	Station Location	Label / Identification	Offset from Centreline (+ is d/s – is u/s)	Elevation (masl)	Details
Vibrating Wire Piezometer Array	31+600	24P1-A1	14.50	111.30	24P1 Top of steel casing: El. 137.45 m
		24P1-A2	14.50	116.30	
		24P1-B1	14.50	121.80	
		24P1-B2	14.50	124.30	
		24P2-A1	2.10	110.15	24P1 Top of steel casing: El. 137.83 m
		24P2-A2	2.10	116.15	
		24P2-B1	2.10	120.65	
		24P2-B2	2.10	123.15	
		24P2-C	2.10	124.65	
		24P3-A1	2.20	110.64	24P3 Top of steel casing: El. 136.72 m
		24P3-A2	2.20	115.64	
		24P3-B1	2.20	121.16	
		24P3-B2	2.20	123.64	
Vibrating Wire Piezometer Array	31+815	25P1-A1	14.26	117.02	25P1 Top of steel casing: El. 137.45 m
		25P1-A2	14.26	122.02	
		25P1-B1	14.26	127.52	
		25P1-B2	14.26	129.52	
		25P2-A1	1.80	113.82	25P1 Top of steel casing: El. 137.77 m
		25P2-A2	1.80	118.82	
		25P2-B1	1.80	124.32	
		25P2-B2	1.80	126.32	
		25P2-C	1.80	127.32	
		25P3-A1	2.13	115.10	25P3 Top of steel casing: El. 138.16 m
		25P3-A2	2.13	120.10	
		25P3-B1	2.13	123.10	
		25P3-B2	2.13	125.10	
Vibrating Wire Piezometer Array	31+885	26P1-A1	14.44	104.44	26P1 Top of steel casing: El. 137.27 m
		26P1-A2	14.44	109.44	
		26P1-B1	14.44	114.94	
		26P1-B2	14.44	117.94	
		26P2-A1	1.85	106.77	26P1 Top of steel casing: El. 137.93 m
		26P2-A2	1.85	111.77	
		26P2-B1	1.85	117.27	
		26P2-B2	1.85	120.27	
		26P2-C	1.85	123.27	
		26P3-A1	2.10	105.00	26P3A Top of steel casing: El. 136.41 m
		26P3-A2	2.10	111.36	
		26P3-B1	2.10	117.46	26P3B Top of steel casing: El. 137.93 m
		26P3-B2	2.10	119.86	

Instrumentation Type	Station Location	Label / Identification	Offset from Centreline (+ is d/s – is u/s)	Elevation (masl)	Details
Vibrating Wire Piezometer Array	32+000	27P1-A1	14.45	113.25	27P1 Top of steel casing: El. 137.58 m
		27P1-A2	14.45	118.25	
		27P1-B1	14.45	123.75	
		27P1-B2	14.45	125.75	
		27P2-A1	2.03	112.61	27P1 Top of steel casing: El. 137.64 m
		27P2-A2	2.03	117.61	
		27P2-B1	2.03	123.11	
		27P2-B2	2.03	125.11	
		27P2-C	2.03	126.61	
		27P3-A1	1.91	111.72	27P3 Top of steel casing: El. 137.71 m
		27P3-A2	1.91	116.72	
		27P3-B1	1.91	122.22	
		27P3-B2	1.91	124.22	
Vibrating Wire Piezometer Array	32+065	28P1-A1	14.40	102.99	28P1 Top of steel casing: El. 136.41 m
		28P1-A2	14.40	107.99	
		28P1-B1	14.40	112.99	
		28P1-B2	14.40	115.99	
		28P2-A1	1.90	105.02	28P1 Top of steel casing: El. 138.13 m
		28P2-A2	1.90	110.02	
		28P2-B1	1.90	115.02	
		28P2-B2	1.90	118.02	
		28P2-C	1.90	124.02	
		28P3-A1	1.86	105.91	28P3 Top of steel casing: El. 137.89 m
		28P3-A2	1.86	110.91	
		28P3-B1	1.86	115.91	
		28P3-B2	1.86	118.91	
Vibrating Wire Piezometer Array	32+105	29P1-A1	14.44	115.32	29P1 Top of steel casing: El. 136.69 m
		29P1-A2	14.44	120.32	
		29P1-B1	14.44	125.32	
		29P1-B2	14.44	127.32	
		29P2-A1	2.01	114.99	29P1 Top of steel casing: El. 136.62 m
		29P2-A2	2.01	119.99	
		29P2-B1	2.01	124.99	
		29P2-B2	2.01	126.99	
		29P2-C	2.01	129.99	
		29P3-A1	2.04	115.91	29P3 Top of steel casing: El. 136.80 m
		29P3-A2	2.04	120.91	
		29P3-B1	2.04	125.91	
		29P3-B2	2.04	127.91	

Instrumentation Type	Station Location	Label / Identification	Offset from Centreline (+ is d/s – is u/s)	Elevation (masl)	Details
Vibrating Wire Piezometer Individual	30+167	6P2	1.98	127.57	6P2 Top of steel casing: El. 136.86 m
	30+249.5	7P2	2.02	129.85	7P2 Top of steel casing: El. 137.80 m
	30+306.5	8P2	1.98	129.65	8P2 Top of steel casing: El. 137.50 m
	30+440	9P2	1.98	126.73	9P2 Top of steel casing: El. 137.43 m
	30+516.5	10P2	2.00	130.26	10P2 Top of steel casing: El. 137.16 m
	30+684.5	11P2	2.04	130.65	11P2 Top of steel casing: El. 137.15 m
	30+770	12P2	2.1	132.16	12P2 Top of steel casing: El. 137.09 m
	30+804.5	13P2	1.95	132.05	13P2 Top of steel casing: El. 137.19 m
	31+052	14P2	2.04	131.06	14P2 Top of steel casing: El. 137.81 m
	31+220	15P2	2.07	130.73	15P2 Top of steel casing: El. 137.01 m
	31+565	16P2	2.10	131.28	16P2 Top of steel casing: El. 137.65 m
	31+615	17P2	2.10	129.40	17P2 Top of steel casing: El. 137.67 m
	31+700	18P2	1.87	130.53	18P2 Top of steel casing: El. 137.59 m
	31+842	22P2	2.01	116.80	22P2 Top of steel casing: El. 137.98 m
	31+928	19P2	1.99	123.22	19P2 Top of steel casing: El. 137.28 m
	31+990	20P2	2.22	122.44	20P2 Top of steel casing: El. 137.70 m
	32+020	21P2	1.93	121.13	21P2 Top of steel casing: El. 137.94 m
Thermistor Strings	30+134	T1	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	30+185	T2	0	135	Beads at Elev. 135, 134, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	30+260	T3	0	130	Beads at Elev. 130, 129.7, 129.4, 129.1, 128.8, 128.5, 128.2, 127.9, 127.6, 127.3, 127, 126.7, 126.4, 126.1, 125.8 and 125.5 masl.

Instrumentation Type	Station Location	Label / Identification	Offset from Centreline (+ is d/s – is u/s)	Elevation (masl)	Details
	30+261.5	T3’	0	136	Beads at Elev. 135.97, 134.97, 133.97, 132.97, 130.97, 128.97, 126.97, 124.97, 122.97, 120.97, 118.97 and 116.97 masl.
	30+272	T4	0	130	Beads at Elev. 130, 129.7, 129.4, 129.1, 128.8, 128.5, 128.2, 127.9, 127.6, 127.3, 127, 126.7, 126.4, 126.1, 125.8 and 125.5 masl.
	30+273.5	T4’	0	136	Beads at Elev. 135.97, 134.97, 133.97, 132.97, 130.97, 128.97, 126.97, 124.97, 122.97, 120.97, 118.97 and 116.97 masl.
	30+288.5	T5	0	130	Beads at Elev. 130, 129.7, 129.4, 129.1, 128.8, 128.5, 128.2, 127.9, 127.6, 127.3, 127, 126.7, 126.4, 126.1, 125.8 and 125.5 masl.
	30+290	T5’	0	136	Beads at Elev. 135.97, 134.97, 133.97, 132.97, 130.97, 128.97, 126.97, 124.97, 122.97, 120.97, 118.97 and 116.97 masl.
	30+330.5	T6	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	30+386	T7	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	30+417.5	T8	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	30+489.5	T9	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.

Instrumentation Type	Station Location	Label / Identification	Offset from Centreline (+ is d/s – is u/s)	Elevation (masl)	Details
	30+553.25	T10	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	30+621.5	T11	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	30+650	T12	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	30+713	T13	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	30+827	T14	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	31+080	T15	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	31+134.5	T16	0	135.08	Beads at Elev. 135.08, 134.08, 133.08, 132.08, 131.08, 130.08, 129.08, 128.08, 127.08, 126.08, 125.08, 123.08, 121.08, 119.08, 117.08 and 115.08 masl.
	31+170	T17	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	31+352	T18	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	31+595	T19	0	135	Beads at Elev. 135, 133.5, 132, 130.5, 129, 127.5, 126, 124.5, 123, 121.5, 120, 118, 116, 114, 111 and 108 masl.

Instrumentation Type	Station Location	Label / Identification	Offset from Centreline (+ is d/s – is u/s)	Elevation (masl)	Details
	31+605	T20	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	31+752.5	T21	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	31+820	T22	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	31+850	T23	0	135	Beads at Elev. 135, 133.5, 132, 130.2, 129, 127.5, 126, 124.5, 123, 121.5, 120, 118, 116, 114, 111 and 108 masl.
	31+880	T24	0	135	Beads at Elev. 135, 133.5, 132, 130.2, 129, 127.5, 126, 124.5, 123, 121.5, 120, 118, 116, 114, 111 and 108 masl.
	31+960	T25	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	31+995	T26	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	32+030	T27	0	135	Beads at Elev. 135, 133.5, 132, 130.2, 129, 127.5, 126, 124.5, 123, 121.5, 120, 118, 116, 114, 111 and 108 masl.
	32+060	T28	0	135	Beads at Elev. 135, 133.5, 132, 130.2, 129, 127.5, 126, 124.5, 123, 121.5, 120, 118, 116, 114, 111 and 108 masl.
	32+100	T29	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
	32+140	T30	0	135	Beads at Elev. 135, 134, 133, 132, 131, 130,

Instrumentation Type	Station Location	Label / Identification	Offset from Centreline (+ is d/s – is u/s)	Elevation (masl)	Details
					129, 128, 127, 126, 125, 123, 121, 119, 117 and 115 masl.
Inclinometer	30+282	1	0	139.8 (collar elevation)	
	30+390	2	0	140.5 (collar elevation)	
	30+640	3	0	139.3 (collar elevation)	
	31+180	4	0	139.5 (collar elevation)	
	31+590	5	0	140.0 (collar elevation)	
	31+815	6	0	139.7 (collar elevation)	
	31+885	7	0	139.3 (collar elevation)	
	32+065	8	0	139.6 (collar elevation)	
Crest survey monuments	30+050	1	0	139.6	
	30+075	2	0	139.5	
	30+100	3	0	139.7	
	30+125	4	0	139.5	
	30+150	5	0	139.4	
	30+175	6	0	139.7	
	30+200	7	0	139.6	
	30+475	8	0	140.3	
	30+500	9	0	140.1	
	30+525	10	0	140.1	
	30+550	11	0	140.0	
	30+575	12	0	139.8	
	30+600	13	0	139.8	
	30+625	14	0	139.6	
	30+650	15	0	139.7	
	30+675	16	0	139.9	
	30+700	17	0	140.1	
	30+725	18	0	140.2	
	30+750	19	0	139.9	

Instrumentation Type	Station Location	Label / Identification	Offset from Centreline (+ is d/s – is u/s)	Elevation (masl)	Details
	30+775	20	0	139.7	
	30+800	21	0	140.0	
	30+825	22	0	139.5	
	30+850	23	0	139.7	
	30+875	24	0	137.0	
	30+900	25	0	139.9	
	30+925	26	0	139.6	
	30+950	27	0	137.0	
	30+975	28	0	139.8	
	31+000	29	0	139.6	
	31+025	30	0	139.6	
	31+050	31	0	139.8	
	31+075	32	0	139.8	
	31+100	33	0	139.8	
	31+125	34	0	139.8	
	31+150	35	0	139.8	
	31+175	36	0	139.7	
	31+200	37	0	139.5	
	31+225	38	0	139.3	
	31+250	39	0	139.4	
	31+275	40	0	139.5	
	31+300	41	0	139.6	
	31+425	42	0	139.4	
	31+450	43	0	139.3	
	31+475	44	0	139.4	
	31+500	45	0	139.6	
	31+525	46	0	139.5	
	31+550	47	0	139.5	
	31+650	48	0	139.6	
	31+675	49	0	139.8	

Instrumentation Type	Station Location	Label / Identification	Offset from Centreline (+ is d/s – is u/s)	Elevation (masl)	Details
	31+700	50	0	139.7	
	31+725	51	0	139.6	
	31+750	52	0	139.6	
	31+775	53	0	139.6	
	32+100	54	0	139.2	
	32+125	55	0	139.9	

3.2.3 Bay-Goose Dike - Seepage Collection System

In 2012, four small seepage areas were identified with a total of 9 seepage channels along the dike. The number of active seepage channels decreases each year, as some channels stop flowing. No turbidity has been observed in the seepage. The total flow coming from these seepages each year has been decreasing. The overall seepage is less than anticipated and is not a concern for now. The area will continue to be monitored to follow the evolution of the seepage in these areas.

Refer to the 2016 Annual Geotechnical Inspection (Golder Associates) for detailed field observations made on the dike. No mitigation measure has been implemented on the dike other than additional geotechnical instrumentation installation and field investigation in certain areas. No seepage collection has been implemented so far as the seepage is not affecting the mine operation or the integrity of the dike. The condition of the dike will continually be monitored and if the condition of the dike is judged to be deteriorating then remediation would be reassessed.

3.2.4 Bay-Goose Dike - Access

Access to the Bay-Goose Dike is from the north and south abutments as shown on Figures 2 and 6. Access to the downstream toe is by foot from the Bay-Goose pit ring road, which is a road that runs around the top circumference of the Bay-Goose pit. The south abutment of the dike is accessible from the main camp, after passing the fuel storage and refuelling station, travelling southward crossing the South Camp Dike. The access road forks, take the access road on the left (east) and continue southward on South Camp Island until reaching the south abutment of the Bay-Goose Dike. The north abutment of the Bay-Goose Dike is accessible from the south abutment of the East Dike.

The Bay-Goose Dike is not intended to be used as a haul road, but merely a structure to dewater the isolated portion and permit open pit mining of the Goose deposit and the southern portion of Portage Pit. Traffic on the dike is restricted to dike and environment personnel only; this measure was taken to protect the dike and the instrumentation.

3.3 SOUTH CAMP DIKE

The South Camp Dike covers a narrow channel within Third Portage Lake and in conjunction with the Bay-Goose Dike isolates the Bay-Goose Basin from Third Portage Lake. No spillways or water diversion works are associated with the South Camp Dike.

The South Camp Dike is located south of the plant site area and is used to connect the mainland to South Camp Island. Figure 2 shows the location of the South Camp Dike. It covers a narrow channel, approximately 60 m in width, where water depths were between 0.5 and 1 m.

The South Camp Dike was primarily constructed between April and June of 2009, prior to ice breakup. During the winter of 2009-2010 additional thermal capping material and rockfill for the haul road was added to the dike. The South Camp Dike has a broad rockfill shell with a bituminous geomembrane liner installed on the upstream side of the shell. The liner was founded on native frozen (permafrost) till material, in a trench approximately 3 to 5 m below the lakebed surface. Compacted granular material mixed with bentonite was placed above the toe of the liner. The haul road is located on the downstream side of the dike.

3.3.1 South Camp Dike – Design and Construction

The South Camp Dike design and as-built drawings are presented within Doc. 802 (Golder 2009a). A plan view and typical section of the as-built dike are shown on Figure 10.

The dike design includes the following components: a rockfill shell, a bituminous geomembrane liner and granular material mixed with bentonite.

3.3.2 South Camp Dike - Instrumentation

Two thermistor strings exist on the upstream side of the South Camp Dike to monitor the thermal behaviour of the foundation soils at the liner key-in trench. Instrumentation is shown in section on Figure 10.

Table 3.3 summarizes existing instrumentation in the South Camp Dike.

Table 3.3 South Camp Dike Existing Instrumentation Summary

Thermistor String	Location		Approx. Offset from Centerline + is d/s; - is u/s	Elevation (masl)	Details
	Northing	Easting			
SD-09-A	7,213,148	638,151	-27 m	133 (1st bead)	Beads at Elev. 133, 132, 131, 130, 129, 128, 127, 126, 124, 122, 120, 118, 116, 114, 112 and 110 masl
SD-10	7,213,142	638,168	-45 m	132.4 (1st bead)	Beads at Elev. 132.4, 131.4, 130.4, 129.4, 128.4, 127.4, 126.4, 125.4, 123.4, 121.4, 119.4, 117.4, 115.4, 113.4, 111.4 and 109.4 masl

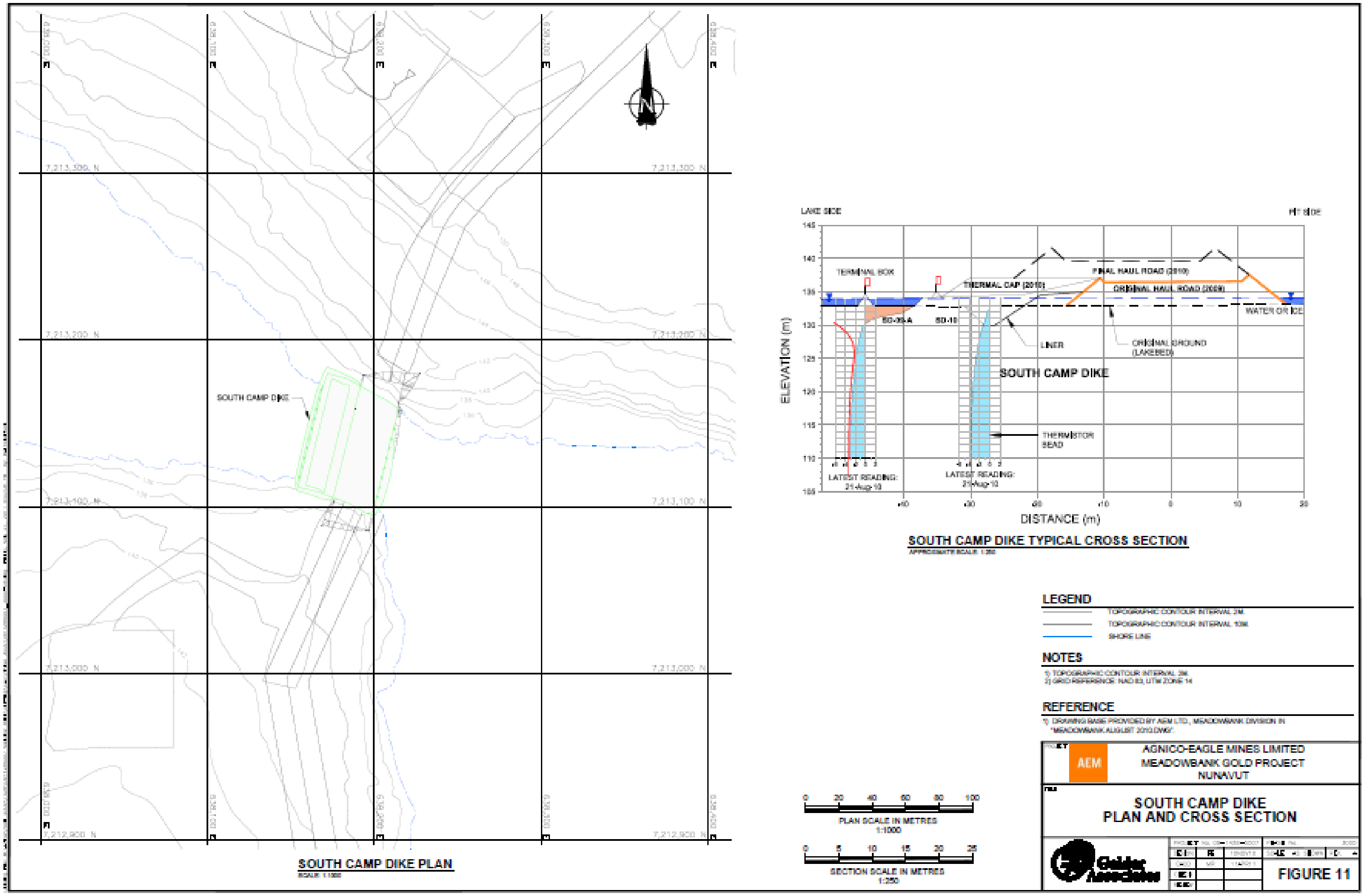
3.3.3 Seepage Collection System

As of summer 2016 no seepage through the South Camp Dike has been discovered. Seepage through the dike will be visually monitored if discovered. Seepage and runoff from the South Camp Dike will be collected in ditches along the downstream toe and directed to topographic lows if required based on the visual monitoring.

3.3.4 South Camp Dike - Access

Access to the South Camp Dike is from the north and south abutments as shown on Figures 2 and 10. The South Camp Dike connects the mainland to South Camp Island.

Figure 9 Plan, cross section and profile of South Camp Dike



3.4 VAULT DIKE

The construction of the Vault Dike at Meadowbank was conducted from February 2013 to March 2013. Vault Dike is located across a shallow creek which connects Wally Lake and Vault Lake, at the Vault Pit area approximately 8 km north of the main Meadowbank site. Vault Dike is essential to allow the dewatering of Vault Lake and to isolate Vault Pit during mining activities from Wally Lake.

Vault Dike is designed and constructed as a zoned rockfill dam with filter zones, an impervious upstream liner consisting of a bituminous membrane, and an upstream key trench made of aggregate mixed with bentonite. The filter zones minimize seepage and internal erosion and facilitate seepage collection. Vault Dike includes a key trench at the base of the upstream side filled with a 0-25 mm fill amended with bentonite surrounding the liner. Coarse and fine filter material was placed on the upstream slope as geomembrane bedding. The bulk part of the dike consists of coarse rockfill material. The embankment crest is at El. 142.4 m and the upstream toe is at approximately El. 139.4 m. The downstream toe is at approximately El. 139.6 m and the bottom of the key trench ranges from El. 135.6m to El. 142.3m, with an average height of El. 137.0m. The upstream and downstream fill slopes of the dam are 1.5H:1V.

The location of the Vault dike is shown on Figure 2. Dewatering of Vault Lake was completed in the summer of 2014.

3.4.1 Vault Dike – Design and Construction

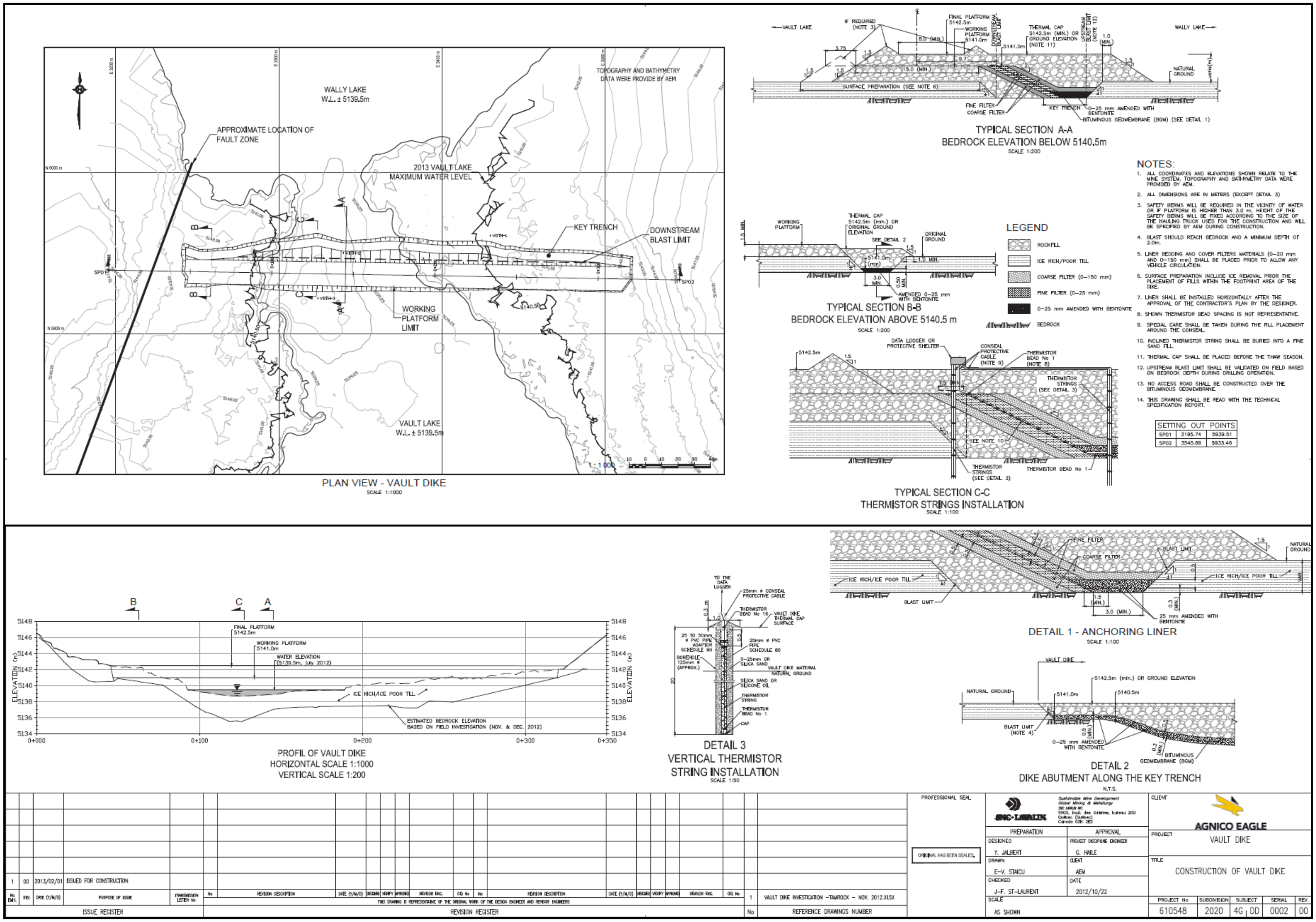
The Vault Dike design is presented in the report "Detailed Engineering of Vault Dike" (SNC, 2013a). A Vault Dike typical section plan view is included in Figure 11. As-built information and as-built drawings of the Vault Dike are provided in Construction Summary Report Vault Dike (AEM, 2013).

Vault Dike is designed and constructed as a zoned rockfill dam with filter zones, an impervious upstream liner consisting of a bituminous membrane, and an upstream key trench made of aggregate mixed with bentonite. The filter zones minimize seepage and internal erosion and facilitate seepage collection.

3.4.2 Vault Dike – Dewatering

Vault Dike is essential to allow the dewatering of Vault Lake and to isolate Vault Pit during mining activities from Wally Lake. The dewatering of Vault Lake started on June 27th, 2013 and was completed in the summer of 2014. The approximate pool volume to be dewatered was 2 Mm^3. The downstream water levels and the upstream water levels needed to be closely monitored during dewatering to preserve the integrity of the dike.

Figure 10 Vault Dike Typical Section



3.4.3 Vault Dike - Instrumentation

Installation of the thermistor strings began on February 26, 2013 and was completed April 14, 2013. Installation of the thermistors was completed by AEM with assistance from the Contractor /TCG and complied with the construction specifications.

TH3 was installed on the downstream side of the dike. TH3 was installed in the deepest channel downstream of the dike. TH5 was installed inclined under the liner on February 26, 2013. TH6, TH7, and TH8 were installed after construction was complete using a Rockmaster drill between April 12, 2013 and April 14, 2013. T6 was installed upstream of the dike in the deepest channel upstream of the liner. TH7 was installed east of the deepest channel in the unthawed till zone found during construction. TH8 was installed upstream of the dike in the deepest channel outside of the key trench. The locations of the five thermistors at Vault Dike are shown on the as-built drawings in plan view in Figure 11 and their details are shown in Table 3-4. The five (5) thermistor strings were installed to monitor Vault Dike and the thermal behaviour of its foundation. At this point, only one critical section has been identified in the deepest section of the dike.

Table 3.4 Vault Dike Existing Instrumentation Summary

Thermistor String	Location		Elevation (masl)	Details
	Northing	Easting		
VD-TH3	5921.97	3324.066	139.5 (1st bead)	Beads at Elev. 139.5, 138.5, 137.5, 136.5, 135.5, 134.5, 133.5, 132.5, 131.5, 130.5, 128.5, 126.5, 124.5, 122.5, 120.5, and 118.5 masl
VD-TH5	5945.52	3322.511	141.4 (1st bead)	Beads at Elev. 141.4, 141.4, 141.4, 141.4, 141.1, 141.0, 140.5, 140.0, 139.5, 139.0, 138.4, 137.9, 137.4, 136.8, 136.4, and 136.1 masl
VD-TH6	5943.00	3322.000	140.5 (1st bead)	Beads at Elev. 140.5, 139.5, 138.5, 137.5, 136.5, 135.5, 134.5, 133.5, 132.5, 131.5, 130.5, 129.5, 127.5, 125.5, 124, and 121.5 masl
VD-TH7	5946.00	3346.00	140.5 (1st bead)	Beads at Elev. 140.5, 139.5, 138.5, 137.5, 136.5, 135.5, 134.5, 133.5, 132.5, 131.5, 129.5, 127.5, 125.5, 123.5, 122.0 and 119.5 masl
VD-TH8	5957.00	3322.00	140.5 (1st bead)	Beads at Elev. 140.5, 139.5, 138.5, 137.5, 136.5, 135.5, 134.5, 133.5, 132.5, 131.5, 129.5, 127.5, 125.5, 123.5, 122.0 and 119.5 masl

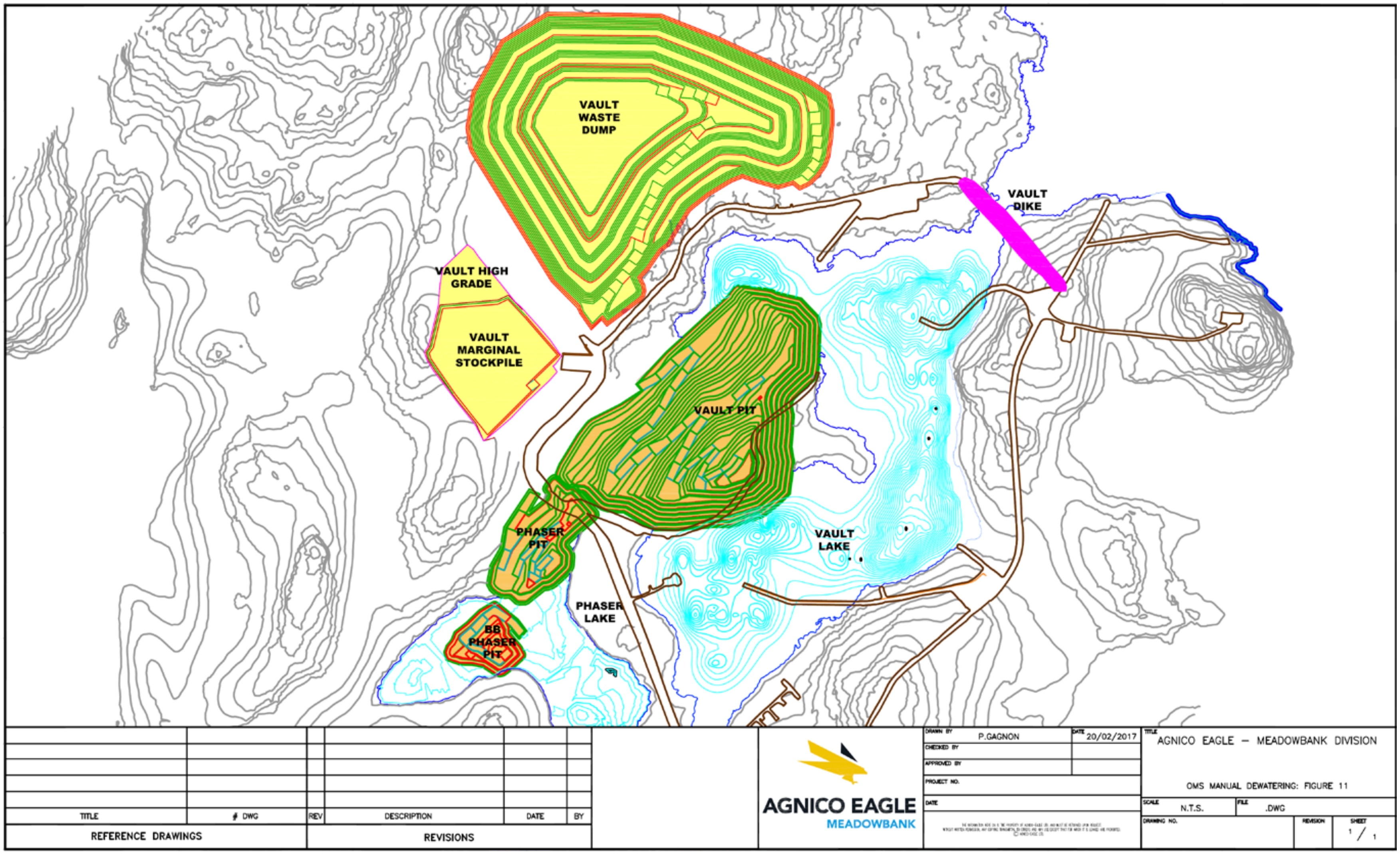
3.4.4 Vault Dike - Seepage Collection System

As of summer 2016 no seepage through the Vault Dike has been discovered. Seepage through the dike will be visually monitored if discovered. Seepage and runoff from the Vault Dike will be collected in ditches along the downstream toe and directed to topographic lows if required based on the visual monitoring.

3.4.5 Vault Dike - Access

Two access roads were constructed to the dike footprint – one from Vault Dike Road West and from Vault Dike Road East. Figure 12 presents a map of the general Vault Pit area with the access roads. Vault Dike Road West begins where Vault Road ends at the Vault Waste Dump, runs northeast to pass Dewatering Road A and ends at the northwest end of the dike (Station 0+000). Vault Dike Road East begins at Vault Road between the Tower Pad and the Office Pad, runs northeast to pass Dewatering Road B and Dewatering Road C and ends at the southeast end of the dike (Station 0+350).

Figure 11: General Vault Pit area with the access roads



SECTION 4 • DEWATERING

The Dewatering Dikes isolate the open pit mining activities from the Second Portage Lake, Third Portage Lake, and Wally Lake. The northwest arm of Second Portage Lake was dewatered upon completion of the East Dike and West Channel Dike in 2009.

The Bay-Goose Dike together with the South Camp Dike isolates the Bay-Goose Basin from Third Portage Lake. Dewatering of the Bay-Goose Basin commenced on July 25, 2011 and was completed on November 14 2011. As the operational stage of Goose Pit has started, both dikes are no longer under dewatering conditions. The approximate pool volume dewatered is in the order of 3 Mm^3. This is referring to the amount of water removed to expose the majority of the downstream toe of the Bay-Goose Dike.

Vault Dike isolates Vault Pit from Wally Lake. Dewatering of Vault Lake started on June 27th, 2013 and was completed during the summer of 2014. The approximate pool volume to be dewatered was in the order of 2 Mm^3.

All of the dewatering dikes are now in the operation phase as dewatering is complete. The following outlines the key criteria and constraints that will need to be observed and followed in accordance with the design objectives, concepts, and assumptions for the Dewatering Dikes.

4.1 FREEBOARD

The design criteria for minimum freeboard for the Dewatering Dikes are presented in Table 4.1. The freeboard may change due to fluctuations in Second Portage and Third Portage Lakes or due to settlement in the dikes. Maintenance may be required to restore loss of freeboard due to settlement.

Table 4.1 Design Minimum Freeboard

Structure	Minimum Freeboard	
	Rockfill Structure (Dike Crest) (m)	**Low Permeability Element (Cutoff Wall or Liner) (m)**
East Dike	3.0	1.0
Bay-Goose Dike	4.0	1.0
South Camp Dike	3.0	1.0
Vault Dike	3.0	1.5

4.2 WATER MANAGEMENT AND QUALITY

Dewatering water from the Vault Lake Basin was pumped and directly discharged to Wally Lake thru a diffusor, or processed through the Water Treatment Plant (WTP) to reduce Total Suspended Solids (TSS). The Nunavut Water Board Water License (No. 2AM-MEA0815) states that the TSS maximum monthly mean value should not exceed 15.0 mg/L and that the short term maximum level is 22.5

mg/L and turbidity maximum monthly mean value should not exceed 15 NTU and the short term maximum level is 30 NTU. The Vault Lake discharge is also considered as an effluent under the Metal Mining Effluent Regulations (MMER) and must meet the criteria of this regulation for arsenic, copper, cyanide, lead, nickel, zinc, TSS and toxicity of trout and daphnia. Under the MMER regulation, the TSS maximum monthly mean value should not exceed 15.0 mg/L and maximum concentration in a grab sample is 30.0 mg/L. In the first stage of the Vault Lake dewatering the WTP was not required because the regulation criteria limit was reached. However, the WTP was used during the latter stages when TSS from bottom sediments was present.

4.3 SURVEILLANCE AND MONITORING REQUIREMENTS

Surveillance and monitoring requirements are defined in Sections 7 and 8 of this manual.

Pore water pressures in the foundation shall be monitored during dewatering as a predictor of possible slope instability. Both pore water pressures and temperature measurements shall be monitored during dewatering as one method of detecting potential zones of seepage. The quantity of water pumped out during dewatering was monitored with flow meters in addition to monitoring the water level downstream of the Vault Dike, within the Vault Lake Basin.

4.4 SAFETY AND SECURITY

Access to the mine site is controlled by AEM security and public access to the area is restricted.

SECTION 5 • OPERATIONS

The following outlines the key criteria and constraints that will need to be observed and followed to operate the dewatering dikes in accordance with the design objectives, concepts and assumptions.

5.1 FREEBOARD

The design criteria for minimum freeboard for the Dewatering Dikes are presented in Table 5-1. The freeboard may change due to fluctuations in lake levels or due to settlement of the dikes. Maintenance may be required to restore loss of freeboard due to settlement.

Table 5.1 Freeboard

Structure	Freeboard	
	To the Dike Crest (m)	To the Dike Cut-off Wall or Liner (m)
East Dike	3.0	1.0
Bay-Goose Dike	4.0	1.0
South Camp Dike	3.0	1.0
Vault Dike	3.0	1.5

5.2 WATER MANAGEMENT

Water from the seepage collection systems of the Dewatering Dikes is to be pumped to the pit sumps and/or directly to the Tailings Storage Facility or Attenuation Pond. Seepage rates may increase with time as the pits are developed downstream of the dikes. As described in Sections 7 and 8 of the document, seepage rates, volumes and the condition of the seepage water (i.e. turbidity, temperature, etc.) are to be monitored.

Table 5.2 summarizes design criteria for the seepage and runoff flow into the seepage collection sumps. The quantity of seepage through the dike is an estimate based on design analyses and should be periodically reviewed during dewatering and operations.

Table 5.2 Sump Design Criteria

Criteria **Type of Storage**	**Description** **Temporary**
Required Storage Capacity	Seepage from the foundation and embankment plus Average daily 10 year freshet volume
Foundation and Embankment Seepage	Design rate: 300 m^3 /day prior to Portage Pit development (East Dike). However, seepage rates in 2009 to 2014 have been between 860 to 1300 m^3/day and 2015 to 2016 between 490-600 m^3/day. Design rate: 700 m^3 /day prior to Goose Island Pit development (Bay-Goose Dike)
Average daily 10 year freshet	Average daily 10 yr snowmelt over 14 day melt period
Design Pump Capacity	Sufficient to pump: Foundation and Embankment Seepage plus 10-year annual snow melt in 14 days

Regular monitoring of the seepage volume is required. Sumps size and pump capacity is to be regularly reviewed and upgrades made if deemed necessary by AEM.

5.3 WATER QUALITY

Water quality of the seepage and runoff collected in the sumps and ditches at the toe of the Dewatering Dikes is to be monitored during operations. Daily inspections during dewatering and weekly inspections during operation are required as an indicator of dike performance to note whether seepage water is clear, cloudy or if fine material is present.

SECTION 6 • MAINTENANCE PROCEDURES

Maintenance is important for the safe operation of the Dewatering Dikes. The Engineering Superintendent is responsible for proper and timely maintenance of the Dewatering Dikes embankments, instrumentation, seepage collection system and access.

6.1 PLANNED AND UN-PLANNED MAINTENANCE

Maintenance is divided into planned and un-planned maintenance. Planned maintenance will be scheduled according to manufacturer's requirements for instrumentation and equipment such as pumps. Planned maintenance may be routine, preventative and/or routine inspection observations including low risk / consequence observations.

Un-planned maintenance shall generally derive from routine inspection observations including medium-high risk / consequence observations and / or extreme events including extreme meteorological events, seismic events, etc. where the maintenance requirement is critical and is required immediately.

All planned and un-planned maintenance will be documented in a database organized and maintained by AEM Maintenance Department.

6.2 EMBANKMENT EROSION

Erosion of the rockfill embankments is not expected during dewatering or operations. In the event that the upstream face is eroded by wave action or ice scouring then any gullies or depressions that develop are to be filled in with rockfill material and re-sloped.

6.3 SEEPAGE COLLECTION SYSTEM

Seepage is expected to exit the downstream toe of the Dewatering Dikes, in particular at low points along the alignment of the structure. Seepage should be monitored and ditches and sumps maintained to avoid erosion and deterioration of the seepage collection system. Sediments, snow and ice may accumulate in the ditches and sumps during operation. The ditches and sumps will require ongoing cleaning and maintenance as needed.

Pumps located at the seepage collection system sumps will require maintenance based on the manufacturer's specifications. Pump installations are to be winterized to provide year round capacity for pumping, if necessary.

Heat tracing of the pipelines will require maintenance. It is expected that the feeder pipelines to the main pipelines are sloped sufficiently to drain the pipes and not permit ice or sediment accumulation, but this should be confirmed in the field.

6.4 INSTRUMENTATION

All cables, thermistors, inclinometers, piezometers, and survey/displacement monuments must be adequately protected with barriers, signs, and flagging to prevent accidental damage. The instrumentation installed in the Dewatering Dikes is to remain operational until closure of the facility.

Instrumentation will require regular maintenance based on manufacturer's specification. The slope inclinometer casing will require either frequent bailing or filling with a solution of non-toxic antifreeze to prevent freezing and icing.

Calibration sheets and initial instrumentation readings will be included upon replacement of malfunctioning instrumentation; the OMS Manual will be updated accordingly.

6.5 ACCESS

Access roads to the Dewatering Dikes along the crest of the dikes need to be maintained. Access will also be maintained along the seepage collection system and to the sumps at the toe of the East Dike and Bay-Goose Dike. Maintenance activities for access will be conducted.

SECTION 7 • SURVEILLANCE

A program of regular surveillance is required to ensure that the Dewatering Dikes, instrumentation and seepage collection systems are performing adequately and that problems are detected so that the necessary corrective actions can be implemented in a timely manner.

7.1 SURVEILLANCE REQUIREMENTS

Surveillance is required for early detection of possible failure mechanisms. In 1995, the International Commission on Large Dams (ICOLD) released a study summarizing failure mechanisms for world-wide water retaining dam incidents during the 1800s and 1900s. The potential failure mechanisms applicable to the Dewatering Dikes, primarily East Dike and Bay-Goose Dike, based on the ICOLD study are summarized in Table 7-1.

Table 7.1 Summary of Consequences and Proposed Monitoring/Action for Rare Events Based on Water Retaining Embankment Failure Modes Identified in ICOLD (1998)

Failure Mode	Scenario	Consequence	Monitoring/Action
Overtopping	(1) Lake level rise because of restricted outflow e.g. Second Portage outlet (excessive inflow is a far less likely scenario).	Water spilling over the crest. The crest is wide and comprises coarse rockfill. Adequate freeboard is provided by the rockfill crest elevation being 3 m above the lake level and the low permeability element 2 m above. Any rise in lake level is anticipated to be less than the freeboard. Significant damage to the dike is unlikely, based on performance of other rockfill structures subjected to overtopping or flow through events. Mining operations might need to be suspended, but there will be considerable warning time given the design freeboard and the storage volume within the lakes.	Outflow channels should be inspected weekly during the thaw and ice break-up. If overtopping is likely, a temporary spillway could be constructed and armoured to control and localize flow at shallow dike sections (e.g. abutment). Lake level to be monitored on a regular basis.
	(2) Dam crest settles more than 2 m over a distance of approximately 50 m. Not a credible failure mechanism. Observed settlement of the East Dike and Bay-Goose Dike crest during construction was on the order of 0.3 m to 0.5 m. Additional settlement is expected to be smaller in magnitude.	Same as (1).	The situation envisaged in this scenario should develop slowly with crest settlement evident. Monitoring of crest settlement is appropriate, and is included in the surveillance program. Rockfill and till are available from the mining operation can be placed to raise the dike crest, if settlement occurs.

Failure Mode	Scenario	Consequence	Monitoring/Action
Internal Erosion	(3) Dike Section: the low permeability element of the dikes Cutoff wall, jet grout columns, shallow foundation is defective, allowing high water flow through the structure. This defect could potentially erode zones of the dike and lead to loss of material from the dam (piping) increase the seepage, sinkholes in the crest.	The East Dike cutoff wall could progressively loose material, thereby increasing the hydraulic conductivity and resulting in an increased rate/volume of seepage through the dike and development of sinkholes in the dam crest. This is not likely to be a catastrophic failure mode as the rockfill shoulders of the dike will be stable and the filters are founded on or near bedrock. At its worst, this would lead to temporary flooding within the open pit of the mine and a cessation of mining. The Bay-Goose Dike cutoff wall system although similar to East Dike, has potential to lose more material from the dike structure, through piping as in the “deep sections” where jet grouting was conducted, downstream filter material does not extend to bedrock and a higher hydraulic head exists. Internal erosion could lead to increased seepage, sinkhole development, settlement of the crest, and although not probable, loss of containment.	Monitor seepage from downstream face for rate and volume, and for presence of sediment in seepage. Would become evident as localized intensive seepage at the dike toe or beyond. May also see settlement in the cutoff wall or dike crest. Will be most likely in deep water sections with higher gradients. Monitor piezometric and thermistor data for signs of increased flow through the cutoff wall and change in piezometric pressures. Selection of a remediation plan would be based on conditions encountered, but could include the installation of a downstream filter blanket and grouting.
	(4) Foundation: Till is non-uniform with more transmissive zones and zones of erodible material (i.e. silt layers) that may not be self-filtering. It is possible that material loss of the foundation tills and/or through the fractured bedrock with silt infillings could occur and result in high rates of seepage and a loss. Seepage could flow along the transmissive zone beneath the downstream rockfill section and erode the foundation tills at the downstream toe or into the downstream rockfill because of the lack of filtering.	Limited seepage at the toe or into the rockfill would accelerate into a larger flow and could lead to the undermining of the dike if no action was taken. This is a credible catastrophic failure mode if increased seepage is not detected in time.	Monitor seepage flow rates and condition and piezometric and thermistor responses for signs of increased seepage. Monitor dike crest for signs of sinkholes, settlement or slope instability. Remedial actions could comprise of grouting, a reverse filter and rockfill buttress depending on location of the flow and configuration of the foundation. In the worst case, the dewatered areas may be deliberately flooded in a controlled manner, the cutoff repaired, and the areas dewatered.
Seepage within Embankment	(5) Seepage on its own is not a credible failure scenario. The downstream rockfill shell has extremely high flow through capacity. The rockfill zone is both	No credible consequences. May require upgrade of the seepage collection system. May need to suspend mining activities while reducing seepage.	Seepage monitoring program.

Failure Mode	Scenario	Consequence	Monitoring/Action
	large and pervious, so that seepage will not daylight on the downstream face and lead to instability. Any seepage related failures must include internal erosion, see above.		
Seepage within Foundation	(6) Defective construction of cutoff system leading to transfer of unexpectedly high fraction of the reservoir head into the downstream part of the dike foundation, or leading to a piping event as described above (internal erosion).	This failure mechanism has caused embankment failures elsewhere because of pore pressure induced instability. However, at East Dike it is unlikely that it could cause failure of this dike. However, for Bay-Goose Dike this is more of a possibility. The most likely consequence is downstream toe slumping requiring a localized stabilizing berm before the crest roadway could be reinstated.	This mechanism is more likely to arise during dewatering. Monitoring of piezometric heads and thermistor string data.
Internal Conduit Rupture	(7) There are no internal conduits or other structures extending through the dikes.	Not applicable.	Not applicable.
Slope Instability	(8) Normal Operation: The rockfill shoulders of the dikes have high shear strength, making it a conservative design. For slope failure to be a concern, it requires failure in the foundation which would then extend into the overlying dike. Sliding failure is considered unlikely given the low horizontal forces generated by water and ice forces relative to the normal frictional force due to the weight of the dike and the friction angles of foundation materials.	A foundation failure would cause a rotational slip or sliding failure until equilibrium was reached. This mechanism would limit access along the dike until repaired. Failure through the rockfill shoulders will not necessarily compromise the water retaining element of the dikes. Failures which reach the core may cause failure.	This mechanism should develop during construction or dewatering, due to increased loads and associated pore water pressure. Initial stages of failure should be observable as tension cracks in the dike crest. Walk-over inspection of the dike by a trained inspector is an appropriate monitoring strategy. Survey of crest, face, and toe is also appropriate. Stabilizing berms can be placed inside the dike or through water along the upstream shoulder.
	(9) Pit Wall instability that extends towards the dike and causes instability of the dike	If the instability impacted the low permeability element of the dike, then failure of the entire structure and loss of mining operations could occur. This is more likely to be a cause of failure for the Bay-Goose Dike as the offset between the low permeability element and pit crest is much	Slope inclinometer monitoring of the cutoff wall. Pit wall stability monitoring. Depressurization of pit walls. Draining of lakebed soils between pit crest and dike and/or removal of these materials.

Failure Mode	Scenario	Consequence	Monitoring/Action
		less than for East Dike.	Adjustment of mine plan, if necessary.
	(10) Earthquake Induced: Occurrence of an extreme earthquake, much in excess of the current understanding of seismicity of the area.	The extreme earthquake loading for this site is a low magnitude. Settlement of the dike could occur in the event of a large earthquake. Dynamic compaction of the core in the East Dike and Bay-Goose Dike during construction may have subjected the rockfill shells to accelerations equivalent to the expected earthquake loading. This would not be a failure situation. The crest is also erosion resistant for any earthquake induced wave action in the impounded water.	Dike inspection following earthquakes felt on site.
Failure of Cutoff Wall Due to Movement of the Dike	(11) Differential horizontal movement of dike due to water or ice loading, or pit wall failure, or blast vibrations. Creates a breach in the cutoff wall system. Ice and water forces are not credible due to the ratio of frictional forces generated by the self weight of the dike versus ice loads and water pressure. Pit wall failure (see above).	Large inflows through the breach. Dewatered areas would flood requiring suspension of mining activities. Potential for loss of life for workers downstream of the dikes. Excessive vibration from overblasting could potentially damage the CSB and/or jet grout columns resulting in cracks or fissure, however the cement content within these portions of the wall should reduce the erodability of the wall and therefore protect the integrity of the dike, even though seepage rates would increase. It is anticipated that the SB material would deform adequately such that cracks would not be produced.	Prism monitoring for pit wall stability. Blast vibration monitoring on the dikes. Monitoring inclinometers within the cutoff wall.
Unexpected Settlements	(12) Unexpected foundation soils consolidate during dike construction. A significant quantity of clay that was not recognized during foundation excavation would be required to generate settlement required for a water release event. Settlement of the core will be limited.	2 m of settlement would be required to allow water flow through the rockfill and over the settled core. This flow would not cause failure of the rockfill shells. It would also be readily repaired by placing more end-dumped till into the settled zone.	Settlement monitoring of the dikes and visual inspection. Excessive settlements may be remediated by excavating rockfill above the core and placing more till.

Table 7-1 to be updated as necessary during operation

7.2 SURVEILLANCE PROTOCOLS

The surveillance program consists of several types of inspections:

During Dewatering:

- Daily Dewatering Inspection – carried out on an on-going basis by designated qualified mine personnel to assess the performance of the dikes during dewatering. Reporting can be daily if routine, or immediately if conditions warrant;
- Weekly Dewatering Inspection – carried out by designated qualified mine personnel, to assess the performance of the dikes during dewatering with reporting occurring weekly or immediately if conditions warrant; and
- Design Engineer Inspection – upon exposure of the downstream toe to view seepage and review the performance of the dike.

During Operations:

- Weekly Routine Inspection – carried out weekly by designated qualified mine personnel to assess operating of the seepage collection systems including the sumps and performance of the structures;
- Monthly Routine Inspection – carried out monthly by a designated qualified mine personnel to assess operating status of the seepage collection systems including the sumps, and performance of the structures;
- Engineering Inspection – carried out annually by a qualified engineer, during open water period, to verify that the facilities are functioning as intended; and
- Dam Safety Review – carried out by an a dike review board of independent engineers every year to review all aspects of the design, construction, operation, maintenance, processes and other systems affecting the dam's safety, including the dam safety management system. The review defines and encompasses all components of the "dam system" under evaluation including the dam, foundations, abutments and seepage collection works.

7.3 RESPONSIBILITIES AND FREQUENCY

It is anticipated that the Engineering Superintendent and support personnel and/or the Environment Superintendent and support personnel and/or Mine Superintendent and support personnel will be responsible for the inspections of the Dewatering Dikes, seepage collection systems, instrumentation and access routes during dewatering and operation. The inspections by the Design Engineer and for the Dam Safety Review will be conducted by qualified independent engineers. The inspection, monitoring and review requirements are summarized in Table 7-2 and described in the following sections.

Table 7.2 Inspection, Monitoring and Review Requirements

Party Responsible	Required Inspection, Review or Monitoring	Required Frequency
Design Engineer	Dewatering Inspection	During dewatering once downstream toe is exposed
Engineering Superintendent and Geotechnical Coordinator/ Geotechnical Engineer/Specialist and/or support personnel; Environment Superintendent and/or support personnel;	Daily Dewatering Inspection	Daily and immediately following earthquakes, high intensity rainfall events and other extreme events
	Daily and Weekly Routine Inspection of Dewatering Dikes, seepage collection system, and access.	Weekly and immediately following blasting, large blasts occurring in close proximity to the structures, earthquakes, high intensity rainfall events and other extreme events
	Monitoring of instrumentation (thermistor strings, vibrating wire piezometers, inclinometers, survey prisms and monuments, pump rates, lake water levels)	Varies – see Section 8.0
Engineering Superintendent and/or Geotechnical Engineer/Specialist and/or designated qualified personnel	Weekly Dewatering Inspection	Weekly and immediately following earthquakes, high intensity rainfall events and other extreme events
	Monthly Routine Inspection of Dewatering Dikes, seepage collection system, and access.	Monthly and immediately following large blasts occurring in close proximity to the dikes, earthquakes, high intensity rainfall events and other extreme events
Qualified Engineer	Engineering inspection of the Dewatering Dikes, drainage works, access and instrumentation.	Annually
Independent Engineer	Dam Safety Review	Annually

7.3.1 Dewatering Inspections (Daily and Weekly)

Inspections during dewatering form part of the duties and responsibilities of the Engineering Superintendent, Geotechnical Engineer/Specialist and/or support personnel and the Environment Superintendent and/or support personnel must be carried out by designated and qualified personnel. It is assumed that daily Inspections may be conducted by less knowledgeable staff and weekly inspections by more knowledgeable staff.

Ideally the inspections should be carried out by the same individual or by a small group in order to maintain continuity in the observations. The main operational and structural parameters should be reviewed and verified by the Engineering Superintendent, Geotechnical Engineer/Specialist and Environment Superintendent. Data collected will be summarized on the respective Dewatering Dike Field Inspection Sheets and stored for easy access and long term record keeping.

The following information should be noted and recorded in the inspection to detect signs of wear, damage or potential loss of structural integrity:

Dike Structure:

- compliance with minimum freeboard requirements:
- crest elevation;
- upstream water elevation; and
- downstream water elevation.

Crest:

- surface cracking; and
- local subsidence.

Upstream face conditions above water line:

- cracking;
- distortion or displacement;
- wave erosion; and
- slope angle.

Downstream face conditions:

- cracking;
- distortion or displacement;
- slumping;
- erosion;
- slope angle;
- seepage quantity and quality (turbidity); and
- wet areas.

Area downstream of dike toe:

- Seepage quantity and quality (turbidity);
- cracking;

- erosion;
- bulging; and
- indications of instability.

Abutments:

- indications of instability;
- erosion at dike – ground surface contact; and
- seepage appearing from abutments.

Barges, Dewatering ramps, and pumps:

- pumping rates and dewatering rate;
- water quality being pumped in regards to turbidity;
- conditions of the holding cables and location of the barge in the dewatering pool;
- presence of ice on the barge due to leaks; and
- general condition of the pumps and the presence of leaks (pumps or piping).

The inspection forms are included in Appendix A.

Photographs should be used to augment the inspection forms. As much as possible, these should be taken from the same vantage points during each inspection so that changes in conditions can be readily identified. Photographs shall be captioned or annotated with a date stamp.

The observations and/or events indicating a trend that are considered “triggers” requiring reference to action items and reporting procedures are outlined in the Emergency Preparedness Plan in Section 11. A summary of triggers for the dewatering inspection are:

- Increasing measurements in total suspended solids at dewatering pump intake or outlet;
- Decrease in the rate of dewatering, when not attributed to a decrease in the pumped volume;
- Instrumentation responses indicating seepage; and
- Increasing measurements in dike displacement such as crest heave/settlement or lateral movements.

7.3.2 Daily and Weekly Routine Inspections

Daily and Weekly Routine Inspections are part of the duties and responsibilities of the Engineering Superintendent, Geotechnical Engineer/Specialist and/or their support personnel and the Environment Superintendent and/or support personnel and must only be carried out by designated and qualified personnel. Ideally the inspections should be carried out by the same individual or small group in order to maintain continuity in the observations. The main operational and structural parameters should be reviewed and verified by the Engineering Superintendent, Principal Geotechnical Engineer/Specialist and the Environment Superintendent.

Daily Routine Inspections are carried out by the geotechnical technicians as they perform their data readings and other daily duties on the dewatering dikes. Technicians are trained to watch for changes in the condition of the dewatering dikes, and report anything out of the ordinary to the geotechnical engineers/Specialists so it can be investigated further. Technicians look for any signs of damage to the dikes and monitor seepage conditions daily. Data collected during the Daily Routine Inspections will be summarized on the respective Dewatering Dike Field Inspection Sheets (see Appendix A), and stored in a suitable location for easy accessibility and long-term record keeping.

Weekly Routine Inspections are carried out by the geotechnical engineers and are more detailed than the Daily Routine Inspections. A Weekly Routine Inspection will also occur if a Daily Routine Inspection discovers anything that needs to be investigated further.

The following information should be noted and recorded in the weekly inspection forms to detect signs of wear, damage, or potential loss of structural integrity:

<u>Dike Structure:</u>

- Compliance with minimum freeboard requirements:
- crest elevation; and
- upstream water elevation.

<u>Crest:</u>

- Any indication of cracking or settlement/subsidence;
- Upstream face conditions:
- surface cracking;
- distortion or displacement; and
- wave erosion.

<u>Downstream face conditions:</u>

- cracking;

- distortion or displacement;
- slumping;
- erosion; and
- seepage quantity and quality (turbidity) and wet areas.

<u>Abutments:</u>

- indications of instability;
- erosion at dike – ground surface contact; and
- seepage appearing from abutments (quantity and quality).

<u>Downstream toe of dike:</u>

- seepage quantity and quality (turbidity);
- changes on surface;
- cracking;
- erosion;
- bulging;
- soft wet zones;
- accumulation of fines/silts; and
- ice.

<u>Ditches / Seepage Collection System:</u>

- changes in surface;
- indication of cracking;
- erosion;
- bulging;
- soft wet zones;
- accumulation of fines/silts; and

- ice blockage.

<u>Sumps:</u>

- changes in surface;
- indication of cracking;
- erosion;
- bulging;
- soft wet zones;
- accumulation of fines/silts; and
- ice blockage.

<u>Pumping structures and pipelines:</u>

- leaks; and
- function at capacity.

<u>Seepage:</u>

- rates and location;
- water quality, specifically the presence of fines (turbidity); and
- access.

<u>Other:</u>

- Review of general condition of the access to the Dewatering Dikes, along the Dewatering Dikes crest surface and access to seepage collection system, including sumps and pumping system at the downstream toe;
- Indications of instability (e.g. potholes, slumping or cracks, in the road or path or the cut slopes above them); and
- Accumulations of debris or other materials on the road or paths.

Sample inspection forms are included in Appendix A.

Photographs shall be used to augment the inspection form. As much as possible, these are to be taken from the same vantage points during each inspection so that changes in conditions can be readily identified. Photos should be annotated or captioned and should include a date stamp.

The observations and/or events indicating a trend that are considered “triggers” requiring reference to action items and reporting procedures are outlined in the Emergency Preparedness Plan (see Section 11).

7.3.3 Monthly Routine Inspections

Monthly Routine Inspections form part of the duties and responsibilities of the Engineering Superintendent and Geotechnical Engineer/Specialist and must only be carried out by designated and qualified personnel. It is assumed that Monthly Routine Inspections will be carried out by more experienced personnel then the Daily/Weekly Routine Inspections. Ideally the monthly inspections should be carried out by the same individual in order to maintain continuity in the observations. The main operational and structural parameters should be reviewed and verified by the Engineering Superintendent, Geotechnical Engineer/Specialist and the Environment Superintendent. Data collected will be summarized on the respective Dewatering Dike Field Inspection Sheet, and stored for easy accessibility and long term record keeping.

The monthly inspection will require the inspector review the same items as in the weekly inspections described above, with the following additional items:

- Review and comment on results of performance monitoring instrumentation; and
- Review operational performance and confirm that the original design assumptions are still valid.

7.3.4 Engineering Inspection

An annual inspection of each of the Dewatering Dikes should be carried out by a qualified engineer. During this inspection, the following dewatering structures will be visited:

- BayGoose Dike;
- East Dike;
- South Camp Dike; and
- Vault dike.

The objective of the inspection is to carry out a detailed review of the conditions of the facilities and facility operations. This will provide information to be used to revise the operation, maintenance and surveillance programs as necessary and to assist in planning for future operation of the facility.

Each inspection should address the following:

- Review of inspections performed during dewatering;
- Review and comment on results of weekly and monthly inspection reports;
- Review and comment on results of performance monitoring instrumentation;

- Review operational performance criteria and confirm that the original design assumptions are still valid; and
- Review and provide recommendations regarding operation, maintenance and monitoring for the following year.

7.3.5 Dam Safety Review

A dike review board of independent engineers should carry out a dam safety review of the Dewatering Dikes and associated facilities annually or after:

- Major modifications to the design or design criteria;
- Discovery of unusual conditions that can endanger the dikes;
- After extreme hydrological or seismic events; and
- Decommissioning.

The high consequence failure rating based on the Dam Safety Guidelines (CDA, 2007) suggests a review every seven years. Instead, AEM - Meadowbank committed to annual review. The review shall be carried out according to the recommendations laid out in the Dam Safety Guidelines (CDA, 2007).

This review will include, but is not be limited to:

- Review of the dikes classification;
- Site inspection;
- Review of design and construction records;
- Review of monitoring practices and the instrumentation records
- Update of the stability assessment based on the results of the instrumentation readings obtained to that time, construction records and site observations;
- Assessment of the operation of the facilities;

SECTION 8 • MONITORING AND INSTRUMENTATION

Monitoring of the Dewatering Dikes is carried out for the purpose of:

- Environmental monitoring during dewatering and operation;
- Assessing physical stability of the structure during dewatering and operation;
- Assessing overall performance of the dikes; and
- Aiding in design of future dikes.

Monitoring complements the Surveillance of the Dewatering Dikes and should be taken into account in combination with the routine surveillance described in Section 7.0.

Monitoring is divided into the following aspects:

- Drawdown rate and water quality during dewatering;
- Geotechnical instrumentation including piezometers, thermistors, inclinometers, survey prisms, etc.; and
- Seepage rates and water quality during operation.

8.1 DEWATERING – DRAWDOWN RATE AND WATER QUALITY

The water quality criteria for discharge are listed in Nunavut Water Board Water License 2AM-MEA0815 Part D, item 16 and into the Metal Mining Effluent Regulation. The water quality data collection protocols and schedule are included in the Water Management Plan.

8.2 GEOTECHNICAL MONITORING

The existing geotechnical instrumentation is shown in the as-built drawings for each dewatering dike.

Section 3.0 of this document describes the existing geotechnical instrumentation of the Dewatering Dikes.

8.2.1 Data Collection Protocols and Schedule

Upstream and downstream elevations of Second Portage Lake and Third Portage Lake water and ice levels, if applicable, should always be recorded when piezometer readings are recorded and when the survey prisms and monuments are monitored.

The following sections describe the routine geotechnical monitoring program of permanent instrumentation and are summarized in Table 8.1 below.

Table 8.1 Geotechnical Instrumentation Monitoring Program

Instrumentation	Monitored By	Reported To	Frequency during Dewatering	Frequency during Operations
Piezometers	Manually by Engineering Personnel during dewatering; and Automatically during operations (overseen by Engineering Personnel)	Engineering Superintendent	Daily / every 3 hours	Daily / every 3 hours
Slope Inclinometer Casings	Manually by Engineering Personnel during dewatering; and Manually during operations (overseen by Engineering Personnel)	Engineering Superintendent	Monthly	Monthly in winter, bi-monthly for the rest of the year
Thermistors	Manually by Engineering Personnel during dewatering; and Automatically and Manualy during operations (overseen by Engineering Personnel)	Engineering Superintendent	Automatically: Daily / every 3 hours. Manually: Every 3 days in Summer & Weekly in Winter	Automatically: Daily / every 3 hours. Manually: Every 3 days in Summer & Weekly in Winter
Surface Monuments and Surface Prisms	Manually by Engineering Personnel during dewatering; and Manually during operations (overseen by Engineering Personnel)	Engineering Superintendent	Not Operational	Bi-Weekly
Seismographs	Manually by Engineering Personnel during dewatering; and Manually during operations (overseen by Engineering Personnel)	Engineering Superintendent	During blasting at the Portage Pit or Goose Island Pit adjacent to the dikes	During blasting at the Portage Pit or Goose Island Pit adjacent to the dikes

The frequency of monitoring will depend, to some degree, on preceding data and on the state of operation. Thus the data is reviewed regularly and the Engineering Superintendent may change the program and amend the OMS Manual as necessary.

Measurements and a review of all instrumentation shall be carried out immediately after significant seismic or climatic events.

An automatic data acquisition system is used to collect data from the piezometers and thermistors. The automatic data acquisition system includes data loggers and instrumentation cabins along the dikes crest. The data collected is downloaded every three hours. Each cabin is supplied with electricity through solar panels and a backup battery.

The equipment for monitoring is maintained by designated mine personnel. Data analysis, review and correction are carried out by the Engineering personnel and reported to the Engineering Superintendent.

8.2.1.1 Thermistors

Data presentation for the thermistors should include:

- temperature vs. time plots (presenting all thermistor beads on each string); and
- temperature vs. depth plots over time.

The plots should indicate the thermistor string reference number and dates of the measurements. Additionally the plots should also indicate air temperature and, if relevant, lithology and both elevations and depths.

8.2.1.2 Survey Monuments and Prisms

The lake elevation is recorded at the same time the survey monuments and prisms are measured. All survey work must be carried out to a minimum precision of 3 mm.

Data presentation for the survey monuments should include:

- total net movement plots (to present total displacement);
- vertical displacement plots; and
- lateral displacement plots parallel and perpendicular to the dike axis.

The plots should indicate the survey monument number, what is considered positive and negative movement (for example, downstream/upstream, heave/settlement) and the dates of the measurements.

8.2.1.3 Slope Inclinometer Casings

The vertical and horizontal position of the top of the inclinometer casing will be recorded by surveying when the slope inclinometers readings are taken. All survey work must be carried out to a minimum precision of 3 mm.

Data presentation for the slope inclinometers should include:

- cumulative displacement plots (to view total displacement);
- incremental displacement plots (to present increasing or accelerating movements between readings);
- cumulative displacement at crest versus time; and

- time plots at zones of identified displacement.

The plots should indicate the slope inclinometer number, what is considered positive and negative movement (for example, downstream/upstream, heave/settlement) and the dates of the measurements. Both elevations and depths should be presented together with the lithology.

8.2.1.4 Vibrating Wire Piezometers

Data presentation for the vibrating wire piezometers should include:

- plots of total head as elevation versus time; and

- plots of temperature versus time for piezometers.

The plots should indicate the vibrating wire piezometers number and dates of the measurements. Additionally the plots should also indicate upstream lake elevation or ice level and, if relevant, lithology and both elevations (referred to the mine datum) and depths.

8.2.1.5 Seismographs

Data presentation for the seismographs should include:

- Weekly summary graph showing peak accelerations registered versus the time when they occurred.

The plots should also indicate the seismograph readout identification, date and location.

8.2.2 Anomalous Instrumentation Data

Anomalous instrumentation data includes the following:

<u>Thermistors:</u>

- Increase or decrease in measurements (over two or more readings) that cannot be explained by seasonal temperature variations;

<u>Survey monuments and prisms:</u>

- Accelerating displacement rate of the survey monuments

  (x, y, z directions) (over two or more readings);

<u>Inclinometers:</u>

- Cumulative increases in displacement (greater than 3 cm);

<u>Piezometers:</u>

- Increases or decreases in pore water pressure measurements that cannot be explained by seasonal lake level variations; and

<u>Seismographs:</u>

- Vibrations during a blast are not observed.

If anomalous readings are observed, the following actions should be taken:

- Inspect the dike where possible and appropriate;
- Check data, reductions and calculations for accuracy and correctness;
- Re-read to check the reading;
- Check readout equipment to verify that it is functioning correctly;
- Verify calibration;
- If instrument has stopped functioning, notify the Engineering Superintendent immediately. If considered critical, a replacement instrument should be installed;
- If the anomalous reading is confirmed, a detailed review of the effects of the reading should be carried out and design or remedial actions should be implemented if determined necessary by the Engineering Superintendent; and
- Increase monitoring frequency to assess progression of anomaly.

8.3 SEEPAGE MONITORING - OPERATIONS

Seepage and runoff will be collected and conveyed in drainage ditches at the downstream toe of the East Dike and Bay-Goose Dike to sumps located at topographic lows. The rate of seepage and quality of seepage should be monitored during operations.

8.3.1 Data Collection Protocols and Schedule

The rate of seepage and run-off will be monitored indirectly by monitoring and recording pumping rates. The seepage location and elevation along the face should be noted during inspections. The water quality should be monitored daily by visual observations for sediments (turbidity). Visual inspection should document sediment, ice or snow deposits in the ditches and sumps. The data shall be collected by designated mine personnel and reviewed by the Engineering Superintendent. The Engineering Superintendent may change the sampling frequency and amend the OMS Manual as necessary.

8.3.2 Anomalous Measurements

Anomalous measurements of the seepage may occur and include the following:

- Increase or decrease in pump rates that are inconsistent with rainfall or runoff events;
- Sediments present in the seepage water; and
- Changes in seepage location, flow, and quality.

If anomalous readings are observed, the following action should be taken:

- Inspect the seepage collection area;
- Check data, reductions, and calculations for accuracy and correctness;
- Re-read to check the reading;
- Check readout equipment to verify that it is functioning correctly;
- Verify calibration;
- If instrument has stopped functioning, notify the Engineering Superintendent immediately. If considered critical, a replacement instrument should be installed;
- If the anomalous reading is confirmed, a detailed review of the effects of the increased seepage should be carried out and design or remedial actions should be implemented if determined necessary by the Engineering Superintendent; and
- Increase monitoring frequency to assess progression of anomaly.

SECTION 9 • REPORTING PROCEDURES AND DATA MANAGEMENT

9.1 REPORTING PROTOCOLS

9.1.1 Inspection Documents

All inspection documents and reviews shall be reported to the Mine Management, Engineering Superintendent and the Environment Superintendent.

9.1.2 Instrumentation Measurements

All geotechnical instrumentation measurements shall be reported to the Engineering Superintendent. Pumping rates during dewatering and operation shall be reported to the Geotechnical Coordinator and the Engineering Superintendent.

9.1.3 Emergencies

All documents regarding instrumentation and inspections prior to an emergency and during an emergency shall be provided to all parties involved including the General Mine Manager, Engineering Superintendent, Environment Superintendent, and Design Engineer.

9.2 DATA MANAGEMENT

An electronic library or database, which is easily accessible, shall be set up to catalogue and store inspection documents, maintenance reports and instrumentation measurements. Hard copies shall also be catalogued and stored on site. The following will be stored in the hard copy and/or electronic format:

<u>Dewatering:</u>

- Daily dewatering inspection report; and
- Instrumentation measurements.

<u>Operations:</u>

- Daily routine operating and structural inspection;
- Monthly routine operating and structural inspection;
- Engineering inspection;
- Dam Safety Review;
- Planned and un-planned maintenance reports; and

- Instrumentation measurements.

SECTION 10 • DECOMMISSIONING

10.1 GENERAL

The decommissioning of the dikes will take place progressively as the Dewatering Dikes are breached and the northwest arm of Second Portage Lake and Bay-Goose Basin are allowed to flood.

The main objectives of the decommissioning are:

- Maintain dike stability;
- Meeting applicable water quality objectives;
- Sequential pit flooding in a controlled manner; and
- Maintain 1 m head difference across the East Dike at closure.

10.2 EAST DIKE EMBANKMENTS

The East Dike will remain intact during the controlled flooding of the Portage Pit and Goose Island Pit areas in order to isolate flooded pit waters from Second Portage Lake. The pit areas are flooded gradually over the course of several years. Once the water levels have stabilized within the flooded pit and water quality is considered acceptable for mixing with neighbouring lakes, parts of the other dewatering dikes will be decommissioned to allow circulation of pit water and lake water.

The East Dike will remain, preserving the 1 m difference in elevation between Third Portage Lake and Second Portage Lake.

10.3 SEEPAGE COLLECTION SYSTEM

The sumps and ditches at the downstream toe of the Dewatering Dikes will be flooded at closure. All pumps, pipes, and equipment shall be removed prior to flooding.

10.4 INSTRUMENTATION AND MONITORING

Long-term inspection shall be carried out to ensure the adequate performance of the post-closure facility.

SECTION 11 • EMERGENCY PREPAREDNESS PLAN

The Dam Safety Guidelines prepared by the Canadian Dam Association (2007) states that "A dam which does not impose an unacceptable risk to people or property, and which meets safety criteria that are acceptable to the government, the engineering profession and the public is a safe dam".

This guiding principle has been taken into account for the design of the dewatering dike embankments and the emergency procedures.

The East Dike and Bay-Goose Dike are rated as "High Consequence of Failure" (CDA 2007) as discussed in Section 1.3. The South Camp Dike and Vault Dike are rated as a "Significant Consequence of Failure" (CDA 2007) as discussed in Section 1.3.

To respond to possible hazards and emergencies involving the dewatering dikes, emergency response plans have been designed. This section provides a summary of the actions, triggers and measures in the event of an emergency.

In case of an emergency, the documents listed in Table 12.1 shall be referenced. The Emergency Response Plan (ERP) shall also be referenced. The Dike Failure Scenario Appendices from the ERP are included in Appendix B.

11.1 EMERGENCY PROCEDURES

The purpose of the Emergency Preparedness Plan (EPP) is to present a basic procedure for responding to potential failure mechanisms. The procedure identifies various measurable or observable effects or causes of the failure mechanisms and identifies the appropriate people to notify. Potential failure mechanisms are summarized in Table 12.2 with potential measurable and observable causes and effects.

11.1.1 Operation

Table 12.3, 12.4, 12.5 and 12.6 summarizes the triggers for implementing the EPP for each of the dewatering dikes with respect to the potential measurable and observable effects or causes of the various failure mechanisms.

Table 12.7 indicates the chain of communication to follow so persons in charge are notified for different states of emergency.

Table 12.8 indicates the responsibilities of persons for each emergency level in terms of who performs the decision making, mobilization, and action to be taken.

Table 12.9 indicates the names and contact numbers of the persons in charge during an emergency event.

11.2 EMERGENCY DETAILS

In the unlikely event of a catastrophic dike breach that could endanger workers the Code 1 procedure described in Section 11.2.4 would be followed to warn all workers of the situation. Then an evacuation of the affected areas and pits would be carried out and directed by the ERT Team in person and over the emergency channel. In the event of an embankment failure, the following information should be used during the emergency response:

Project Name: Meadowbank Gold Project

Dike Names: East Dike, Bay-Goose Dike, South Camp Dike, Vault Dike

Owner's Name: Agnico Eagle Mines Limited (867) 793-4610

Lake Name: Second Portage Lake /Third Portage Lake /Wally lake

Site Location: Latitude: 65°01'07''N Longitude: 96°04'26''W

11.2.1 Access to the Project Site

- 80 km north of the Hamlet of Baker Lake
- Site accessible by all-weather private road from Baker Lake.
- Site accessible by aircraft and helicopter.

	Name	**Phone Number**
Local Charter Company:	Calm Air International Ltd.	Baker Lake : (867) 793-2873
Local Helicopter Company:	Kitikmeot Helicopters Ltd	(867) 983-2544
Charter Aircraft Company:	Nolinor Aviation	(450) 476-0018

11.2.2 Emergency Assessment and Risk Assessment

In case of an event, emergency assessment will be done first by AEM Geotechnical Engineering personnel and the Engineering Superintendent on site. Assessment will be done according the criteria stated in the Table 12.2 and Table 12.3, 12.4, 12.5, 12.6.

11.2.3 Emergency Communication and Actions

In case of an event, after the emergency assessment, the persons involved in the emergency response team need to be notified following the chain of command stated in Table 12.7. Contact details of each person are available in Table 12.9.

According to the state of the event, decision and action plan will be taken by the persons notified. Action plan will be defined according to the level of emergency and the cause of the event. Immediate action plan will be taken with material and equipment available on site, as listed in Section 11.4.

Table 12.10 is based on Appendix A of the AEM Emergency Response Plan, which describes the risk of failure for East Dike and Bay-Goose Dike and provides contingency or corrective actions for possible failure mechanisms.

Table 12.12 is the risk assessment for East Dike, Bay-Goose Dike, South Camp Dike and Vault Dike. The ratings for the likelihood and consequence of failure have been included for the risk assessment in Table 12.11. The overall risk rating is the product of the likelihood and consequence ratings. The overall risk rating of the structure for the identified failure mechanism can then be determined. The controls which are in place can potentially reduce the overall risk rating.

11.2.4 Site Emergency Procedure

As specified in the Emergency Response Plan, Ver. 11, Section 4:

In the event of an immediate emergency that is or could impact persons or equipment, the employee will have to follow our emergency procedure:

- Emergency is initiated - by calling **6911** on desk type phones, or calling on two-way radio on "**Working Channel" – Code 1 – Code 1 – Code 1.**
- All communication stops except for those involved with the Emergency – i.e.: First Aid Room attendants, Medics, ERT as required.
- All work stops in First Aid Room / Clinic – and in affected area – depending on seriousness of Emergency – the whole site.
- First Aid Room Attendant / Medic will answer the phone and/or radio.

  Note: if the First Aid Room Attendant / Medic do not answer, then Security Guard will answer and/or a Supervisor on radio will answer so that Emergency Response can be initiated.
- **Responder –** will ask where the medic is required.
- **Caller –** will give a brief description of the Emergency – name, location and what is wrong and/or required.
- **Responder –** will confirm location and details of incident and activate the **ERT** team. Security will be notified by responder and a page will be sent out to all **ERT** team members on site. (All **ERT** team members on site now carry pagers).
- The person at the casualty(s) will administer First Aid if trained to do so.
- Incident Commander Center will be immobilized as to ensure that communications, transportation, and effective deployment of **ERT** resources are conducted. It is mandatory that the Official In-Charge be notified immediately.
  - Transportation will be arranged to meet at the **ERT** hall by the two large doors for medical gear and **ERT** team members.

The **ERT** team (minimum of 6 team members) will assemble as quickly as possible. (Expectation – when the pager goes off – all **ERT** team members will make their way expediently to the **ERT** hall).

11.2.5 Communication Equipment Location

Communication equipment can be found at the following locations (*to be updated if required*):

- 3 phone land lines are located in the main office;
- Base station radios are located in the main office;
- Drills will have either base station radios or handhelds—depending on their distance from camp and will have satellite phones available; and
- Emergency Communication Plans (including emergency contact numbers) are located adjacent to all phones and radios and in each drill.

11.3 MEDICAL AND FIRST AID SERVICES

In case of injury the medic and First Aid station are located in the Service Building. The first aid channel on the radio is 1. The nearest hospital is located in Baker Lake.

Health Center:	Baker Lake Health Center	*Phone #:*	(867) 793-2816 (867) 793-2817

11.4 ON SITE EQUIPMENT AND MATERIAL

11.4.1 Pumping Equipment

The following is a list of onsite pumping equipment available for use during an emergency event:

Unit Number	Description	Model
61PWA01	Dewatering pump #1	Godwin model HL250M
61PWA02	Dewatering pump #2	Godwin model HL250M
61PWA03	Dewatering pump #3	Godwin model HL250M
61PWA04	Dewatering pump #4	Godwin model HL250M
61PWA05	Dewatering pump #5	Godwin model HL250M
61PWA06	Dewatering pump #6	Godwin model HL250M
61PWA07	Pit Dewatering pump #7	Godwin model CD80M
61PWA08	Pit Dewatering pump #8	Godwin model CD80M
61PWA09	Dike Dewatering pump #9	Godwin model CD100M
61PWA10	Dike Dewatering pump #10	Godwin model CD103M
61PWA11	Dike Dewatering pump #11	Godwin model CD103M

61PWA12	Dike Dewatering pump #12	Godwin model CD103M
61PWA13	Pit Dewatering pump #13	Godwin model HL5MS
61PWA14	Pit Dewatering pump #14	Godwin model HL5MS
61PWA15	Bay-Goose Seepage dewatering pump #9	Godwin model CD103M
61PWA16	Bay-Goose Seepage dewatering pump #10	Godwin model CD103M
61PWA17	Bay-Goose Seepage dewatering pump #11	Godwin model CD103M
61PWA18	Bay-Goose Seepage dewatering pump #12	Godwin model CD103M

Note: To be updated as required

11.4.2 Mobile Equipment

The following are lists of onsite mobile equipment of AEM and SANA available for use during an emergency event:

EM Mobile Equipment List (to be updated as required)

Unit Number	Description	Unit Number	Description	Unit Number	Description	Unit Number	Description	Unit Number	Description	Unit Number	Description
6151COM11	PNEUMATIC COMPRESSOR (AIR)	61GEN10	CUMMINS GEN SET 6CT, TWIN	61HTR28	HAUL TRUCK 150T CAT 785C	61PCK15	PICK UP F350 (MOB.MNTCE CRANE)	61PCK79	PICK-UP F250 MNTCE SUPERINTEND	61TRK07	WATER DELIVERY TRUCK FORD
61ATV01	HONDA ATV	61GEN13	CATERPILLAR GENSET 200KW D200P	61HTR29	HAUL TRUCK 150T CAT 785D 2011	61PCK16	PICK UP F350 (BLASTER)	61PWA01	DEWATERING PUMP # 1	61TRK08	SEPTIC TRUCK TRUCK FORD
61ATV02	HONDA ATV	61GEN16	CATERPILLAR GENSET 30KW D30-8	61HTR30	HAUL TRUCK 150T CAT 785D 2011	61PCK17	PICK UP F350 WAREHOUSE	61PWA02	DEWATERING PUMP # 2	61TRK11	CEMENT TRUCK MAC - AMARUQ
61ATV03	HONDA ATV	61GEN34	WHITEOUT GENERATOR	61HTR31	HAUL TRUCK 150T CAT 785D	61PCK18	PICK UP F350 (GEOLOGY)	61PWA03	DEWATERING PUMP # 3	61TRK12	1 AXLE SHUNT TRUCK
61ATV04	HONDA ATV	61GEN37	JOHN DEERE MODEL 6081AF001	61HTR32	HAUL TRUCK 150T CAT 785D	61PCK19	PICK UP F250 (MOBILE MNTCE)	61PWA04	DEWATERING PUMP # 4	61TRK13	KENWORTH TRUCK
61ATV05	HONDA ATV	61GEN49	ERT GENERATOR	61HTR33	HAUL TRUCK 150T CAT 785D	61PCK20	PICK UP F250 (ENVIRONMENT)	61PWA05	DEWATERING PUMP # 5	61TRK14	KENWORTH TRUCK
61BAC01	BACKOE TEREX O&K RH40-E	61GEN50	ERT GENERATOR	61HTR34	HAUL TRUCK 150T CAT 785D	61PCK21	PICK UP F250 MINE PIT DEWATER.	61PWA06	DEWATERING PUMP # 6	61TRK15	KENWORTH TRUCK
61BAC02	BACKOE CATERPILLAR 345CL	61GEN51	KUBOTA GENSET #1 - AMARUQ	61LGT01	AMIDA TOWER LIGHT AL5080D	61PCK22	PICK UP F250 (MINE RESUCE)	61PWA07	DEWATERING PUMP # 7	61TRK16	KENWORTH TRUCK
61BAC03	BACKOE CATERPILLAR 307	61GEN52	KUBOTA GENSET #2 - AMARUQ	61LGT02	INGERSOLL RAND L20 TOWER LIGHT	61PCK23	PICK UP F250 (ELECT MILL)	61PWA08	DEWATERING PUMP # 8	61TRK17	KENWORTH TRUCK
61BAC04	BACKOE CATERPILLAR 330D	61GEN53	AMARUK ROAD SHELTER GENSET	61LGT03	INGERSOLL RAND L20 TOWER LIGHT	61PCK24	PICK UP F250 MINE HELP/BIT SHO	61PWA09	DEWATERING PUMP # 9	61TRK18	GARBAGE TRUCK KENWORTH
61BAC05	BACKOE CATERPILLAR 345DQ	61GRA01	MOTOR GRADER 16H CAT	61LGT04	INGERSOLL RAND L20 TOWER LIGHT	61PCK25	PICK UP F250 MINE HELP/BIT SHO	61PWA10	DEWATERING PUMP # 10	61TRK19	FIRE TRUCK
61BAC06	BACKOE CATERPILLAR 385C	61GRA02	MOTOR GRADER 160H CAT	61LGT05	INGERSOLL RAND L20 TOWER LIGHT	61PCK26	PICK UP F250 (SITE SERV FIELD)	61PWA11	DEWATERING PUMP # 11	61TRK21	FUEL TRUCK
61BAC07	BACKOE CATERPILLAR 345DL	61GRA03	MOTOR GRADER 16M CAT	61LGT06	INGERSOLL RAND L20 TOWER LIGHT	61PCK27	PICK UP F250 (SITE SERVICE)	61PWA12	DEWATERING PUMP # 12	61TRK22	SNOW PLOW WITH WING&SANDER
61BAC08	BACKOE PC1250 KOMATSU	61GRA04	MOTOR GRADER 16M CAT	61LGT07	INGERSOLL RAND L20 TOWER LIGHT	61PCK28	PICK UP F250 (DYKE SUPER.)	61PWA13	DEWATERING PUMP # 13	61TRK23	SNOW PLOW WITH WING&SANDER
61BAC09	BACKOE 390DL CATERPILLAR	61GRA05	CATERPILLAR GRADER 16M	61LGT08	LIGHT TOWER GEOLOGY	61PCK29	PICK UP F250 MINE.SUP.AUX.EQUI	61PWA14	DEWATERING PUMP # 14	61TRK24	STEAMER TRUCK
61BAC10	BACKOE TEREX O&K RH120-E	61HEA01	FROST FIGHTER IDF-350	61LGT09	WACKER TOWER LIGHT LTC4	61PCK30	PICK UP F250 DIKES /DEWATERING	61PWA15	DEWATERING PUMP # 15	61TRK28	INTERNATIONAL TIRE TRUCK
61BAC11	BACKOE BUCYRUS RH120-E	61HEA02	ALLMAND HEATER MH-1000 MNTCE	61LGT11	WACKER TOWER LIGHT LTC4	61PCK31	PICK UP F250 (MILL)	61PWA16	DEWATERING PUMP #16	61TRK30	LUBE TRUCK
61BAC12	BACKOE TEREX O&K RH120-E	61HEA03	ALLMAND HEATER MH-1000 MNTCE	61LGT12	WACKER TOWER LIGHT LTC4	61PCK32	PICK UP F250 (ELECT. DEPT.)	61PWA17	DEWATERING PUMP #17	61TRK31	MECHANICAL SERVICE TRUCK
61BAC13	BACKOE CAT6030	61HEA05	LANAIR WASTE OIL BURNER MX 300	61LGT13	INGERSOLL RAND L20 TOWER LIGHT	61PCK33	PICK UP F250 (ENGINEERING)	61PWA18	ENVIRONMENT EMERGENCY PUMP	61TRK32	GMC AIR PLANE FUEL TANKER
61BUC06	BUCKET CAT6030	61HEA08	FROST FIGHTER IDF-350	61LGT14	LGT WACKER LTC4L	61PCK34	PICK UP F250 SECURITY ON SITE	61PWA19	150HP ELECTRICAL PUMP	61TRK33	CAT LUBE TRUCK T300
61BUS01	BUS YELLOW BLUE BIRD	61HEA11	FROST FIGHTER IDF-350	61LGT18	AMIDA TOWER LIGHT LT5000-4MH	61PCK35	PICK UP F250 (ROAD CREW)	61RBD01	ROTARY BLAST DRILL 6" ATLAS	61TRK34	STERLING SERVICE TRUCK
61BUS02	MINIBUS BLUE BIRD	61HEA12	FROST FIGHTER IDF-350	61LOA01	LOADER IT14G CAT	61PCK36	PICK UP F250 (ROAD CREW)	61RBD02	ROTARY BLAST DRILL 6" ATLAS	61TRK35	FUEL TRUCK PETERBILT 367
61BUS03	MINIBUS BLUE BIRD	61HEA13	FROST FIGHTER IDF-350	61LOA02	LOADER IT14G CAT	61PCK37	PICK UP F250 (EXPLORATION)	61RBD03	ROTARY BLAST DRILL 6" ATLAS	61TRK36	SNOW PLOW WITH WING&SANDER WHT
61BUS04	BAKER LAKE PASSANGER VAN E350	61HEA14	FROST FIGHTER IDF-350	61LOA03	LOADER 992G CATERPILLAR	61PCK38	PICK UP F250 (EXPLORATION)	61RBD04	ROTARY BLAST DRILL 6" ATLAS	61TRK38	FORD SERVICE TRUCK
61BUS05	BUS RED BLUE BIRD	61HEA15	MILL FROST FIGHTER # 1	61LOA04	LOADER 992G CATERPILLAR	61PCK39	PICK UP E350 AMBULANCE	61RBD05	LONG HOLE DRILL CM785	61TRK39	LUBE TRUCK
61BUS06	BAKER LAKE MINI BUS	61HEA16	MILL FROST FIGHTER # 2	61LOA05	LOADER 420E IT CAT (PEPINE)	61PCK40	PICK UP (IT GREY RENTAL)	61RBD06	DML DRILL 6" ATLAS	61TRK40	CEMENT TRUCK MACK
61BUS07	INTERNATIONAL BUS - AMARUQ	61HEA17	MILL FROST FIGHTER # 3	61LOA06	LOADER 966H CATERPILLAR-AMARUQ	61PCK41	PICK UP F250 (P.A BOSSE)	61RBD07	DML DRILL 6" ATLAS	61TRK41	PUMP TRUCK MACK
61BUS08	BLUE BIRD BUS	61HEA18	MILL FROST FIGHTER # 4	61LOA07	SCRAP-LOADER 966H CATERPILLAR	61PCK42	PICK UP F250 (FIELD TEAM LEAD)	61RBD08	DML DRILL 6" ATLAS	61TRK42	FUEL TRUCK (VAULT)
61BUS09	BUS YELLOW BLUE BIRD	61HEA19	MILL FROST FIGHTER # 5	61LOA08	LOADER TC44H JOHN DEERE	61PCK43	PICK UP F350 (CONSTRUCTION)	61SBL03	SNOWBLOWER T85-R52	61TRK43	WATER TRUCK (VAULT)
61BUS10	USED INTERNATIONAL BUS	61HEA20	FROST FIGHTER IDF-350	61LOA09	LOADER 966H CATERPILLAR	61PCK44	PCK F250 2011 (SUP. BLASTER)	61SCI05	SCISOR LIFT GENIE GS3232	61TRK44	SERVICE TRUCK (VAULT)
61BUS11	BLUE BIRD BUS	61HEA21	FROST FIGHTER IDF-350	61LOA10	LOADER 980H CATERPILLAR	61PCK45	PCK F350 2011 (BLASTER PICK)	61SCI06	GENIE S85	61TRK45	LUBE TRUCK (VAULT)
61BUS12	BLUE BIRD BUS	61HEA22	FROST FIGHTER IDF-350	61LOA11	LOADER 420E CATERPILLAR-AMARUQ	61PCK46	PCK F250 2011 GEOLOGY	61SCI07	MAN LIFT GENIE Z-45/25	61TRK46	FIRE TRUCK
61COM01	DOOSAN MOBILE COMPRESSOR	61HEA24	FROST-FIGHTER IDF-350	61LOA12	LOADER 980H CATERPILLAR	61PCK47	PCK F250 2011 PIT PROD. SUP.	61SCI08	MAN LIFT GENIE Z-45/25	61TRL01	BEDARD TANKER TRAILER
61COM02	MOBILE AIR COMPRESSOR	61HEA26	FROST-FIGHTER IDF-350	61LOA13	WHEEL LOADER 992K CATERPILLAR	61PCK49	PCK F250 2011 DRILL&BLAST SUP	61SCI10	GENIE S85 (OLD 61REN07)	61TRL03	BELLY DUMP TRAILER
61COM03	COMPRESSOR QGD25 QINCY	61HEA27	FROST-FIGHTER IDF-350	61LOA14	TIRE HANDLER LOADER	61PCK50	F-250 BLUE 2011 MINE SERV. SUP	61SCI11	GENIE S85 - AMARUQ	61TRL04	LOW BED TRAILER
61COM04	COMPRESSOR 2545 IR	61HEA28	INGERSOLL RAND	61LOA15	LOADER 980K CATERPILLAR	61PCK51	PCK F250 2012 (S.S FIELD SERV)	61SCI12	GENIE S85	61TRL05	LOW BED TRAILER
61COM05	DOOSAN AIR COMPRESSOR	61HEA33	FROST-FIGHTER IDF-350	61LOA16	LOADER IT14G CATERPILLAR	61PCK52	PCK F450 2011 (WAREHOUSE)	61SCI13	GENIE S125	61TRL06	FUEL TANKER BEDARD 54000L
61COM06	MILL MOBILE COMPRESSOR	61HEA35	FROST-FIGHTER IDF-350	61LOA17	LOADER WA-600 KOMATSU	61PCK53	PICK UP F250 (PROCESS PLANT)	61SCI14	GENIE S125	61TRL07	FUEL TANKER BEDARD
61CPT01	CATERPILLAR COMPACTOR CS76	61HEA36	FROST-FIGHTER IDF-350	61LOA18	LOADER 966H CATERPILLAR	61PCK54	PICK UP F250 (ENGINEERING)	61SCI15	SCISSOR LIFT GENIE 32'	61TRL08	DOUBLE DROP LOW BOY
61CPT02	CATERPILLAR COMPACTOR CS563	61HTR01	HAUL TRUCK 100T CATERPILLAR	61MCR01	CRANE 120T MANITOWOC	61PCK55	PICK UP F250 (SURVEY)	61SCI16	SCISSOR LIFT GENIE 32'	61TRL09	FIRE TRAILER SKID W/ PUMP
61DOZ01	DOZER D8T CATERPILLAR	61HTR02	HAUL TRUCK 100T CATERPILLAR	61MCR02	CRANE 80T TEREX	61PCK56	PICK UP F250 (GEOLOGY)	61SCI17	MAN LIFT JLG 30' MODEL E300AJP	61TRL10	DISPATCH COMM TRAILER
61DOZ02	DOZER D9T CATERPILLAR	61HTR03	HAUL TRUCK 100T CATERPILLAR	61MCR03	CRANE 35T GROVE	61PCK57	PICK UP F250 (ROAD CREW)	61SCI18	MAN LIFT JLG 30' MODEL E300AJP	61TRL11	DISPATCH COMM TRAILER
61DOZ03	DOZER D8R CATERPILLAR	61HTR04	HAUL TRUCK 100T CATERPILLAR	61MCR04	90T LORAINE CRANE	61PCK58	PICK UP F250 - EXPLORATION	61SKD01	SKID STEER 262C CATERPILLAR	61TRL12	DISPATCH COMM TRAILER
61DOZ04	SCRAP - DOZER D7H CATERPILLAR	61HTR05	HAUL TRUCK 100T CATERPILLAR	61MCR05	25T INTERNATIONAL BOOM TRUCK	61PCK59	PICK UP F250 ELEC. SUPERINTEND	61SKD02	SKID STEER 753 CATERPILLAR	61TRL13	DISPATCH COMM TRAILER
61DOZ05	DOZER D9T CATERPILLAR	61HTR06	HAUL TRUCK 100T CATERPILLAR	61MCR06	CRANE 200T AMERICAN	61PCK60	PICK UP F250 (G.F DYKE)	61SKD03	SKID STEER 262C CATERPILLAR	61TRL14	DISPATCH COMM TRAILER
61DOZ06	DOZER D9T CATERPILLAR	61HTR07	HAUL TRUCK 100T CATERPILLAR	61MFT01	MOBILE FUEL TANKER TRAILLER	61PCK61	PICK UP F250 (SITE SERVICE)	61SKD04	SKID STEER 262C CAT	61TRL15	DISPATCH COMM TRAILER
61DOZ07	DOZER D9T CATERPILLAR	61HTR08	HAUL TRUCK 100T CATERPILLAR	61MFT02	MOBILE FUEL TANKER TRUCK	61PCK62	PICK UP F250 (MINE G.F)	61SMD01	MILLER BIG BLUE 400D MOB WELD	61TRL16	DISPATCH COMM TRAILER
61DOZ08	DOZER 834H CATERPILLAR	61HTR09	HAUL TRUCK 50T CATERPILLAR	61MFT03	MOBILE FUEL TANKER TRUCK	61PCK63	PICK UP F250 (A. HAMEL)	61SNC01	SNOWCAT EMERGENCY VEHICULE	61TRL17	DISPATCH COMM TRAILER
61DOZ09	DOZER D6T CATERPILLAR	61HTR10	TOW HAUL 120T	61PCK01	PICK UP F350 (MILL)	61PCK64	FORD EXPEDITION (AIR STRIP)	61SNO01	SNOW MOBILE	61TRL18	DISPATCH COMM TRAILER
61ENG53	BOAT ENGINE HONDA 75 HP	61HTR11	HAUL TRUCK 777F CATERPILLAR	61PCK02	PICK UP F350 (GARBAGE PICK UP)	61PCK65	PICK UP F-350 2008 (WAREHOUSE)	61SNO02	SNOW MOBILE	61TRL19	DISPATCH COMM TRAILER
61FKL02	FORK LIFT HYSTER RH35	61HTR12	HAUL TRUCK 777F CATERPILLAR	61PCK03	PICK UP F350 (MILL MNTCE)	61PCK66	PICK UP F-550 (MOBILE)	61SNO03	SKI DOO SCANDIC	61TRL20	DISPATCH COMM TRAILER
61FKL03	FORK LIFT WAREHOUSE CAT	61HTR13	HAUL TRUCK 777F CATERPILLAR	61PCK04	PICK UP F350 (PROCESS PLANT)	61PCK67	PICK UP F250 TRAINING/ KITCHEN	61TPA01	ZOOM BOOM GENIE GTH844	61TRL21	DISPATCH COMM TRAILER
61FKL04	FORK LIFT ZOOM BOOM RZ2	61HTR14	HAUL TRUCK 777F CATERPILLAR	61PCK05	PICK UP F350 (BLASTER)	61PCK69	PICK UP F250 TRAINING MINE DEP	61TPA02	ZOOM BOOM GENIE GTH844	61TRL22	STEAM-PRESSURE WASH TRAILER
61FKL05	MILL FORK LIFT CAT	61HTR15	WATER TRUCK 773D CATERPILLAR	61PCK06	PICK UP F350 (POWER PLANT)	61PCK70	PICK UP F250 FIELD SITE SERVIC	61TPA03	HYSTER CONTAINER HANDLER	61TRL23	STEAM-PRESSURE WASHER TRAILER
61FKL06	TRUCK SHOP FORKLIFT CAT DP40KL	61HTR20	HAUL TRUCK 150T CATERPILLAR	61PCK07	PICK UP F350 (MINE HELPER)	61PCK71	PICK UP F250 (GEOLOGY)	61TPA04	IR ZOOM BOOM 1056C (OLD REN16)	61TRL24	EXTENSIBLE TRAILER MANAC
61FKL07	RAYMOND LIFT 740DR32IT	61HTR21	HAUL TRUCK 150T CATERPILLAR	61PCK08	PICK UP F350 (MILL MNTCE)	61PCK72	PICK UP F250 (TO REPLACE)	61TPA05	TELEHANDLER VR1056D (OLD REN15	61TRL26	SPLEIPNER
61FKL08	RAYMOND LIFT ETDR40TT	61HTR22	HAUL TRUCK 150T CATERPILLAR	61PCK09	PICK UP F350 (ENGINEERING)	61PCK73	PICK UP F250 - EXPLORATION	61TRK01	KENWORTH WATER TRUCK 4000 GL	61TRL27	MOBILE FUEL TANKER JET-A
61FKL09	TRUCK SHOP FORKLIFT HYSTER	61HTR23	HAUL TRUCK 150T CAT 785D	61PCK10	PICK UP F350 (DEWATERING)	61PCK74	PICK UP F250 (VAULT)	61TRK02	KENWORTH TRUCK	61VSE01	KAWASKI MULE
61FKL10	ZOOM BOOM TL1255C CAT	61HTR24	HAUL TRUCK 150T CAT 785D	61PCK11	PICK UP F350 (SECURITY BAKER)	61PCK75	PICK UP F450 BIT TRUCK (VAULT)	61TRK03	KENWORTH TRUCK	61VSE02	KAWASKI MULE
61FKL11	FORK LIFT R80 CAT	61HTR25	HAUL TRUCK 150T CAT 785D	61PCK12	PICK UP F350 (WAREHOUSE)	61PCK76	PICK UP F250 MTNCE SUPERVISOR	61TRK04	KENWORTH TRUCK	61VSE05	KAWASKI MULE (SITE SERVICES)
61GEN08	CATERPILLAR 3508 GENSET	61HTR26	HAUL TRUCK 150T CAT 785C	61PCK13	MINI-VAN E350 CLUB WAGON (BL)	61PCK77	PICK-UP F250 - EXPLORATION	61TRK05	KENWORTH TRUCK (3AXLE TRACTOR)	61VSE06	KAWASKI MULE
61GEN09	CUMMINS GEN SET 6CT, TWIN	61HTR27	HAUL TRUCK 150T CAT 785C	61PCK14	EXPEDITION XLT MOB.MNTCE SUP.	61PCK78	PICK-UP F250 MINE SUPERINTEND	61TRK06	KENWORTH TRUCK	61VSE08	KUBOTA MULE RTV1100

SANA Mobile Equipment List (to be updated as required)

Dozer	
Cat D8T	438
Cat D8T	443

Excavator	
Cat Bac 345	11-0301
Cat Bac 345	12-0303
Cat Bac 345 DLS	13-0301
Komatsu PC 1250	11-0303
Cat Bac 365 C	12-0305
Komatsu PC 450	16-0304

Loader	
Cat Loader 906	10-0202
Cat Loader 980H	268
Cat Loader 980CR	10-0201
Komatsu Loader WA500	278
Komatsu Loader WA600	11-0201
Komatsu Loader WA600	13-0201

50T Hault Truck	
Cat HTR 773F	1516
Cat HTR 773F	1517
Cat HTR 773F	1518
Cat HTR 773F	1519
Cat HTR 773F	1520
Cat HTR 773F	1535
Cat HTR 773F	1536
Komatsu HD605	16-1001
Komatsu HD605	16-1002
Komatsu HD605	16-1003
Komatsu HD605	16-1004

Heavy Equipment	
Fuel Truck	11-0121
Fardier Mack	1166
Water truck	1231
Water truck	10-0106
Bus Blue Bird	1760
Light truck	1244
White bus	15-0101
Fardier Kenworth	1220
Sableur	1217
Grader 14 M Cat	513

Compacteur	
Compactor Hamm	744
Compactor Cat	11-1101

Light Plant	
Magnum	10-5605
Magnum	11-5602
Magnum	11-5603
Magnum	12-5601
Magnum	12-5602
Magnum	12-5603
Magnum	12-5604
Magnum	12-5605
Magnum	12-5606
Allmand	15-5613
Allmand	15-5615

Drill	
Novamac TCG 03	10-0901
Novamac TCG 04	10-0902
Novamac TCG 05	9928
Tamrock	9932
Tamrock	996

Generator	
Generator	G - 19
Generator	G - 214
Generator	G - 229
Generator	G - 241
Generator	G - 250
Generator	G - 257
Generator	10-5502
Generator	
Generator	

Zoom-Boom	
Zoom-Boom	1773
Zoom-Boom TH255	1779
Zoom-Boom JCB	16-1202

Garage	
Welding machine	S-01
Welding machine	S-02
Welding machine	S-03
Welding machine	S-04
Welding machine	S-05
Welding machine	S-06
Compressor	COMP-01
Compressor	COMP-02

Pickup Truck	
Dodge Ram 2500	1743
Dodge Ram 2500	1744
Dodge Ram 2500	1765
Dodge Ram 2500	1767
Dodge Ram 2500	1769
Dodge Ram 2500	1772
Dodge Ram 2500	1798
Dodge Ram 2500	10-0004
Dodge Ram 2500	10-0005
Dodge Ram 2500	10-0006
Dodge Ram 2500	10-0007
Dodge Ram 2500	10-0008
Dodge Ram 2500	10-0010
Dodge Ram 2500	10-0016
Dodge Ram 2500	11-0014
Dodge Ram 2500	11-0022
Dodge Ram 3500	12-0014
Dodge Ram 3500	12-0015
Dodge Ram 2500	12-0016
Dodge Ram 2500	12-0017
Dodge Ram 2500	16-0006
Dodge Ram 2500	16-0007
Dodge Ram 2500	16-0008
Dodge Ram 2500	16-0009
Ram 2500 Promaster	16-0010

Compressor	
Compressor	919
Compressor	9925
Compressor	15-6902
Compressor	16-6901
Compressor	16-6902

Service Unit	
Service Unit	10-0103
Service Unit	11-0118
Service Unit	11-0119
Service Unit	12-0111

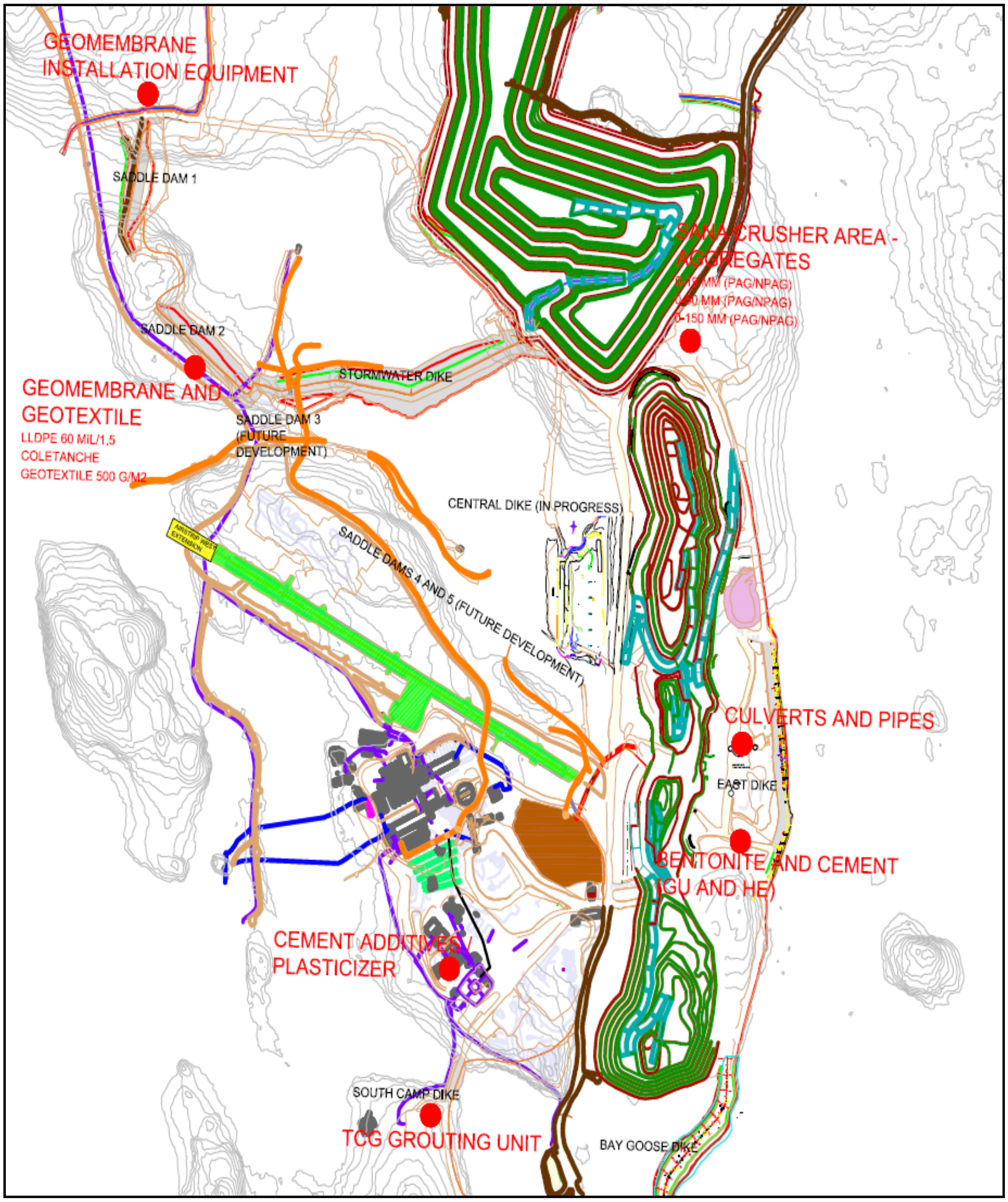
Crusher	
Jaw crusher	7004
Cone crusher and screen	7005
Convoyeur	7006

Ambulance	
Flagro	12-5906
Flagro	

11.4.3 Earthwork Material and Equipment

The following map presents the earthwork material, including geomembrane and cement, available on site in case of an emergency.

Figure 12 Earthwork Material and Equipment Location



SECTION 12 • EMERGENCY RESPONSE REFERENCE DOCUMENTS

Table 12.1 Emergency Response Reference Documents

Document	Current Revision
Emergency Response Plan	Updated by AEM. Version 11, January 2017. (Intelex)
Emergency Preparedness Plan	In Dewatering Dikes OMS Manual, Version 6, February 2017

Note: To be updated as required

Table 12.2 Potential Effects or Causes of Failure Mechanisms

Failure Mechanism	Potential Measurable and Observable	
	Causes	**Effects**
Overtopping	(1) Lake level rise. (2) Dam crest settlement	Water inflow leading to erosion of downstream foundation soils and associated crest settlement.
Internal Erosion	(1) Loss of cut-off wall/liner at construction defects in cut-off wall/liner, Core Backfill and filter. (2) Loss of bentonite from cut-off wall at defect in construction (3) Loss of till foundation at defect in dike section.	Sinkhole observable at crest Slower lake drawdown during dewatering Increase in seepage pumping rate during operations Increase in pore water pressures downstream of cut-off wall/liner Increase in turbidity / suspended solids of seepage
Seepage Within Embankment	Increase in seepage rate due to cut-off wall/liner failure	Increased seepage water handling. Not likely to compromise stability of dike.
Seepage Within Foundation	Un-observable defects in cut-off/liner construction.	High flow during initial dewatering or shortly thereafter.
Internal Conduit Rupture	Not applicable	Not applicable
Slope Instability	(1) ice or wave forces, or traffic on crest, seepage, weakness of foundation soils (2) Earthquake seismic event or blasting (3) Pit wall failure	Increase in settlement and/or settlement rate Increase in displacement and/or displacement rate of dike toe Cracks along the dike crest Sloughing of the face Bulging of dike toe Disruption of seepage collection ditch

Failure Mechanism	Potential Measurable and Observable	
	Causes	**Effects**
Failure of Cut-off Wall/Liner Due to Movement of the Dike (Cut-off wall/liner lateral movement)	Differential horizontal movement of dike due to water or ice loading, pit wall stability, excessive dike settlement Seepage.	Large inflows associated with a breach in the dike. Increase in lateral deformation or increase in rate of deformation in slope inclinometer reading Increase in pore water pressure downstream of cut-off wall/liner Increase in pumping rate Dislocation, cracks, settlement localized above or adjacent to cut-off wall/liner
Unexpected settlements	Consolidation of foundation soils or dike fills	Overtopping in extreme case large settlement of cut-off wall/liner.

Table 12.3 Threshold Criteria during Operation for East Dike

		Threshold Criteria During Operation			
		Green **Acceptable Situation**	**Yellow** **Areas of concern**	**Orange** **High Risk Situation**	**Red** **Emergency Situation**
Criteria	Downstream toe displacement, sloughing or bulging	None visible	Visible displacement or bulging	Toe displacement related to a sloughing slide from near downstream crest to 5 m from centreline Bulging > 1 m in height	Toe displacement related to a sloughing slide reaching 5 m from centreline Bulging greater than 4m in height
	Tension crack along downstream rockfill embankment (more than 3 m from centreline)	Within 7 m of the downstream crest edge and < 0.1 m deep and < 3 m length along the dike	Within 10 m of the downstream crest edge and > 0.1 m and < 1.0 m deep	> 1.0 m deep	> 1.0 m deep
	Tension crack along upstream rockfill embankment (more than 3 m from centreline)	< 0.1 m deep and < 3 m length along the dike	> 0.1 m and < 1.0 m deep	> 1.0 m deep	> 1.0 m deep
	Tension crack within 3 m each side of the cutoff wall at crest (upstream or downstream)	None visible	< 0.1 m deep or < 0.1 m wide	> 0.1 m deep or > 0.1 m wide	> 0.1 m deep or > 0.1 m wide
	Sinkhole on crest	Not visible	> 5 m outside from centreline	Within 5 m from centreline	Within 5 m from centreline
	Cut-off wall lateral cumulative deformation (based on survey monument)	None	<0.05 m	> 0.05 and 0.10 m	> 0.10 m
	Cut-off wall lateral cumulative deformation (based on inclinometer)	None	< 0.05 m	> 0.05 m and < 0.10 m	> 0.10 m
	Lake elevation	< 134.1 masl	> 134.1 and < 134.8 masl	> 134.8 and < 135.6 masl	> 135.6 masl
	Pore water pressure (based on piezometers)	Pore water pressure measurements stable or decreasing.	Increasing trend in pore water pressure downstream of cut-off wall.	Anomalous trends (sharp increase) in pore water pressure downstream of cut-off wall.	Anomalous trends (sharp increase) in pore water pressure downstream of cut-off wall.
	Temperature variation along centreline (based on thermistors and piezometers)	Temperature measurement stable and similar variation at surface from previous years.	Increasing trend in temperature below the active layer	Continuous increasing trend in temperature below the active layer	Continuous increasing trend in temperature below the active layer
	Seepage through dike (excluding Freshet water)	< 3,000 m^3/day	>3,000 m^3/day and <6,000 m^3/day and / or turbidity in the water	> 6,000 m^3/day and < 20,000 m^3/day and / or turbidity in the water	> 20,000 m^3/day *Condition where the seepage inflow is rapidly increasing and projected to soon exceed pumping capacity*
Action Required		• Instrumentation monitoring and visual inspection according to frequency set out in OMS manual. • Possibility of a mitigation plan to be evaluated by Engineering Department.	• Increased instrumentation monitoring frequency, particularly in area of concern. • Document location, photograph, survey, and increase inspection and monitoring in area of concern. • Identify potential cause • Implement engineering review.	• Suspend activities on dike crest at area of concern • Increased instrumentation monitoring frequency, particularly in area of concern. • Document location, photograph, survey, and increase inspection and monitoring in area of concern. • Plan and take appropriate mitigation measures with engineering review. (Use as reference contingency measures for different scenarios proposed by AEM (See Table 12-9)). • Reassess thresholds and conditions for red category (emergency situation) taking into account the changing conditions presently observed and interactions of various items.	• Temporary evacuation of personnel and equipment from pit and suspension of activities. • Update planning and take appropriate mitigation with engineering review.
Personnel Notified		Geotechnical Engineer/Specialists, Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder or SNC, if required).	Geotechnical Engineer/Specialist, Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder or SNC), Specialized Contractor (if required), Environment Superintendent, Mine Manager, Discuss at MDRB Meeting.	Geotechnical Engineer/Specialist, Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder or SNC), Specialized Contractor, Environment Superintendent, Mine Manager, Dike Review Board, Mine Inspector, Health and Safety, ERT (Emergency Personnel, if required).	Geotechnical Engineer/Specialist, Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder or SNC), Specialized Contractor, Environment Superintendent, Mine Manager, Dike Review Board, Mine Inspector, Health and Safety, ERT (Emergency Personnel).

Table 12.4 Threshold Criteria during Operation for Bay-Goose Dike

		Threshold Criteria During Operation			
		Green **Acceptable Situation**	**Yellow** **Areas of concern**	**Orange** **High Risk Situation**	**Red** **Emergency Situation**
Criteria	Downstream toe displacement, sloughing or bulging	None visible	Visible displacement or bulging	Toe displacement related to a sloughing slide from near downstream crest to 5 m from centreline and bulging > 1 m in height	Toe displacement related to a sloughing slide reaching 5 m from centreline Bulging greater than 4m in height
	Tension crack along downstream rockfill embankment (more than 3 m from centreline)	Within 7 m of the downstream crest edge and < 0.1 m deep and < 3 m length along the dike	Within 10 m of the downstream crest edge and > 0.1 m and < 1.0 m deep	> 1.0 m deep	> 1.0 m deep
	Tension crack along upstream rockfill embankment (more than 3 m from centreline)	< 0.1 m deep and < 3 m length along the dike	> 0.1 m and < 1.0 m deep	> 1.0 m deep	> 1.0 m deep
	Tension crack within 3 m of either side of the cutoff wall at crest	None visible	< 0.1 m deep or < 0.1 m wide	> 0.1 m deep or > 0.1 m wide	> 0.1 m deep or > 0.1 m wide
	Sinkhole on crest	Not visible	> 5 m outside from centreline	Within 5 m from centreline	Within 5 m from centreline
	Cut-off wall lateral cumulative deformation (based on survey monument)	None	<0.05 m	> 0.05 and 0.10 m	> 0.10 m
	Cut-off wall lateral cumulative deformation (based on inclinometer)	None	< 0.05 m	> 0.05 m and < 0.10 m	> 0.10 m
	Lake elevation	< 135.1 masl	> 135.1 and < 135.8 masl	> 135.8 and < 136.1 masl	> 136.1 masl
	Pore water pressure (based on piezometers)	Pore water pressure measurements stable or decreasing.	Increasing trend in pore water pressure downstream of cut-off wall.	Anomalous trends (sharp increase) in pore water pressure downstream of cut-off wall.	Anomalous trends (sharp increase) in pore water pressure downstream of cut-off wall.
	Temperature variation along centreline (based on thermistors and piezometers)	Temperature measurement stable and similar variation at surface from previous years.	Increasing trend in temperature below the active layer	Continuous increasing trend in temperature below the active layer	Continuous increasing trend in temperature below the active layer
	Seepage through dike at toe (excluding Freshet water)	< 300 m^3/day	>300 m^3/day and <1,000 m^3/day and / or turbidity in the water	> 1,000 m^3/day and < 2,000 m^3/day and / or turbidity in the water	> 2,000 m^3/day *Seepage inflow is rapidly increasing and projected to soon exceed pumping capacity*
	Seepage through dike in North Channel area	< 150 m^3/day	>150 m^3/day and <500 m^3/day and / or turbidity in the water	> 500 m^3/day and < 1,000 m^3/day and / or turbidity in the water	> 1,000 m^3/day *Seepage inflow is rapidly increasing and projected to soon exceed pumping capacity*
	Seepage through dike in pit (excluding Freshet water, estimated visually)	Slow trickle of water along pit walls, easily handled by regular pit sumps	Steady stream of water along pit walls, easily handled by regular pit sumps	Large quantity of water flowing down the pit walls, cannot be easily handled by regular pit sumps, mining activities are impacted	Water flowing down the walls cannot be handled by regular pit sumps and has markedly increased in flow rate and quantity, mining activities are disrupted.
Action Required		• Instrumentation monitoring and visual inspection according to frequency set out in OMS manual. • Possibility of a mitigation plan to be evaluated by Engineering Department.	• Increased instrumentation monitoring frequency, particularly in area of concern. • Document location, photograph, survey, and increase inspection and monitoring in area of concern. • Identify potential cause • Implement engineering review.	• Suspend activities on dike crest at area of concern • Increased instrumentation monitoring frequency, particularly in area of concern. • Document location, photograph, survey, and increase inspection and monitoring in area of concern. • Plan and take appropriate mitigation measures with engineering review. (Use as reference contingency measures for different scenarios proposed by AEM (See Table 12-9)). • Reassess thresholds and conditions for red category (emergency situation) taking into account the changing conditions presently observed and interactions of various items.	• Temporary evacuation of personnel and equipment from pit and suspension of activities. • Update planning and take appropriate mitigation with engineering review.
Personnel Notified		Geotechnical Engineer/Specialist, Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder or SNC, if required).	Geotechnical Engineer/Specialist, Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder or SNC), Specialized Contractor (if required), Environment Superintendent, Mine Manager, Discuss at MDRB Meeting.	Geotechnical Engineer/Specialist, Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder or SNC), Specialized Contractor, Environment Superintendent, Mine Manager, Dike Review Board, Mine Inspector, Health and Safety, ERT (Emergency Personnel, if required).	Geotechnical Engineer/Specialist, Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder or SNC), Specialized Contractor, Environment Superintendent, Mine Manager, Dike Review Board, Mine Inspector, Health and Safety, ERT (Emergency Personnel).

Table 12.5 Threshold Criteria during Operation for South Camp Dike

		Threshold Criteria During Operation			
		Green **Acceptable Situation**	**Yellow** **Areas of concern**	**Orange** **High Risk Situation**	**Red** **Emergency Situation**
Criteria	Downstream toe displacement, sloughing or bulging	None visible	Visible displacement or bulging	Toe displacement related to a sloughing slide from near downstream crest to 5 m from centreline Bulging > 1 m in height	Toe displacement related to a sloughing slide reaching 5 m from centreline Bulging greater than 4m in height
	Tension crack along downstream rockfill embankment (more than 3 m from centreline)	Within 7 m of the downstream crest edge and < 0.1 m deep and < 3 m length along the dike	Within 10 m of the downstream crest edge and > 0.1 m and < 1.0 m deep	> 1.0 m deep	> 1.0 m deep
	Tension crack along upstream rockfill embankment (more than 3 m from centreline)	< 0.1 m deep and < 3 m length along the dike	> 0.1 m and < 1.0 m deep	> 1.0 m deep	> 1.0 m deep
	Sinkhole on crest	Not visible	> 5 m outside from centreline	Within 5 m from centreline	Within 5 m from centreline
	Lake elevation	< 135.6 masl	> 135.6 and < 136.3 masl	> 136.3 and < 136.6 masl	> 136.6 masl
	Temperature variation within foundation (based on thermistors)	Temperature measurement stable and similar variation at surface from previous years.	Increasing trend in temperature below the active layer	Continuous increasing trend in temperature below the active layer	Continuous increasing trend in temperature below the active layer
	Seepage through dike (excluding Freshet water)	< 300 m^3/day	>300 m^3/day and <1,000 m^3/day and / or turbidity in the water	> 1,000 m^3/day and < 2,000 m^3/day and / or turbidity in the water	> 2,000 m^3/day *Condition where the seepage inflow is rapidly increasing and projected to soon exceed pumping capacity*
Action Required		• Instrumentation monitoring and visual inspection according to frequency set out in OMS manual. • Possibility of a mitigation plan to be evaluated by Engineering Department.	• Increased instrumentation monitoring frequency, particularly in area of concern. • Document location, photograph, survey, and increase inspection and monitoring in area of concern. • Identify potential cause • Implement engineering review.	• Suspend activities on dike crest at area of concern • Increased instrumentation monitoring frequency, particularly in area of concern. • Document location, photograph, survey, and increase inspection and monitoring in area of concern. • Plan and take appropriate mitigation measures with engineering review. • Reassess thresholds and conditions for red category (emergency situation) taking into account the changing conditions presently observed and interactions of various items.	• Temporary evacuation of personnel and equipment from pit and suspension of activities. • Update planning and take appropriate mitigation with engineering review.
Personnel Notified		Geotechnical Engineer/Specialist, Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder or SNC, if required).	Geotechnical Engineer/Specialist, Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder or SNC), Specialized Contractor (if required), Environment Superintendent, Mine Manager, Discuss at MDRB Meeting.	Geotechnical Engineer/Specialist, Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder or SNC), Specialized Contractor, Environment Superintendent, Mine Manager, Dike Review Board, Mine Inspector, Health and Safety, ERT (Emergency Personnel, if required).	Geotechnical Engineer/Specialist, Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder or SNC), Specialized Contractor, Environment Superintendent, Mine Manager, Dike Review Board, Mine Inspector, Health and Safety, ERT (Emergency Personnel).

Table 12.6 Threshold Criteria during Operation for Vault Dike

		Threshold Criteria During Operation			
		Green **Acceptable Situation**	**Yellow** **Areas of concern**	**Orange** **High Risk Situation**	**Red** **Emergency Situation**
Criteria	Downstream toe displacement, sloughing or bulging	None visible	Visible displacement or bulging	Toe displacement related to a sloughing slide from near downstream crest to 5 m from centreline Bulging > 1 m in height	Toe displacement related to a sloughing slide reaching 5 m from centreline Bulging greater than 4m in height
	Tension crack along downstream rockfill embankment (more than 3 m from centreline)	Within 7 m of the downstream crest edge and < 0.1 m deep and < 3 m length along the dike	Within 10 m of the downstream crest edge and > 0.1 m and < 1.0 m deep	> 1.0 m deep	> 1.0 m deep
	Tension crack along upstream rockfill embankment (more than 3 m from centreline)	< 0.1 m deep and < 3 m length along the dike	> 0.1 m and < 1.0 m deep	> 1.0 m deep	> 1.0 m deep
	Sinkhole on crest	Not visible	> 5 m outside from centreline	Within 5 m from centreline	Within 5 m from centreline
	Lake elevation	< 141.5 masl	> 141.5 and < 142.2 masl	> 142.2 and < 142.5 masl	> 142.5 masl
	Temperature variation within foundation (based on thermistors)	Temperature measurement stable and similar variation at surface from previous years.	Increasing trend in temperature below the active layer	Continuous increasing trend in temperature below the active layer	Continuous increasing trend in temperature below the active layer
	Seepage through dike (excluding Freshet water)	< 300 m^3/day	>300 m^3/day and <1,000 m^3/day and / or turbidity in the water	> 1,000 m^3/day and < 2,000 m^3/day and / or turbidity in the water	> 2,000 m^3/day *Condition where the seepage inflow is rapidly increasing and projected to soon exceed pumping capacity*
Action Required		• Instrumentation monitoring and visual inspection according to frequency set out in OMS manual. • Possibility of a mitigation plan to be evaluated by Engineering Department.	• Increased instrumentation monitoring frequency, particularly in area of concern. • Document location, photograph, survey, and increase inspection and monitoring in area of concern. • Identify potential cause • Implement engineering review.	• Suspend activities on dike crest at area of concern • Increased instrumentation monitoring frequency, particularly in area of concern. • Document location, photograph, survey, and increase inspection and monitoring in area of concern. • Plan and take appropriate mitigation measures with engineering review. • Reassess thresholds and conditions for red category (emergency situation) taking into account the changing conditions presently observed and interactions of various items.	• Temporary evacuation of personnel and equipment from pit and suspension of activities. • Update planning and take appropriate mitigation with engineering review.
Personnel Notified		Geotechnical Engineer/Specialist, Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder or SNC, if required).	Geotechnical Engineer/Specialist, Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder or SNC), Specialized Contractor (if required), Environment Superintendent, Mine Manager, Discuss at MDRB Meeting.	Geotechnical Engineer/Specialist, Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder or SNC), Specialized Contractor, Environment Superintendent, Mine Manager, Dike Review Board, Mine Inspector, Health and Safety, ERT (Emergency Personnel, if required).	Geotechnical Engineer/Specialist, Geotechnical Coordinator, Engineering Superintendent, Engineering Assistant Superintendent, Corporate Environment Director, Designer (Golder or SNC), Specialized Contractor, Environment Superintendent, Mine Manager, Dike Review Board, Mine Inspector, Health and Safety, ERT (Emergency Personnel).

Table 12.7 Communication Charts for Each Emergency Level

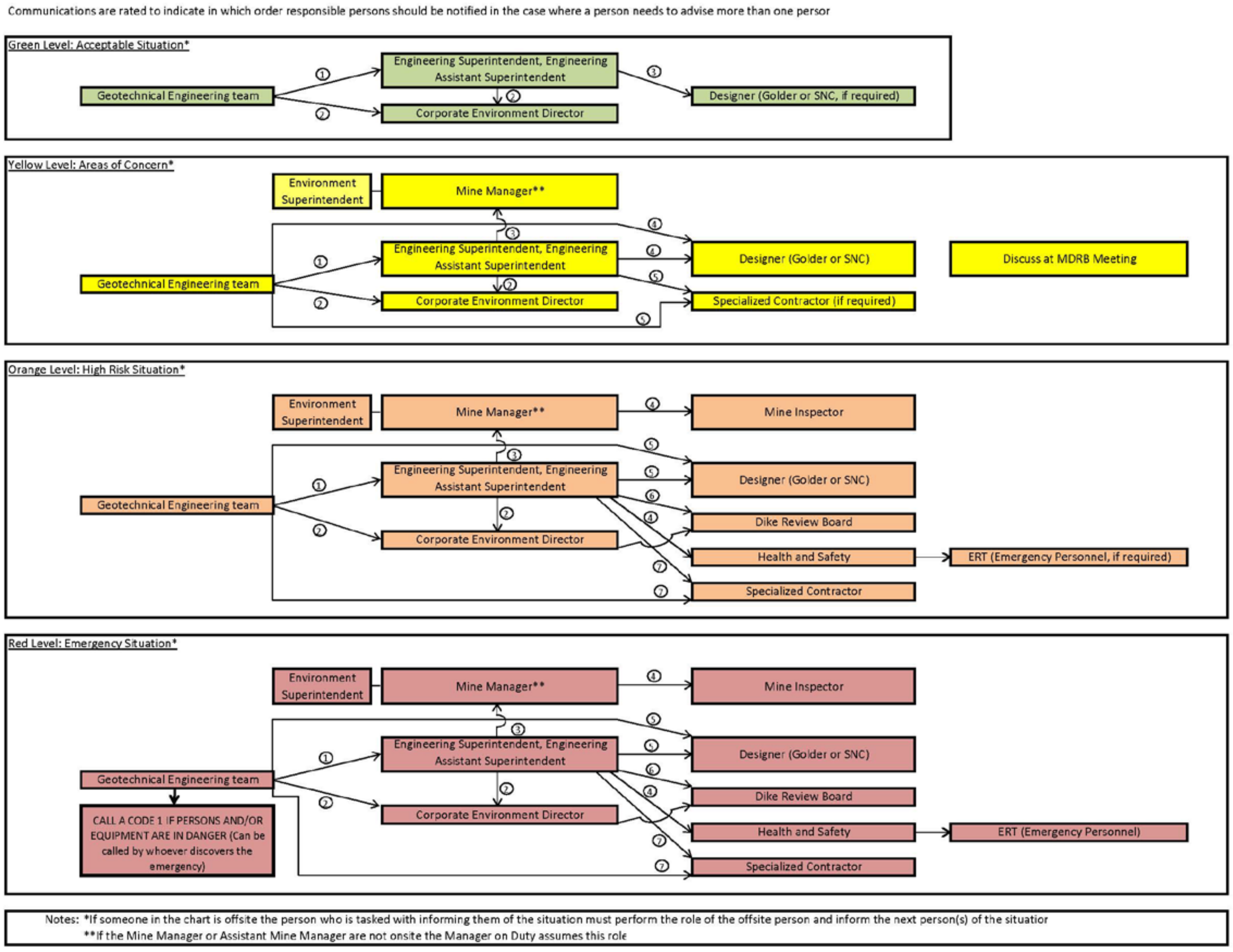


Table 12.8 Responsibilities of Persons for Each Emergency Level

	Decision Making	Mobilization	Performing the Action to be Taken
Green Acceptable Situation	Geotechnical Engineer/Specialist	Geotechnical Engineer/Specialist	Geotechnical Team*
Yellow Areas of Concern	Geotechnical Engineer/Specialist, Geotechnical Coordinator Engineering Superintendent Engineering Assistant Superintendent Designer (Golder or SNC)	Geotechnical Engineer/Specialist, Geotechnical Coordinator	Geotechnical Team* Specialized Contractor (if required)
Orange High Risk Situation	Geotechnical Engineer/Specialist, Geotechnical Coordinator Engineering Superintendent Engineering Assistant Superintendent Designer (Golder or SNC) Corporate Environment Director Dike Review Board Mine Manager Health and Safety (if required)	Geotechnical Engineer/Specialist, Geotechnical Coordinator Engineering Superintendent Engineering Assistant Superintendent	Geotechnical Team* Specialized Contractor ERT (if required)
Red Emergency Situation	Geotechnical Engineer/Specialist, Geotechnical Coordinator Engineering Superintendent Engineering Assistant Superintendent Designer (Golder or SNC) Corporate Environment Director Dike Review Board Mine Manager Health and Safety	Geotechnical Engineer/Specialist, Geotechnical Coordinator Engineering Superintendent Engineering Assistant Superintendent Mine Manager Health and Safety	Geotechnical Team* Specialized Contractor ERT

*The Geotechnical Team consists of the Geotechnical Coordinator, Geotechnical Engineer/Specialist, the Project Technician, Tailings & Water Management Engineers, and the Geotechnical Technicians.

Table 12.9 Names and Contact Details

Internal Emergency Response Contact Information Chart		
Position	**Name/Location**	**24-Hour Contact #**
Geotechnical Engineer/Specialist	Patrice Gagnon	Ph: 819-759-3555 ext. 6726 cell: 418-376-0975
	Alexandre Lavallée	Ph: 819-759-3555 ext. 6726 cell: 438-868-1905
Geotechnical Coordinator	Michel Groleau	Ph: 819-759-3555 ext. 6837 cell: 418-670-6590
Engineering Superintendent	Julie Belanger	Ph: 819-759-3555 ext. 6721 cell: 819-856-1667
Engineering Assistant Superintendent	Pierre McMullen	Ph: 819-759-3555 ext. 6721 cell: 819-860-2556
Corporate, Vice-President Environment	Michel Julien	Ph: 461-947-1212 ext. 3738 cell: 514-244-5876
Designer (Golder or SNC)	Golder Burnaby: Dan Walker, Fiona Esford Golder Montreal: Yves Boulianne, Annie Beaulieu	Burnaby Office: 604-296-4200 Montreal Office: 514-383-0990
	SNC: Yohan Jalbert, Simon Beaulieu	Quebec City Office: 418-621-5500
Specialized Contractor	SANA (FGL Group)	Onsite Ph: 819-759-3555 ext. 6963 Ph: 418-615-0559
Environment Superintendent	Jamie Quesnel	Ph: 819-759-3555 ext 6838 Cell: 819-651-2974
Mine Manager	Bertin Paradis	Ph: 819-759-3555 ext. 6725 cell: 819-355-9348
	Luc Chouinard (asst.)	Ph: 819-759-3555 ext. 6725 cell: 819-856-8160
Dike Review Board	Anthony Rattue Norbert Morgenstern Don Hayley	anthony.rattue@bell.net norbertm@ualberta.ca don.hayley@icloud.com
Mine Inspector	Martin VanRooy	Martin.vanRooy@wscc.nu.ca_contact1
Health and Safety	Normand Ladouceur	Ph: 819-759-3555 ext. 6720 cell: 819-860-6258
	Yves Levesque (asst.)	Ph: 819-759-3555 ext. 6720 cell: 819-856-9051
ERT (Emergency Personnel)	Emergency response personnel available on site to assist with spill and emergency response activities	Coordinated by the Emergency Measures Counsellor
Incident Commander	André Rouleau	Ph: 819-759-3555 ext. 6809 cell: 819-355-2191 Code 1
	Normand Ladouceur	Ph: 819-759-3555 ext. 6720 cell: 819-860-6258 Code 1
Emergency Measures Counsellor	André Rouleau Bernard Paradis	Ph: 819-759-3555 ext. 6809 cell: 819-355-2191

Health Professionals / Medical Clinic	Medical Clinic 1	Ph: 819-759-3555 ext. 6734
	Medical Clinic 2	Ph: 819-759-3555 ext. 6751
AEM Management Representative	Bertin Paradis	Ph: 819-759-3555 ext. 6725 cell: 819-355-9348
Human Resource Superintendent	Dominic Richard	Ph: 819-759-3555 ext 6723 cell: 819-856-0426

Table 12.10 Emergency Response Summary for East Dike and Bay-Goose Dike

Concern	Area		Failure Likelihood	Comments/Monitoring	Contingency or Corrective Action
Overtopping and Subsidence	1a	Lake level rise because of restricted outflow from Third Portage or Second Portage Lake (excessive inflow is a far less likely scenario)	Low	Lake levels and crest elevations should be monitored as part of daily safety information provided to mine management. Outflow channels should be inspected during thaw, open water season and during ice break-up.	The crest is wide and comprises coarse rockfill. Significant damage to the dike is not credible, based on performance of other rockfill structures subjected to overtopping or flow through events. Mining operations may need to be suspended, but there will be considerable warning time given the design freeboard and the storage volume within the lakes.
	1b	Dam crest settles more than 2 m	Low	This scenario requires extensive loss of support in the foundation since the rockfill of the dikes is essentially not settlement prone itself after construction and dewatering. For foundation settlement of this magnitude to occur, a piping event must develop or there is unexpected layer of compressible soil in the foundation. A foundation investigation was carried out prior to construction. The situation would develop slowly with crest settlement evident at least several weeks before a run-away event develops. Easily observed cracks should be evident. Monitoring of the crest settlement should be conducted routinely.	The crest is wide and comprises of coarse rockfill. Significant damage to the dike is not credible, based on performance of other rockfill structures subjected to overtopping or flow through events Rockfill and till available from the mining operations can be placed to raise the dike crest. Mining operations may need to be suspended, but there will be considerable warning time given the slow development of the scenario.
	1c	Wave action	Low	Wide beach, large freeboard and wide rock dam crest zone makes this a low concern	If large wave action is observed, can add rip-rap and/or raise dam crest
Internal Erosion	2a	Dike Section: Cut-off wall is defective, allowing high water flow. This defect occurs at a location where the core allows high flows and where the fills are defective; the combination allows erosion of the cut-off and/or the Core Backfill.	Low	The cut-off wall and/or core backfill will develop a progressively increasing void ratio, thereby increasing the rate of water flow through the dike. This is not a catastrophic failure mode as the rockfill will be stable and at its worst would lead to temporary suspension of mining.	Monitor seepage from downstream face for rate of seepage and for presence of sediment in seepage. Will become evident as localized intensive seepage at dike toe and can be repaired. May also see settlement in the core or cut-off wall near the filter. Will be most likely in deepest section. Gradients across the core in shallow water may not be high enough to cause piping.
	2b	Dike Section: Cut-off wall loses bentonite because of improper construction	Low	The cut-off wall will develop progressively increasing voids, thereby increasing the rate of water flow through the dike. This is not a catastrophic failure mode as the rockfill will be stable and at its worst would lead to temporary suspension of mining.	Monitor seepage from downstream face for rate of seepage and for presence of sediment in seepage. Will become evident as localized intensive seepage at dike toe and can be repaired. May also see settlement in the core near the filter. Will be most likely in deepest section. Gradients across the core and cut-off in shallow water may not be high enough to cause piping.
	2c	Foundation till is possibly non-uniform with more transmissive zones and not self-filtering. It is possible that one of these zones may align with defective construction of the cut-off wall allowing high flows. Seepage would lead to erosion of the cut-off into the downstream rockfill. Seepage could also erode the foundation tills at the downstream toe or into the downstream rockfill because of the lack of filtering.	Low	Limited seepage at the toe or into the rockfill would accelerate in to a large inflow, and could lead to the undermining of the dike if no action was taken. This is a credible catastrophic mode if increased seepage is not detected in time. No particular instrumentation is needed as this failure mode will show itself as localized and increasing seepage. It could be detected by walk-over inspection by an experienced engineer or technician.	Remedial action could comprise a reverse filter and rockfill buttress depending on location of the flow and configuration of the foundation, freezing or grouting, if identified in time. In the worst case, the pit may be deliberately flooded in a controlled manner, the cut-off repaired and the pit dewatered. Build additional dike downstream increasing pumping.

Concern	Area		Failure Likelihood	Comments/Monitoring	Contingency or Corrective Action
Seepage	3a	Within the Embankment	Low	Seepage on its own is not a credible failure scenario. The downstream rockfill shell has extremely high flow through capacity. The rockfill zone is both large and pervious, so that seepage will not daylight and lead to instability. Any seepage related failures must include internal erosion.	No credible consequences. May require upgrade of the seepage collection system. May need to suspend mining activities while reducing seepage.
	3b	Within the Foundation	Medium	Defective construction of cut-off leading to transfer of unexpectedly high fraction of the reservoir head into the downstream part of the dike foundation, or leading to a piping event as described in internal erosion(2c). If this mechanism arises it should show itself during initial dewatering or very shortly thereafter.	This failure mechanism has caused embankment failures elsewhere because of straightforward pore water pressure induced instability. However it is unclear that it could cause failure of the dike because of the large width compared to the retained water head. The most likely consequence is downstream toe slumping requiring a localized stabilizing berm before the crest could be reinstated.
Structural - Slope Instability	4a	Normal Operation: Slope Failure	Low	The rockfill shoulders of the dike are wide and have high shear strength, making it a conservative design. Slope failure requires failure in the foundation and which would extend into the overlying dike. Sliding failure is considered unlikely given the low horizontal forces generated by the water and ice relative to the normal frictional force due to the weight of the dikes and the frictional angles of foundational materials. This mechanism should develop during construction or dewatering, due to the increase in load and associated pore water pressure development. Initial stages of failure should be observable as tension cracks in the dike crest. Walk-over inspection of the dike by trained inspector is an appropriate monitoring strategy in addition the instrumentation. Survey of crest face and toe should also be conducted.	A foundation failure would cause a rotational slip or sliding failure until equilibrium was reached. This mechanism would limit access along the dike until repaired. Failure through the rockfill should not necessarily compromise the water retaining function of the dike. Slope failures which reach the core may cause dam failure. Stabilizing berms can be placed at the downstream toe of the dike.
	4b	Earthquake Induced: Slope Failure	Low	Site is located in a low seismic zone. Dam consisting of massive rock zone has a low sensitivity to seismic motion.	In the event a seismic event produced cracks, construction material and equipment will be available for rapid response.
	4c	Erosion; washout, ice scour	Low	Crest – minimum 50 m section, Downstream – large quarry rock face.	Monitor – if any erosion is observed place additional mine rock
Structural – Lateral Movement	5a	Failure of Cut-off Wall	Low	Differential horizontal movement of the dike due to dewatering, water or ice loading or pit wall failure may create a breach in the cut-off wall. Ice and water forces are not credible due to the ratio of frictional forces generated by the self weight of the dike versus ice loads and water pressure. Pit wall failure unlikely based on assessments of pit wall stability. Large inflows through the breach may occur as a consequence if the cut-off wall breached. Pit would flood requiring suspension of mining activities. Potential for loss of life of workers inside dikes. Inclinometer, settlement prism and monument monitoring should be done routinely.	If the pit floods, then repairs to cut-off would be done prior to dewatering.
Subsidence	6	Foundation Soils	Low	Unexpected foundation soils consolidated during dike construction or dewatering. A significant quantity of clay would be required to generate settlement resulting in a water release event. Settlement of the core zone will be limited by dynamic compaction. Prism and monument monitoring should be done routinely.	A 2 m core settlement would be required to allow water to flow through the rockfill and over the settled cut-off. This flow would not cause failure of the rockfill shells. It would also be readily repaired by excavating rockfill above the cut-off wall and placing more till. Soil conditions will be observed during dewatering to accommodate actual conditions.

Concern	Area		Failure Likelihood	Comments/Monitoring	Contingency or Corrective Action
Premature Closure	7	Corporate Bankruptcy or Early Resource Depletion	Low	Bond is provided for this eventuality. Design of rehabilitation is the same as rehabilitation at closure of project.	Pumping will be suspended and the downstream area allowed to flood. The East Dike and Bay-Goose Dike will be monitored to meet closure requirements.
Pump and Pipeline Failure	8	Pumping from Sumps to Process Plant	Medium	Freezing protection is provided by heat tracing and insulation. Pipelines monitored pump pressures at plant and frequent site inspection.	Sump designed for expected seepage capacity. Pumping equipment designed for 1 in 25 year storm events and average freshet. Redundant lines (Minimal interruption to Process Plant operation).

Table 12.11 Risk Matrix

			Consequence :				
			HIGH	**HIGH** / **MEDIUM**	**MEDIUM**	**LOW**	**LOW**
Likelihood:			Catastrophic 5	Major 4	Significant 3	Minor 2	Insignificant 1
Almost Certain	**HIGH**	5	25 (very high risk)	20	15	10	5
Likely	**HIGH** / **MEDIUM**	4	20	16 (high risk)	12	8	4
Possible	**MEDIUM**	3	15	12	9 (medium risk)	6	3
Unlikely	**LOW**	2	10	8	6	4 (low risk)	2
Rare	**LOW**	1	5	4	3	2	1 (very low risk)

Table 12.12 Risk assessment for East Dike, Bay-Goose Dike, South Camp Dike and Vault Dike

Failure Mechanism	Cause	Likelihood Rating	Effect	Consequence Rating	Controls: Monitoring	Controls: Corrective Action	Overall Risk Rating
Overtopping	Lake level rise because of restricted outflow (e.g., blockage of outlet from Second Portage Lake).	**LOW – 2** Temporary ice jam occurring at the outlet is possible for a short duration in the spring. The cutoff wall and liner system provide adequate freeboard above normal lake level.	Water spilling over the crest. Erosion of the dike abutment and / or downstream foundation	**LOW - 2** The crest is wide and comprises coarse rockfill. Significant damage to the dike is unlikely based on design.	Routine monitoring of lake levels. Outflow channels should be inspected regularly just before and during the thaw and ice break-up (freshet).	If an obstruction is present, clear blockage at outlet. Develop action plan based on conditions encountered.	4
	Lake level rise because of excessive inflow.	**LOW – 2** Due to the large surface area of the lakes, a large volume of water is required to cause a significant increase in the lake elevation. The cutoff wall and liner system provide adequate freeboard above normal lake level.	Water spilling over the crest. Erosion of the dike abutment and / or downstream foundation	**LOW - 2** The crest is wide and comprises coarse rockfill. Significant damage to the dike is unlikely based on design.	Routine monitoring of lake levels.	Develop action plan based on conditions encountered.	4
	Settlement of the cutoff wall system. (NOT APPLICABLE TO SOUTH CAMP DIKE OR VAULT DIKE)	**MED – 3** The cutoff wall system is founded on or close to bedrock reducing potential for the foundation, and in turn the cutoff wall, to settle. Some settlement of the soil bentonite may be expected. The maximum depth of the soil bentonite cutoff wall is typically such that settlement exceeding the minimum freeboard is unlikely.	Water spilling over the crest. Erosion of the dike abutment and / or downstream foundation.	**MED - 3** The crest is wide and comprises coarse rockfill. Significant damage to the dike is unlikely based on design.	Survey of cutoff wall to detect and quantify settlement. Routine monitoring of lake levels.	Till available from the mining operation could be placed above the cutoff wall if significant settlement occurred. (Note – all material over cut-off wall would need to be excavated (i.e. thermal cap, grouting platform))	9
	Settlement of the rockfill embankment over a significant width of the crest.	**EAST DIKE** **BAY-GOOSE DIKE** **LOW – 2** Adequate rockfill freeboard has been provided such that settlement in excess of the freeboard is not anticipated. Settlement can only occur where lakebed soils were left underneath the rockfill embankment but the majority of the settlement is anticipated to have occurred during construction since additional fill was placed to bring to design elevation. The East Dike has had additional maintenance as it was operated as a haul road.	Potential erosion of upstream filters and cutoff for BG and ED. Potential exposure to wave action (see below in wave action section).	**MEDIUM - 3** The hydraulic barrier, cutoff wall system, remains in place. Wave erosion of the cutoff system unlikely due to the presence of surrounding granular material.	Monitoring of Rockfill settlement	Rockfill available from the mining operation can be placed to raise the crest height, if settlement occurs.	6
	Settlement of the rockfill embankment over a significant width of the crest.	**SOUTH CAMP DIKE** **VAULT DIKE** **LOW – 1** Existing monitoring of the dike within the foundation shows that it remains frozen throughout the year; therefore, thawing of foundation material is unlikely to happen, but in the event it does happen, it will allow settlement of the rockfill.	Potential exposure to wave action (see below in wave action section).	**LOW - 2** The hydraulic barrier, liner system, remains in place. Additional water will flow towards the open pit and mining infrastructures.	Routine monitoring of the foundation's temperature.	Develop an action plan to add low hydraulic conductivity barrier if flow is not manageable.	2
	Wave Action	**LOW – 2** Adequate freeboard is provided by the rockfill crest elevation. A wide rockfill crest which is erosion resistant reduces potential impact to the cut-off wall/liner.	Water spilling over the crest. Erosion of the dike abutment and / or downstream foundation	**LOW - 2** Wave erosion of the cutoff wall system unlikely due to the presence of surrounding granular filter system.	Monitor wave height during storm events or periods of strong winds.	Rockfill can be placed to raise the crest height, if necessary.	4

Failure Mechanism	Cause	Likelihood Rating	Effect	Consequence Rating	Controls		Overall Risk Rating
					Monitoring	Corrective Action	
Internal Erosion (piping)	Erosion of the cutoff wall. If a component of the cutoff wall is defective allowing high water flow through the structure. This defect could potentially erode the cutoff wall. (NOT APPLICABLE TO SOUTH CAMP DIKE OR VAULT DIKE)	**MEDIUM HIGH – 4** The soil bentonite has the potential to be eroded under high hydraulic gradients. Although erosion of the downstream foundation soils could potentially occur in association with erosion of the cutoff wall, the width of the rockfill embankment, thickness of soils, and hydraulic head significantly reduce the likelihood of failure. The granular materials within the dike have been designed to be filter compatible reducing the risk for erosion. This mechanism is more likely to occur during dewatering or shortly thereafter. **EAST DIKE**: As the East Dike has been dewatered since 2010, the likelihood of further deterioration is less. **BAY-GOOSE DIKE**: The cement content of the cement soil bentonite and jet grout should reduce its potential for erosion. A layer of erodible material (e.g. silt) at the base of the cutoff wall / bedrock contact, was identified and jet grouted to reduce erosion potential. Other areas of erodible material may still exist beneath the cutoff wall. Two areas at Bay-Goose Dike (Sta. 30+230 to 03+350 and Sta. 30+795 to 30+850) have a higher risk for flow through the cutoff wall because the more rigid cement soil bentonite was placed over softer, more deformable soil bentonite. A gap at the interface due to differential settlement or cracking of the cement soil bentonite is possible. The zone between Sta. 30+230 and 30+350 is considered at greater risk. The Bay-Goose design has included a filter blanket downstream of the cutoff wall to reduce internal erosion of the cut-off wall.	Increased seepage, through the dike core evident as localized intensive seepage at the dike toe or beyond. Settlement of the cutoff wall or dike crest, most likely in deep water sections with higher gradients.	**MEDIUM HIGH - 4** This is not likely to be a catastrophic failure mode as the filter material and rockfill embankments of the dike will remain stable. Additional seepage would come into the pit as the seepage collection system is not designed for such inflow. Could lead to the undermining of the dike if no action was taken and significant erosion of the foundation soils on the downstream side of the dike occurred. Loss of containment may result. Potential economic loss due to cessation/suspension of mining. **BAY-GOOSE DIKE**: High seepage leading to erosion is more likely to occur during dewatering when the pit has not been developed. The high seepage rate would delay the start of mining, with financial implication. With no pit development, minimal health and safety risk to personnel are expected.	Monitor seepage flow for rate and volume, and for presence of sediment in seepage (turbidity). Monitor piezometric and thermistor data for signs of increased flow through the cutoff wall and change in piezometric pressures. Monitor dike crest for signs of sinkholes or settlement. Increased seepage, evident as localized flow at the dike toe or beyond, in particular in topographic lows along the dike alignment	Based on conditions encountered, develop an action plan. This could include grouting, compaction grouting, and/or the installation of a downstream filter blanket.	**16**
	BAY-GOOSE DIKE ONLY: Erosion of the foundation (primarily applies where initial excavation was terminated above bedrock). Seepage flows through / between the jet grout columns, along sand and gravel zones within the till, and through potential erodible material. The foundation tills may be eroded into the downstream rockfill or through fractures in the bedrock.	**MEDIUM-4** The potential for gaps within the jet grout columns exist and allow for flow. The cement content of the jet grout columns should reduce the columns potential for erosion. Till is non-uniform with discontinuous layers / lenses of sand and gravel, and erodible material (i.e. silt layers) that may not be self-filtering. For erosion to occur, the seepage through or between the jet grout columns would need to connect with a permeable zone (e.g. zone of sand and gravel) which in turn needs to be in close proximity to a zone of erodible material that can be removed and the seepage forces need to be sufficient to cause the erosion. If this mechanism arises, it should show itself during initial dewatering or very shortly thereafter. May result in slower lake drawdown.	Increased seepage, evident as localized intensive seepage at the dike toe or beyond.	**MEDIUM HIGH-4** This is a significant failure mode if increased seepage is not detected in time. Undermining of the dike could lead to overall failure of the structure and flooding within the open pit resulting in cessation of mining and economic loss. Could lead to the undermining of the dike if no action was taken and significant erosion of the foundation soils on the downstream side of the dike occurred. Loss of containment may result.	Monitor seepage flow for rate and volume, and for presence of sediment. Monitor piezometric and thermistor data for signs of increased flow through the foundation and change in piezometric pressures. Monitor dike crest for signs of sinkholes, settlement or slope instability. Monitor inclinometers.	Remedial action could comprise grouting, a reverse filter on downstream and rockfill buttress, depending on location of the flow and configuration of the foundation. In the extreme, the dewatered areas may be deliberately flooded in a controlled manner, the cutoff wall repaired, and then dewatered.	**16**

Failure Mechanism	Cause	Likelihood Rating	Effect	Consequence Rating	Controls		Overall Risk Rating
					Monitoring	Corrective Action	
	Interconnected open fractures in the bedrock that permit foundation material or cutoff wall material to be lost. (Not applicable to South Camp Dike or Vault Dike)	**MEDIUM – 3** High hydraulic gradients exist at the base of the cutoff wall and potentially within the bedrock, especially along deeper areas of the dike. Grouting was conducted to reduce the permeability of the bedrock and contact zone. There is, however, a potential that bedrock fractures were initially infilled with silt prior grouting. This silt may erode once a hydraulic gradient is imposed and thereby form a pathway for either foundation soil or soil bentonite cutoff wall material to erode. Large setback of dike from pit crest in some parts increases the seepage path thereby reducing the hydraulic gradient imposed. BAY-GOOSE DIKE The cement content of the cement soil bentonite and jet grout reduces potential erodability and was used in the deepest portions of the dike.	Increased seepage, initially evident downstream of the dike or within the pit wall.	**HIGH - 5** This is a catastrophic failure mode if increased seepage is not detected in time. Could lead to the undermining of the dike if no action was taken and significant erosion of the foundation soils on the downstream side of the dike occurred. Loss of containment may result. This could lead to flooding within the open pit of the mine and a cessation of mining.	Monitor seepage flow for rate and volume, and for presence of sediment (turbidity). Monitor piezometric and thermistor data for signs of increased flow through the foundation and change in piezometric pressures. Monitor dike crest for signs of sinkholes, settlement or slope instability. Monitor inclinometers.	Grouting of the fractured bedrock. Deep bedrock grouting. In shallower areas, grouting or freezing. Installation of downstream filter blanket, stability berm.	**15**
	Erosion along instrumentation installed within the cutoff wall system. (Not applicable to South Camp Dike or Vault Dike)	**LOW – 1** Preferential flow paths may exist along the edge of vertical instrumentation conduits (thermistors, inclinometers, grout casings) due to inadequate sealing. Preferential seepage path of precipitation and melt water are potential sources of water which can flow down along the edge of the conduits. Erosion caused by precipitation and melt water is very unlikely due to the small volume of water. If this mechanism arises, it should show itself during initial dewatering or very shortly thereafter.	Gradual erosion of the SOIL BENTONITE material adjacent to the instrumentation.	**LOW – 2** This is not a catastrophic failure mode as the filter material and rockfill embankments of the dike will remain stable.	Monitor seepage flow for rate and volume, and for presence of sediment. Monitor piezometric and thermistor data for signs of increased flow through the foundation and change in piezometric pressures. Monitor dike crest for signs of sinkholes, settlement or slope instability.	Replacement of the instrumentation and sealing of the annular space.	**2**
High Seepage rates with no internal erosion	Through the Dike Section (including bedrock contact) : **EAST DIKE DIKE:** Increase in hydraulic conductivity of the dike's cutoff wall system resulting in high seepage flow through the structure. **BAY-GOOSE DIKE:** Increase in hydraulic conductivity of the dike's cutoff wall system (cutoff wall and jet grout columns) resulting in high seepage flow through the structure. **SOUTH CAMP DIKE AND VAULT DIKE:** Punctured or torn liner which will likely increase flow through the structure.	**MEDIUM – HIGH– 4** This seepage on its own is not a failure scenario. Seepage-related failures must include internal erosion (see above). Interface between different material exist and could lead to seepage with preferential paths (bedrock contact and for Bay-Goose dike: cement soil bentonite over soil bentonite material and potential gaps between jet grouting columns) If this mechanism arises it should show itself during initial dewatering or very shortly thereafter.	Increased seepage water handling.	**MEDIUM -3** May require upgrade of the seepage collection system. May need to suspend mining activities while reducing seepage. The downstream rockfill shell is both large and pervious and has an extremely high flow through capacity. **EAST DIKE AND BAY-GOOSE DIKE:** The large filter zone combination of core backfill and coarse filter are filter compatible and would maintain the structural integrity of the dike.	Monitor seepage flow for rate and volume, and for presence of sediment (turbidity).	Upgrade seepage collection system and increase pump capacity. Investigate and delineate high permeability zone. Installation of downstream filter blanket, stability berm	**12**

Failure Mechanism	Cause	Likelihood Rating	Effect	Consequence Rating	Controls		Overall Risk Rating
					Monitoring	Corrective Action	
	Through the bedrock: Fractures in the bedrock results in increased seepage into the pit.	**MEDIUM - 3** Seepage on its own is not a failure scenario. **EAST DIKE AND BAY-GOOSE DIKE:** Extensive bedrock grouting within the dike foundation reduces the likelihood for seepage at shallow depths. If this mechanism arises it should show itself as the pit advances with depth. **SOUTH CAMP DIKE AND VAULT DIKE:** Existing monitoring show that foundation material and bedrock beneath the structure is frozen throughout the year.	Increased seepage through the pit wall.	**LOW – 1** No significant consequences for the dike itself. May require upgrade of the seepage collection system. May result in increased inflows into the pit, and the potential cessation of mining with resulting financial loss.	Monitor seepage flow for rate and volume, and for presence of sediment (turbidity).	Installation of dewatering / depressurization wells to remove water before it reaches the pit. Deep bedrock grouting. In shallower areas, grouting or freezing.	**3**
Slope Instability (rotational or slip or sliding failure on the upstream and downstream side)	Failure through the dike and/or foundation. Concentrated seepage and elevated pore pressures may result in weakening of the foundation.	**LOW -2** The rockfill embankments have high shear strength. For slope failure to be a concern, it requires failure in the foundation which would then extend into the dike. Failure through the rockfill embankments will not necessarily compromise the water retaining element of the dike. Sliding failure is considered unlikely given the low horizontal forces generated by water and ice forces relative to the normal frictional force due to the weight of the dike and the friction angles of foundation materials. Limited available information on soil properties for dike stability analysis. This mechanism should develop during construction or dewatering, due to increase loads and associated pore water pressure.	Sloughing of the face Large seepage / inflow only if instability resulted in loss of the cutoff wall system.	**HIGH - 5** If failure were to occur it is likely to be through the lakebed soils affecting the rockfill embankments Failure which reaches the core may cause overall failure of the structure, leading to flooding within the open pit of the mine and a cessation of mining. Potential for loss of life for workers downstream of the dike. Limited access along the dike until repaired.	Initial stages of failure should be observable as tension cracks in the dike crest. Walk-over inspection of the dike by a trained inspector. Monitoring for bulging of dike toe. Survey of the dike crest, face, and toe. Slope inclinometer monitoring of the cutoff wall. Monitor piezometric and thermistor data for signs of increased flow through the foundation and change in piezometric pressures.	Stabilizing berms can be placed upstream and/or downstream of the dike. Installation of downstream filter blanket, buttress	**10**
	Excessive Vibration Due to blasting within the pit; or due to the occurrence of an extreme earthquake.	**LOW -2** The extreme earthquake loading for this site is of low magnitude. The East Dike setback of dike from pit crest reduces the vibration caused by blasting. The Bay-Goose Dike setback of dike from pit crest reduces the vibration caused by blasting. Rockfill structures are designed to resist against wave created by earthquake. **EAST DIKE AND BAY-GOOSE DIKE:** Dynamic compaction of the core during construction likely subjected the rockfill shells to accelerations equivalent to the expected earthquake loading and blasting vibration. Excessive vibration is unlikely to cause failure through the rockfill. The vibration may result in increased pore pressures within the foundation soils, weakening the foundation. This may cause failure in the rockfill but is unlikely to extend into the cutoff wall system.	Settlement of the dike could occur in the event of large vibrations. Increase in displacement and/or displacement rate of dike toe Sloughing of the face. Large seepage / inflow only if instability resulted in loss of the cutoff wall system.	**MEDIUM - 4** If failure were to occur it is likely to be through the lakebed soils affecting the rockfill shell. Limited access along the dike until repaired. Although unlikely, failure which reaches the core / liner may cause overall failure of the structure, leading to flooding within the open pit of the mine and a cessation of mining. Potential for loss of life for workers downstream of the dikes.	Survey of the dike crest, face, and toe. Dike inspection following larger than anticipated vibrations and earthquakes. Blast vibration monitoring Monitoring for bulging of dike toe. Look for cracks along the dike crest.	In the event the vibration produced cracks, monitor and assess the situation, and develop a remediation plan.	**8**

Failure Mechanism	Cause	Likelihood Rating	Effect	Consequence Rating	Controls: Monitoring	Controls: Corrective Action	Overall Risk Rating
	Pit wall instability that extends towards the dike and causes instability of the dike (NOT APPLICABLE TO SOUTH CAMP DIKE AND VAULT DIKE)	**EAST DIKE: LOW -2** **BAY-GOOSE DIKE: MEDIUM -3** Pit wall failure unlikely based on assessments of pit wall stability and setback. East Dike setback is greater than Bay-Goose Dike setback; therefore, it is viewed that the likelihood rating would be different for each structure. The respect of the setback established from pit crest. East Dike has a large setback from the pit crest, and therefore a low probability that pit instability will affect the dike. The Bay-Goose Dike setback from the pit crest is less than East Dike, and therefore has a higher probability that pit instability will affect the dike.	Increase in displacement and/or displacement rate of dike toe. Large seepage / inflow only if instability resulted in loss of the cutoff wall system.	**HIGH-5** If the instability impacted the cutoff wall system of the dike, then failure of the entire structure could result. Cessation /suspension of mining operations would have already occurred due to significant pit wall instability or failure.	Slope inclinometer monitoring of the cutoff wall. Survey of the dike crest and visual inspection. Pit wall stability monitoring. Visual observation related to cracks along the dike crest.	Depressurization of pit walls. Draining of lakebed soils between pit crest and dike and/or removal of these materials. Cut back slopes of pit wall and soils to unload the crest. Adjustment of mine plan, if necessary. Develop action plan to stabilize the instable pit wall area.	**EAST DIKE** **10** **BAY-GOOSE DIKE** **15**
Failure of cutoff wall	**BAY-GOOSE DIKE ONLY:** Excessive vibration from overblasting or earthquake above design could potentially damage the cement soil bentonite and/or jet grout columns resulting in cracks or fissures.	**LOW-2** The vibration may result in increased pore pressures within the foundation soils, weakening the foundation. This may cause failure in the rockfill but is unlikely to extend into the cutoff wall system. Refer to internal erosion as a failure mechanism if cracks lead to internal erosion. It is anticipated that the soil bentonite material would deform such that cracks would not be produced.	Increased seepage water handling.	**MEDIUM HIGH-4** May require upgrade of the seepage collection system. May need to suspend mining activities while reducing seepage. The cement content within these portions of the wall should reduce the erodability of the wall and therefore protect the integrity of the dike, even though seepage rates would increase.	Monitor seepage flow for rate and volume, and for presence of sediment (turbidity). Blast vibration monitoring on the dikes. Monitoring inclinometers within the cutoff wall.	Upgrade seepage collection system and increase pump capacity. Develop action plan related to potential grouting in cutoff wall fractured zone.	**8**
Failure of the liner system	**SOUTH CAMP DIKE AND VAULT DIKE ONLY:** Settlement of the foundation material	**LOW-2** In the unlikely event of thawing of the foundation material beneath the liner, settlement of the dike's foundation material will increase tension in liner, and potentially tear the liner	Increased seepage water handling.	**LOW-2** No significant consequences for the dike itself. May require upgrade of the seepage collection system.	Monitor seepage flow for rate and volume. Monitor thermistor data for signs of increased flow through the foundation.	Upgrade seepage collection system and increase pump capacity. Installation of downstream filter blanket, buttress Develop mitigation plan to decrease seepage through the structure	**4**
Premature Closure	Corporate Bankruptcy or Early Resource Depletion	**LOW-2**	Pumping will be suspended allowing the downstream area to flood (Note – long term closure plan is for flooding to occur). No or limited monitoring of dikes.	**LOW-2** Bond is provided for this eventuality. Design of rehabilitation is the same as rehabilitation at closure of project. Before mining operations could resume any water downstream would need to be pumped out and assessment of performance would need to be done.	Environmental monitoring to ensure closure requirements are met.		**4**

SECTION 13 • REFERENCES

Table 13.1 References

No.	Title	Document Centre Reference
1	AEM 2012. South Camp Dike Construction Summary Report. March 2012.	
2	AEM 2013. Construction Summary Report Vault Dike. July 29, 2013. Ver. 1.	
3	AMEC (AMEC Earth and Environmental) 2003. Baseline Hydrology Study.December 2003 with January 2004 errata sheets.	
4	AMEC 2005a. Meadowbank Gold Project Hydrologic Monitoring 2004 Draft Data Report. February.	
5	AMEC 2005b. Meadowbank Gold Project Feasibility Study Report. June.	
6	CDA (Canadian Dam Association) 2007. Dam Safety Guidelines.	
7	Golder (Golder Associates Ltd.) 2002. Factual Report on Geotechnical Drilling, Hydrogeological and Geophysical Investigations, Meadowbank Project, Nunavut. July 12. Doc. No. 116	
8	Golder 2003. Summary Report on Spring 2003 Field Geotechnical Studies, Meadowbank Project, Nunavut. September 8. Doc. No. 208	
9	Golder 2007a. Final Report Detailed Design of Dewatering Dikes Meadowbank Gold Project. Final Report. March 13. Doc. No. 342 Ver. 0.	
10	Golder 2007b. Report Addendum Detailed Design of Dewatering Dikes Meadowbank Gold Project. July 12. Doc. No. 492 Ver. 0.	
11	Golder 2008a. 2007 Till Core Material Investigation and Laboratory Testing, Meadowbank Gold Project. Technical Memo. January 25. Doc. No. 538 Ver. 0.	
12	Golder 2008b. East Dike Design Meadowbank Gold Project. Report. October 31 Doc. No. 572 Ver. 0.	
13	Golder 2009a. Bay-Goose Dike and South Camp Dike Designs. Meadowbank Gold Project, Nunavut. February 2. Doc. No. 802 Ver. 0.	
14	Golder 2009b. Meadowbank East Dike Grouting Response Plan - Completed Works. July 14. Doc. No. 916 Ver. 0.	
15	Golder 2009c. 2009 Annual Geotechnical Inspection - Meadowbank Gold Project. November 30. Doc. No. 969 Ver. 0.	
16	Golder 2009d. East Dike Additional Details for Work Carried Out Between Stations 60+452 and 60+500. Meadowbank Gold Project. November, 2009. Doc. No. 961 Ver. 0.	
17	Golder 2009e. East Dike Construction As-Built Report Meadowbank Gold Project, Nunavut. December 15. Doc. No. 900 Ver. 0 Rev. 1.	
18	Golder 2009f. West Channel Dike Construction As-Built Report Meadowbank Gold Project, Nunavut. December 16. Doc. No. 980 Ver. 0.	
19	Golder 2010a. East Dike Sinkhole Investigation Program, October-November 2009, Meadowbank Gold Project. March 5 2010. Doc. No. 986 Ver. 0.	
20	Golder 2010. Draft of South Camp Construction As-built report. No. 1037 Ver. B. Meadowbank Gold Project. 22 April 2010	
21	Golder 2010b. East Dike CPT Investigation - Meadowbank Gold Project, Nunavut. July 22. Doc. No. 953 Ver. 0.	
22	Golder 2010c. 2010 Annual Geotechnical Inspection. Meadowbank Gold Project, Nunavut. December 3. Doc. No. 1216 Ver. 0.	

No.	Title	Document Centre Reference
23	Golder 2011a. Draft of 2011 Annual Geotechnical Inspection. Meadowbank Gold Project, Nunavut. November 21 2011. Doc. No. 1305 Ver. B.	
24	Golder 2013. Bay Goose Dike Construction As-Built Report Meadowbank Gold Project. Meadowbank Gold Project, Nunavut. April 2013. Doc. No. 1328 Ver. 0.	
25	ICOLD (International Congress of Large Dams) 1998. Dam Failures and Statistical Analysis. Bulletin 99.	
26	MAC (Mining Association of Canada) 2005. Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities.	
27	MMC (Meadowbank Mining Corporation) 2014. Emergency Response Plan. November. Ver. 9	
28	SNC 2013a. Detailed Engineering of Vault Dike. Meadowbank Gold Project, Nunavut. January 14. Doc. No. 610548-2020-4GER-0001 Ver. 0.	
29	SNC 2013b. Construction of Vault Dike – Technical Specifications. Meadowbank Gold Project, Nunavut. February 1. Doc. No. 610548-2020-4GEF-0001 Ver. 0.	

Appendix A

Inspection Forms

DETAILED FIELD INSPECTION FORM A
DEWATERING / DIKE INSPECTION REPORT
MEADOWBANK GOLD PROJECT

All parts of this inspection form should be completed. Adverse conditions should be described and location stated. Additional information and relevant photographs should be attached.

Inspecting Officer	Choose an item.
Report No.	
Inspection Date	12/12/2014

Dam ☐ ***Dike*** ☐	
Crest Elevation (m)	
Reclaim Water Elev. (m)	

Last Inspection Date											
Weather during the current inspection	C°	Sunny	☐	Overcast	☐	Rain	☐	Snow	☐	Wind	☐
	Comments:										
Main changes occurred since the last inspection											

TABLE OF CONTENT

DOWNSTREAM SLOPE AREA 2
UPSTREAM SLOPE AREA 3
DOWNSTREAM BERMS: 4
UPSTREAM BERMS 5
CREST SURFACE 6
DAM / DIKE INSTRUMENTATION 7
GENERAL CONDITION SUMMARY 8
RECOMMENDATIONS 8
APPENDIX I : PLAN 9
APPENDIX II : PHOTOGRAPHS 10

DETAILED FIELD INSPECTION FORM A
DEWATERING / DIKE INSPECTION REPORT
MEADOWBANK GOLD PROJECT

AGNICO EAGLE
MEADOWBANK

DOWNSTREAM SLOPE AREA

	Presence	Crest	Slope	Toe	Pictures
A) Erosion	☐	☐	☐	☐	☐
B) Settlements	☐	☐	☐	☐	☐
C) Bulging	☐	☐	☐	☐	☐
D) Sloughing	☐	☐	☐	☐	☐
E) Slope Protection	☐	☐	☐	☐	☐
F) Vegetation	☐	☐	☐	☐	☐
G) Animals Burrows	☐	☐	☐	☐	☐
H) Seepage*	☐	☐	☐	☐	☐
I) Ice	☐	☐	☐	☐	☐
J) Snow	☐	☐	☐	☐	☐

* Seepage

Location 1					
Rate	Damp ☐	Trickle ☐	Steady ☐		(L/s)
Clarity	Clear ☐	Muddy ☐	*Comments :*		
Sample taken					
Location 2					
Rate	Damp ☐	Trickle ☐	Steady ☐		(L/s)
Clarity	Clear ☐	Muddy ☐	*Comments :*		
Sample taken					

☐ **Sand boils presence**	Type	
	Location(s)	

Comments :

DETAILED FIELD INSPECTION FORM A
DEWATERING / DIKE INSPECTION REPORT
MEADOWBANK GOLD PROJECT

AGNICO EAGLE
MEADOWBANK

UPSTREAM SLOPE AREA

	Presence	Crest	Slope	Toe	Pictures
A) LLDPE	☐	☐	☐	☐	☐
B) Bituminous Membrane	☐	☐	☐	☐	☐
C) Sink Holes	☐	☐	☐	☐	☐
D) Water on Liner	☐	☐	☐	☐	☐
E) Objects over the Liner	☐	☐	☐	☐	☐
F) Damages on Liner	☐	☐	☐	☐	☐
G) Erosion	☐	☐	☐	☐	☐
H) Settlements	☐	☐	☐	☐	☐
I) Bulging	☐	☐	☐	☐	☐
J) Sloughing	☐	☐	☐	☐	☐
K) Slope Protection	☐	☐	☐	☐	☐
L) Vegetation	☐	☐	☐	☐	☐
M) Animals Burrows	☐	☐	☐	☐	☐
N) Ice	☐	☐	☐	☐	☐

Comments:

**DETAILED FIELD INSPECTION FORM A
DEWATERING / DIKE INSPECTION REPORT
MEADOWBANK GOLD PROJECT**

AGNICO EAGLE MEADOWBANK

DOWNSTREAM BERMS:

	Presence	*Pictures with scale*
A) Cracks	☐	☐
B) Erosion	☐	☐
C) Settlements	☐	☐
D) Bulging	☐	☐
E) Sloughing	☐	☐
F) Vegetation	☐	☐
G) Animals Burrows	☐	☐
H) Seepage*	☐	☐
I) Drainage Trench	☐	☐
J) Snow	☐	☐

* Seepage

Location 1								
Rate	Damp	☐	Trickle	☐	Steady	☐		(L/s)
Clarity	Clear	☐	Muddy	☐	*Comments :*			
Sample taken								
Location 2								
Rate	Damp	☐	Trickle	☐	Steady	☐		(L/s)
Clarity	Clear	☐	Muddy	☐	*Comments :*			
Sample taken								

☐ ***Sand boils presence***	Type	
	Location(s)	

Comments:

DETALED FIELD INSPECTION FORM A
DEWATERING / DIKE INSPECTION REPORT
MEADOWBANK GOLD PROJECT

AGNICO EAGLE
MEADOWBANK

UPSTREAM BERMS

	Presence	Pictures with scale
A) Cracks	☐	☐
B) Erosion	☐	☐
C) Settlements	☐	☐
D) Bulging	☐	☐
E) Sloughing	☐	☐
F) Vegetation	☐	☐
G) Animals Burrows	☐	☐
H) Seepage*	☐	☐
I) Drainage Trench	☐	☐
J) Snow	☐	☐

* Seepage

Location 1					
Rate	Damp ☐	Trickle ☐	Steady ☐		(L/s)
Clarity	Clear ☐	Muddy ☐	*Comments :*		
Sample taken					
Location 2					
Rate	Damp ☐	Trickle ☐	Steady ☐		(L/s)
Clarity	Clear ☐	Muddy ☐	*Comments :*		
Sample taken					

☐ *Sand boils presence*	Type	
	Location(s)	

Comments:

DETAILED FIELD INSPECTION FORM A
DEWATERING / DIKE INSPECTION REPORT
MEADOWBANK GOLD PROJECT

AGNICO EAGLE
MEADOWBANK

CREST SURFACE

	Presence	*Pictures with scale*
A) Cracks	☐	☐
B) Erosion	☐	☐
C) Settlements	☐	☐
D) Bulging	☐	☐
E) Sloughing	☐	☐
F) Vegetation	☐	☐
G) Animals Burrows	☐	☐
H) Seepage*	☐	☐
I) Drainage Trench	☐	☐
J) Rutting	☐	☐
K) Mud	☐	☐
L) Pond (Puddle)	☐	☐
M) Saturated Soil	☐	☐
N) Snow	☐	☐

* Seepage

Location 1							
Rate	Damp	☐	Trickle	☐	Steady	☐	(L/s)
Clarity	Clear	☐	Muddy	☐	*Comments :*		
Sample taken							
Location 2							
Rate	Damp	☐	Trickle	☐	Steady	☐	(L/s)
Clarity	Clear	☐	Muddy	☐	*Comments :*		
Sample taken							

☐ ***Sand boils presence***	Type	
	Location(s)	

Comments:

DETAILED FIELD INSPECTION FORM A
DEWATERING / DIKE INSPECTION REPORT
MEADOWBANK GOLD PROJECT

AGNICO EAGLE
MEADOWBANK

DAM / DIKE INSTRUMENTATION

(Plot any newly installed instrumentation on relevant plans and cross-sections)

Instruments	*Operational*	*Damaged*	*Measurement Taken*
☒ ***Inclinometers***	☐	☐	☐ Bi-monthly
☒ ***Piezometers***	☐	☐	☐ Daily 3hrs interval
☐ ***Thermistors***	☐	☐	☐ Daily 3hrs interval
☐ ***Survey Prisms***	☐	☐	☐ Bi-monthly
☐ ***Thermistors (manual) (4)***	☐	☐	☐ Every 7 Days (winter)

DETALED FIELD INSPECTION FORM A
DEWATERING / DIKE INSPECTION REPORT
MEADOWBANK GOLD PROJECT

AGNICO EAGLE
MEADOWBANK

GENERAL CONDITION SUMMARY

- A
- B

RECOMMENDATIONS

- A
- B

☐ ***Action required***	☐ *None*	☐ *Further monitoring*	☐ *Immediate remediation*
☐ ***Plan or Sketch Attached***	See Appendix I		
☐ ***Photographs (13)***	See Appendix II		

Review Officer: ____________ Review Agency: ____________ Date Reviewed: Click here to enter
(DD/MM/YR)

REVIEW COMMENTS:

DETAILED FIELD INSPECTION FORM A
DEWATERING / DIKE INSPECTION REPORT
MEADOWBANK GOLD PROJECT

APPENDIX I : PLAN

Figure 1 :

DETAILED FIELD INSPECTION FORM A
DEWATERING / DIKE INSPECTION REPORT
MEADOWBANK GOLD PROJECT

AGNICO EAGLE
MEADOWBANK

APPENDIX II : PHOTOGRAPHS

Figure 2 :

Figure 3 :

DAILY REPORT
DIKE AND GEOTECHNICAL ENGINEERING
AGNICO-EAGLE MINES MEADOWBANK PROJECT

AGNICO EAGLE MEADOWBANK

Date: 12/12/2014 **Technician / Engineer:**

Weather : Sunny ☐ Overcast ☐ Rain ☐ Snow ☐ Wind ☑ Comments:

Health and Safety: Concern / Incident Y ☐ N ☑

Comments:

Dewatering Dikes						
	BayGoose Dike		Field Visit	Y ☐	N ☑	Comment / Observation:
Instrumentation	Piezometers (Auto.)	☑	Photos	Y ☐	N ☑	
		☐				
	Thermistors (Auto.)	☑				
	Thermistors (4) (Manual)	☐				
	Inclinometer	☐	Work Activity	Y ☐	N ☑	Description:
	SeePage (2,6,7,9,10,11)	☐				
	USB key (DL9)	☐				
	East Dike		Field Visit	Y ☐	N ☑	Comment / Observation:
Instrumentation	Piezometers (Auto.)	☑	Photos	Y ☐	N ☑	
	Thermistors (Auto.)	☑				
	Thermistors (Manual)	☐	Work Activity	Y ☐	N ☑	Description:
	Inclinometer	☐				
	Survey Prisms	☐				
	South Camp Dike		Field Visit	Y ☐	N ☑	Comment / Observation:
Instrumentation	Thermistor (Manual)	☐	Photos	Y ☐	N ☑	
			Work Activity	Y ☐	N ☑	Description:
	Vault Dike		Field Visit	Y ☐	N ☑	Comment / Observation:
Instrumentation	Thermistors (Manual)	☐	Photos	Y ☐	N ☑	
Vault Lake :	2 Flowmeter	☐	Work Activity	Y ☐	N ☑	Description:
Instrumentation	Piezo. Vpond 11 (Manual)	☐				
Tailings Facilities System						
	Stormwater Dike		Field Visit	Y ☐	N ☑	Comment / Observation:
			Photos	Y ☐	N ☑	
			Work Activity	Y ☐	N ☑	Description:
	Saddle Dam 1		Field Visit	Y ☐	N ☑	Comment / Observation:
			Photos	Y ☐	N ☑	
Instrumentation	Thermistors (Manual)	☐				
			Work Activity	Y ☐	N ☑	Description:
	Saddle Dam 2		Field Visit	Y ☐	N ☑	Comment / Observation:
			Photos	Y ☐	N ☑	
Instrumentation	Thermistors (Manual)	☐				
			Work Activity	Y ☐	N ☑	Description:
	Coffer Dam - Central Dike		Field Visit	Y ☐	N ☑	Comment / Observation:
			Photos	Y ☐	N ☑	
Instrumentation	Piezometers (Manual)	☐				
Instrumentation	Thermistor (Manual)	☐	Work Activity	Y ☐	N ☑	Description:
	OTHER		Work Activity	Y ☐	N ☑	Description:
		☐				

Ground Control Inspection - Open Pit				
Review of Ground Control F Y ☐	N ☑	**Pit Visit** Y ☐	N ☑	Comment/Observations:
Items to Review (num.):				
Items Follow Up in Ground Control Registrer (after visit) Y ☐	N ☑			

X:\General\Reports\Daily Reports\2014\[Template_2014.xlsx]Sheet1

Appendix B

Dike Failure Scenario from the ERP

Dewatering Dike System

The Dewatering Dike System includes the East Dike, Bay Goose Dike, South Camp Dike and Vault Dike as shown on the general mine site plan provided at the beginning of this document. The dike construction for East Dike and Bay Goose Dike involved the dumping of rockfill into water to create the shells of the dikes, excavation through rockfill and lakebed soils to bedrock, placement of granular filter and core materials, dynamic compaction, construction of the cut off wall using slurry supported trench techniques and grouting of the bedrock and contact between the cut off wall and bedrock using cementitious grout. South Camp Dike and Vault Dike both include a bituminous liner and a key trench cut-off to make the structure impermeable. East Dike and Bay Goose Dike have crest widths in excess of 50 m and are not used by haul trucks during normal mine operation. South Camp Dike and Vault Dike have crest widths in excess of 25 m and may be used as haul roads during normal mine operation.

East Dike and Bay Goose Dike are considered high consequence structures, based on Canadian Dam Association (CDA, 2007) Dam Safety Guidelines. South Camp Dike is considered to be a significant consequence structure, based on Canadian Dam Association (CDA, 2007) Dam Safety Guidelines. Vault Dike is considered to be a low consequence structure, based on Canadian Dam Association (CDA, 2007) Dam Safety Guidelines. The dikes are relatively low, wide structures that exceed the minimum design criteria factors-of-safety (FoS) for stability for pre-drawdown conditions, operation conditions with maximum head difference across the dikes, pseudo-static earthquake conditions, and post closure conditions. Consequently, the probability of dike failure is considered to be low provided that the dikes are constructed according to the design. Mitigation against failure of the dikes includes a quality control and quality assurance program during construction, and an ongoing program of dike surveillance and monitoring during operations, as specified in the design.

For information on the consequences and monitoring/action for the various embankment failure modes possible at the Dewatering Dikes see Table A.1 below.

East Dike

The East Dike was constructed in 2008, with foundation grouting continuing into early 2009. The East Dike has a crest length of 800 m, including abutments, and was constructed in water with a maximum water depth to bedrock at the cut off of 7.2 m. The crest of the East Dike is at elevation 137.1 m and the average lake level along the dike is 133.1 m. The main components of the East Dike include a rockfill shell, a granular core with downstream filter zone, a soil-bentonite cut-off wall through the densified granular core zone to the underlying foundations, and a grout curtain from the base of the cut-off wall into the underlying bedrock.

During operations, the East Dike separates the eastern portion of Second Portage Lake from the Portage Pit and the Tailings Storage Facility behind the Central Dike. Following closure, the East Dike will remain as a permanent structure that will separate Third Portage Lake (El. 134.1 m) from Second Portage Lake (El. 133.1 m) and maintain the existing water elevation difference of 1 metre.

The East Dike is approximately 800 m in length through an average water depth of approximately 2.3 metres, and a maximum water depth to bedrock of about 7.2 m. Crest width is approximately 55 metres. Minimum setback from the Portage Pit (distance between dike toe and pit crest) is greater than 170 metres.

Bay Goose Dike

The Bay Goose Dike together with the South Camp Dike isolates the Bay-Goose Pit from Third Portage Lake. The Bay Goose Dike acts as a permanent structure to allow mining of the Goose Pit and the southern portion of Portage Pit. The main components of the Bay Goose Dike include a rockfill shell, a granular core with downstream filter zone, a soil-bentonite and cement-soil-bentonite cut-off wall through the densified granular core zone to the underlying foundations, a jet grouted wall between the base of the cut-off wall and bedrock where the cut-off wall was not constructed on bedrock, and a grout curtain from the base of the cut-off wall or jet grouted wall into the underlying bedrock.

The Bay Goose Dike is approximately 2,200 m in length, and was constructed in water depths less than 9 metres at the cut off. Crest width varies between approximately 85 and 100 m. Minimum design setback from the Portage and Goose Pit is 70 metres.

South Camp Dike

The South Camp Dike covers a narrow channel within Third Portage Lake and in conjunction with the Bay Goose Dike isolates the Bay Goose Pit from Third Portage Lake.

The South Camp Dike is located south of the plant site area and is used to connect the mainland to South Camp Island. It covers a narrow channel, approximately 60 m in width, where water depths were between 0.5 and 1 m.

The South Camp Dike was primarily constructed between April and June of 2009, prior to ice breakup. During the winter of 2009-2010 additional thermal capping material and rock fill for the haul road was added to the dike. The South Camp Dike has a broad rock fill shell with a bituminous geo-membrane liner installed on the upstream side of the shell. The liner was founded on native frozen (permafrost) till material, in a trench approximately 3 to 5 m below the lakebed surface. Compacted granular material mixed with bentonite was placed above the toe of the liner. The haul road is located on the downstream side of the dike. The South Camp Dike is approximately 85 m in length through water depths between 0.5 and 1m. Crest width is approximately 25 metres.

Vault Dike

The construction of the Vault Dike at Meadowbank was conducted from February 2013 to March 2013. Vault Dike is located across a shallow creek which connects Wally Lake and Vault Lake, at the Vault Pit area approximately 8 km north of the main Meadowbank site. Vault Dike is essential to allow the dewatering of Vault Lake and to isolate Vault Pit from Wally Lake during mining activities.

Vault Dike is designed and constructed as a zoned rock fill dam with filter zones, an impervious upstream liner consisting of a bituminous membrane, and an upstream key trench made of aggregate mixed with bentonite. The filter zones minimize seepage and internal erosion and facilitate seepage collection. Vault Dike includes a key trench at the base of the upstream side filled with a 0-25 mm fill amended with bentonite surrounding the liner. Coarse and fine filter material was placed on the upstream slope as geomembrane bedding. The bulk part of the dike consists of coarse rock fill material. The embankment crest is at El. 142.4 m and the upstream toe is at approximately El. 139.4 m. The downstream toe is at approximately El. 139.6 m and the bottom of the key trench ranges from El. 135.6m to El. 142.3m, with an average height of El. 137.0m. The upstream and downstream fill slopes of the dam are 1.5H: 1V. The Vault Dike is approximately 275 m in length through a maximum water depth of 1 m. The crest width is approximately 25 metres.

Table A.1: Meadowbank Dewatering Dikes Summary of Consequences and Proposed Monitoring/Action for Rare Events Based on Water Retaining Embankment Failure Modes Identified in ICOLD Study (1995)

Failure Mode	Scenario	Consequence	Monitoring/Action
Overtopping	(1) Lake level rise because of restricted outflow from Third Portage, Second Portage Lake or Wally Lake (excessive inflow is a far less likely scenario).	Water spilling over the crest. The crest is wide and comprises coarse rock fill. Significant damage to the dike is not credible, based on performance of other rock fill structures subjected to overtopping or flow through events. Mining operations might need to be suspended, but there will be considerable warning time given the design freeboard and the storage volume within the lakes.	Lake levels should be part of safety information provided to mine management. Outflow channels should be inspected weekly during thaw, open water season, and during ice break-up. If overtopping is likely, a temporary spillway could be constructed and armoured to control and localize flow at shallow dike sections.
	(2) Dam crest settles more than 2m over a distance of (say) 50m or so. This scenario requires extensive loss of support in the foundation since the rock fill of the dikes is essentially not settlement prone itself. For foundation settlement of this magnitude to occur, a piping event must develop and which in itself might be a failure mode. Or, there would have to be an unexpected layer of compressible soil in the foundation.	Same as (1).	The situation envisaged in this scenario should develop slowly with crest settlement evident at least several weeks before a run-away event develops. Easily observed cracks should be evident. Monitoring of crest settlement is appropriate, and is included in the design. Rockfill and till available from the mining operation can be placed to raise the dike crest.
Internal Erosion	(1) Dike Section: Cut off wall, cut off key trench or bituminous liner is defective, allowing high water flow across the wall. This defect occurs at a deep water location where the core backfill and filters are segregated and permeable; the combination allows erosion of the cut off wall and increasing seepage.	The cut off wall will develop a progressively increasing void ratio, thereby increasing the rate of water flow through the dike. This is not a catastrophic failure mode as the rockfill shoulders of the dike will be stable, and at its worst, would lead to temporary suspension of mining.	Monitor seepage from downstream face for rate of seepage, and for presence of sediment in seepage. Will become evident as localized intensive seepage at dike toe and can be repaired. May also see settlement in the cut off wall. Will be most likely in deep water sections. Gradients across the cut off wall in shallow water are not high enough to cause piping.
	(2) Dike Section: Cut off wall loses bentonite because of improper construction.	Same consequences as erosion because of defect, as above.	Bentonite makes up 2% of the cut off wall fill. Loss of this material will increase the permeability of the cut off wall and increase the rate of seepage.

Failure Mode	Scenario	Consequence	Monitoring/Action
	(3) Foundation: Till is possibly non-uniform with more transmissive zones and not self-filtering. It is possible that one of these zones may align with defective construction of the core backfill and defective construction of the cut off wall allowing high flows. Seepage along the transmissive zone beneath the downstream rockfill section could erode the foundation tills at the downstream toe or flow into the downstream rockfill because of the lack of filtering.	Limited seepage at the toe or into the rockfill would accelerate into a large inflow, and could lead to the undermining of the dike if no action was taken. This is a credible catastrophic failure mode if increased seepage is not detected in time.	No particular instrumentation is needed as this failure mode will show itself as localized and increasing seepage. It could be detected by walk-over inspection by an experienced engineer or technician. Remedial action could comprise a reverse filter and rockfill buttress depending on location of the flow and configuration of the foundation, freezing, or grouting if identified in time. Quality control of cut off is important, and most important for deep water sections. In the worst case, the pit may be deliberately flooded in a controlled manner, the cut off repaired, and the pit dewatered.
Seepage within Embankment	Seepage on its own is not a credible failure scenario. The downstream rockfill shell has extremely high flow through capacity. The rockfill zone is both large and pervious, so that seepage will daylight on the downstream face and lead to instability. Any seepage related failures must include internal erosion, see above.	No credible consequences. May require upgrade of the seepage collection system. May need to suspend mining activities while reducing seepage.	Seepage monitoring program.
Seepage within Foundation	Defective construction of cut off leading to transfer of unexpectedly high fraction of the reservoir head into the downstream part of the dike foundation, or leading to a piping event as above.	This failure mechanism has caused embankment failures elsewhere because of straightforward pore pressure induced instability. However, it is unclear that it could cause failure of the Dewatering Dikes because of their large width compared to the retained water head. The most likely consequence is downstream toe slumping requiring a localized stabilizing berm before the crest roadway could be reinstated.	If this mechanism arises it should show itself during initial dewatering or very shortly thereafter.

Failure Mode	Scenario	Consequence	Monitoring/Action
Internal Conduit Rupture	There are no water off take works or other structures extending through the dikes.	Not applicable.	Not applicable.
Slope Instability	(1) Normal Operation: The rockfill shoulders of the dikes are wide and have high shear strength, making it a conservative design. Slope failure requires failure in the foundation and which would then extend into the overlying dike. Sliding failure is considered unlikely given the low horizontal forces generated by water and ice forces relative to the normal frictional force due to the weight of the dikes and the friction angles of foundation materials	A foundation failure would cause a rotational slip or sliding failure until equilibrium was reached. This mechanism would limit access along the dike until repaired. Failure through the rockfill shoulders will not necessarily compromise the water retaining function of the dikes. Failures which reach the core may cause failure.	This mechanism should develop during construction or dewatering, due to increase in load and associated pore water pressure increase. Initial stages of failure should be observable as tension cracks in the dike crest. Walk-over inspection of the dikes by a trained inspector is an appropriate monitoring strategy. Survey of crest, face, and toe is also appropriate. Stabilizing berms can be placed inside the dikes or through water along the upstream shoulder.
	(2) Earthquake Induced: Occurrence of an extreme earthquake, much in excess of the current understanding of seismicity of the area.	The extreme earthquake loading for this site is a low magnitude. Settlement of the dikes could occur in the event of a large earthquake. Dynamic compaction of the core during construction may have subjected the rockfill shells to accelerations equivalent to the expected earthquake loading. This would not be a failure situation. The crest is also erosion resistant for any earthquake induced wave action in the impounded water.	Dike inspection following earthquakes felt on site.

Failure Mode	Scenario	Consequence	Monitoring/Action
Failure of Cut off Wall or Bituminuous Liner Due to Movement of the Dikes	Differential horizontal movement of dikes due to water or ice loading, or pit wall failure. Creates a breach in the cut off wall, cut off key trench or bituminuous liner. Ice and water forces are not credible due to the ratio of frictional forces generated by the weight of the dike versus ice loads and water pressure. Pit wall failure involving the dike unlikely based on assessments of pit wall stability and setback distance between the pit and the dikes.	Large inflows through the breach. Pit would flood requiring suspension of mining activities. Potential for loss of life for workers inside dikes.	No enhanced monitoring. Prism monitoring program sufficient. If the pit floods, then repairs to cut off or bituminuous liner would be done prior to dewatering.
Unexpected Settlements	Unexpected foundation soils consolidate during dike construction. A significant quantity of clay that was not recognized during foundation excavation would be required to generate settlement required for a water release event. Settlement of the core will be limited by dynamic compaction.	2 m of core settlement would be required to allow water flow through the rockfill and over the settled core. This flow would not cause failure of the rockfill shells. It would also be readily repaired by placing more end-dumped till into the settled zone.	No enhanced monitoring required, as settlement would be apparent from prism monitoring data and visual inspection. Excessive settlements may be remediated by excavating rockfill above the core and placing more till. Soil conditions will be observed during construction, and design revised to accommodate actual conditions.

A.1.1 Failure Scenario during Operations

The 'worst-case' scenario for failure of the dewatering dikes during operations would involve a movement of the dikes that compromises the integrity of the cut off wall, cut off key trench or bituminous liner. However, the rockfill has a very high flow-through capacity and a high strength and will not move unless the foundation is involved. The water will flow through the upstream rockfill first, then through the core and cut off wall, cut off key trench or bituminous liner, and finally through the downstream rockfill berm. Flow through cracks opening in the foundation may erode the foundation soils and the core. The upstream rockfill will choke the flow to some degree, and flow will decrease once the downstream toe of the dike is inundated and the head difference across the dike begins to reduce.

Although this describes a 'worst-case' scenario, a catastrophic failure of the pit dewatering dike system is not considered a credible failure mode. Elements of the dike design, including the width of the dike section, and the inclusion of filters, in addition to the cut off wall, cut off key trench and bituminous liner make catastrophic failure of the dike highly unlikely. However, for the purposes of this document, the effects of such a failure are described below.

Potential Effect

In the case of East Dike, the worst-case scenario would be associated with the short portion of the dike through the deepest water along the alignment at the centre of the dike. In this area the water depth is as much as 7 m to bedrock at the cut off wall within the dike. This inflow could potentially result in loss of workers caught in flowing water. Breach of the East Dike would be unlikely to trap workers in the pit when access ramps are on the west side, opposite the inflows. Breach of the East Dike would result in cessation of mining, either temporarily or permanently.

Upon completion of the East Dike and dewatering of the northwest arm of Second Portage Lake, there was approximately 17 million m^3 (Mm^3) of water remaining in Second Portage Lake. If the segment of dike at the deepest portion were suddenly removed, flow from Second Portage Lake into the pit would continue until the elevation of the lake drops by several metres, at which time the current lake bottom would be exposed and would act as a barrier to flow towards the pit. This scenario is the worst in the final year of pit operation when pit volume is the largest. The volume of water associated with this drawdown would be on the order of about 10 Mm^3. Some erosion of the till between the pit crest and dike toe would be expected, so the depth of water loss from the lake may be larger, but this would take some time to fully develop.

Inflow to the pit could expose large amounts of shoreline and shoal habitat around the lake. Water flowing into the pit could entrain suspended solids and dissolved constituents from the dike material and pit walls. If necessary, the water could be retained within the pit and diked area and would be amenable to treatment (e.g., particle settling, in-situ amendment) before discharge, should it be required.

The ecological effects of the exposure of shoreline and shoal habitat on fish and fish habitat would be to temporarily eliminate spawning areas and result in reduced water quality from exposure of sediment to wave and wind induced erosion. The effect of this would last approximately one year as inflow from Third Portage Lake to Second Portage Lake averages 10 Mm^3 annually (AMEC, 2003). Presuming that the dike breach is repaired, water levels in Second Portage Lake would rise over the spring and summer to return to pre-breach elevations and would re-fill the lake in the event of a 'worst-case' scenario.

In the case of Bay Goose Dike, the worst-case scenario dike breach that could allow the greatest amount of water inflow would be associated with the southeast segment of the dike through the deepest water along the alignment. In this area, water depth is as much as 20 m deep at the cut off, and the pit could be as deep as 130 m. This inflow could potentially result in loss of workers caught in flowing water. Breach of the Bay Goose Dike would be unlikely to trap workers in the pit when access ramps are on the northwest side, opposite the inflows. Breach of the Bay Goose Dike would result in cessation of mining of the Goose Pit, either temporarily or permanently.

In the unlikely event that such a failure of the Bay Goose Dike were to occur, the rate and volume of water entering the downstream pit would depend on the magnitude of the breach and the length of time to repair the breach. Third Portage Lake has an estimated volume of 446 Mm^3 (Golder, 2006). The final volume of Portage Pit (30.0 Mm^3) is roughly 6.7% of the volume of the lake, while Goose Pit (14.8 Mm^3) is approximately 3.3% of the volume. In the case of a catastrophic breach of the Bay Goose Dike, the estimated Third Portage Lake water level drawdown would be approximately 1.0 m and 0.5 m, respectively assuming that the failure occurs when the pits are completely excavated and a complete filling of the pits. These estimated worst-case scenario changes in water level are comparable to the mean average annual difference between high and low water (0.3 m) on Third Portage Lake.

There would be a small impact to fish and fish habitat in Third Portage Lake in the event of a 0.5 m to 1.0 m drop in water level. Areas used for spawning may be slightly nearer to the ice cover and a small amount of habitat might be vulnerable to freezing. Water quality within the pit would be temporarily impaired from an increase in suspended and dissolved solids, although water quality would return to near background during the first winter as sediment would settle under the ice cover.

In the case of South Camp dike, the worst-case scenario dike breach that could allow the greatest amount of water inflow would be associated with the centre segment of the dike through the deepest water along the alignment. In this area, the water depth is only a maximum of 1 m. This inflow could put the workers at risk at the site on a temporary basis and a potential loss of life between 0 and 10 due to workers caught in flowing water. Breach of South Camp Dike could eventually result in cessation of mining, either temporarily or permanently.

If the segment of dike at the deepest portion were suddenly removed, flow from Third Portage Lake into the pit would continue until the elevation of the lake drew down slightly as South Camp Dike retains a maximum depth of 1 m of water. The impact of a potential failure would likely be limited.

Inflow to the pit could expose a limited amount of shoreline and shoal habitat around the lake. Water flowing into the pit could entrain suspended solids and dissolved constituents from the dike material and pit walls. If necessary, the water could be retained within the pit and diked area and would be amenable to treatment (e.g., particle settling, in-situ amendment) before discharge, should it be required.

The ecological effects of the dike failure will probably have no significant fish or wildlife habitat, affected or deteriorated. Presuming that the dike breach is repaired, water levels in Third Portage Lake would rise over the spring and summer to return to pre-breach elevations and would re-fill the lake in the event of a 'worst-case' scenario.

In the case of Vault dike, the worst-case scenario dike breach that could allow the greatest amount of water inflow would be associated with the centre segment of the dike through the deepest water along the alignment. In this area, the water depth is only a maximum of 1 m. This inflow could put the workers at risk at the site on a temporary basis and a potential loss of life between 0 and 10 due to workers caught in flowing water. Breach of the Vault Dike could eventually result in cessation of mining, either temporarily or permanently.

If the segment of dike at the deepest portion were suddenly removed, flow from Wally Lake into the pit would continue until the elevation of the lake drew down slightly as Vault Dike retains a maximum depth of 1 m of water. The impact of a potential failure would be limited.

Inflow to the pit could expose a limited amount of shoreline and shoal habitat around the lake. Water flowing into the pit could entrain suspended solids and dissolved constituents from the dike material and pit walls. If necessary, the water could be retained within the pit and diked area and would be amenable to treatment (e.g., particle settling, in-situ amendment) before discharge, should it be required.

The ecological effects of the dike failure will probably have no significant fish or wildlife habitat, affected or deteriorated. Presuming that the dike breach is repaired, water levels in Wally Lake would rise over the spring and summer to return to pre-breach elevations and would re-fill the lake in the event of a ‘worst-case’ scenario.

Mitigation, Management, and Monitoring

A major cut off breach scenario due to pit wall movement, while possible, has a low probability of occurrence in East Dike or Bay Goose Dike. If foundation movement was sufficient to compromise the cut off wall, then the core backfill would act as a semi-permeable element and limit flow. Water would first need to flow through the rockfill shell, the core backfill, the damaged cut off wall, and then through more of the core, filters, and the downstream rockfill. Provided that the downstream filter elements against the rockfill shell are properly constructed, then migration of the core and cut off wall into the rockfill will not occur. Some additional seepage may occur due to failure of the cut off wall; however this would be noted during regular monitoring. Mitigation could be by jet grouting, freezing, or installation of sheet piling through the cut off wall.

The use of appropriately graded filters in the design of dikes and dams is standard engineering practice, and is the key to preventing internal erosion. The dike design includes the use of a two zone filter on the upstream face of the pit side rockfill. During the construction of the dikes a quality control and quality assurance program was undertaken.

Routine visual inspection of the dikes is to be conducted on a regular basis to document any changes in the dikes.

During the operation of the dikes, a series of monitoring instrumentation will be installed, including:

- Thermistors to monitor the thermal regime in the dike and foundations;
- Slope inclinometers and prisms to monitor deformations within the dikes; and
- Piezometers to measure pressure and to infer flow through the dikes.

Piezometers downstream of the cut off wall would be monitored for pressure changes as the pits are deepened. Increasing pressure would indicate that less head loss is occurring across the seepage cut off, which might indicate that a crack has formed, permeability is increasing, or the pit is experiencing inflows from some other potential flow pathway. The instrumentation will be monitored to identify any potentially problematic areas relating to dike instability. Mitigation measures for seepage and piping could include:

- Additional pressure grouting of bedrock materials;
- De-pressurization wells;
- Construction of a slurry cut off wall within the core just upstream of the suspected seepage area;
- Jet grouting of the core and foundation in the suspected seepage or crack area;
- Construction of a cutter soil mixing (CSM) wall in the suspected crack area;
- Freezing;
- Installation of toe drains; and
- Construction of interceptor ditches within the down-stream overburden materials.
- Allow pit to flood, install new cut off or bituminous liner under no-flow conditions, then dewater and resume mining.

Specific monitoring and mitigation strategies have been developed as part of an Operations Plan (OMS Manual) for the dewatering dikes.

A.1.2 Failure Scenario during Closure

At end of mine life, once the water quality of the pit lake has been determined to be suitable for release, a portion of the south end of the Bay-Goose Dike will be removed resulting in a hydraulic connection between the Goose/Portage Pit Lake and Third Portage Lake. The East Dike will be the only dike that will remain in service. The elevation of the pit lake will be equal to Third Portage Lake. The elevation difference between the pit lake and Second Portage Lake will be approximately 1 m. Consequently, there will be a low hydraulic gradient from the pit lake towards Second Portage Lake. During the closure and post-closure period, the natural central and east channel outlets that connect Third Portage to Second Portage Lake will continue to carry the entire flow between the two lakes.

Potential Effect

A breach of the East Dike would create an additional outlet and cause water to leave the Portage/Goose pit area and spill into Second Portage Lake at a greater rate, partly at the expense of flow from the central and east channel outlets. This would cause a rise in water level in Second Portage Lake and a reduction in level in Third Portage Lake. The additional water would flow through the channel connecting Second Portage Lake to Tehek Lake until the water elevations in Second and Third Portage lakes equilibrated.

In the event of such a scenario, water would flow from Third Portage Lake, northward through the pit lake area, and then east through a potential East Dike breach and into Second Portage Lake. There is a naturally large outlet capacity via the connecting channel from Second Portage to Tehek Lake. Water residence time in Second Portage Lake during and after mine development is less than one year. Thus, in the event of an East Dike breach, any additional water added to Second Portage Lake would leave the system relatively quickly. Given the flow-through nature of the lake there would be little net change in Second Portage Lake volume or lake elevation as water would easily be absorbed into the much larger Tehek Lake.

Drawdown of Third Portage Lake would be limited, given the large size of the lake (33 km^2) and the constriction points within the system that would slow drawdown. Specifically, the magnitude of drawdown in the event of a breach would depend on the magnitude and depth of the breach, time of year (winter ice cover would prevent loss of water), response time, flow rate (i.e., the loss of water depends on the location of the breach and friction through the system), and the outlet capacity of Second Portage Lake. For example, total annual average discharge from Third Portage to Second Portage Lake is approximately 10 Mm^3 with a mean annual difference in water level between spring and fall of 0.3 m. Given the large size of Third Portage Lake, a breach resulting in the loss of 10 Mm^3 of water, which is equivalent to an entire open water season of runoff through all discharge channels would result in a drawdown of only about 0.3 m. Maximum drawdown would be one metre.

Reductions in water level would therefore be small and have only minor impacts to fish habitat in Third Portage Lake. Adverse impacts to water quality would not be expected given that water quality within Goose/Portage pits is expected to be very high.

Mitigation, Management and Monitoring

Internal erosion of the cut off wall could result in an increase of the rate of water flow through the East Dike. However, this is extremely unlikely due to the low hydraulic gradient across the East Dike (~ 1 m of head difference) and the filter effect of the core backfill. Such a scenario is more likely to occur during the operational phase of the East Dike when the hydraulic gradient across the dike section is much higher, though in the opposite direction. If such a scenario were to occur, it would not be considered a catastrophic failure mode due to the stability of the rockfill shoulders comprising the outside structural elements of the dike.

A breach in the East Dike during closure could be managed by the placement of material to reduce the flow of water and reduce potential erosion of the till core. The hydraulic gradient across the dike at closure is low. The dike could be repaired and hydrologic conditions restored without any danger to the overall stability of the dike, provided annual monitoring is carried out following closure.

AGNICO EAGLE

MEADOWBANK GOLD PROJECT

Groundwater Monitoring Plan

In Accordance with Water License 2AM-MEA1525

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

Version 7
March 2017

EXECUTIVE SUMMARY

This document presents the Meadowbank Mine Groundwater Monitoring Plan which summarizes the activities realised on site in 2016, propose the Monitoring Plan for 2017 and finally, review the methodology and best practices for wells installation and groundwater sampling.

The annual monitoring plan is a requirement of the Meadowbank Type A Water License No. 2AM-MEA1525 and is in continuity of previous Monitoring Plan.

The following activities were realised on site in 2016:

- Two groundwater observation wells were successfully sampled in 2016 (MW-08-02 and MW-16-01).

- Groundwater was sampled from water flowing out of three preshear or production drill holes. One located in North Portage Pit A (GW-Pit A), and two horizontal boreholes in South Portage Pit E3 (Pit E3 B6 and Pit E3 B7).

- A temporary well installed in South Portage Pit in July and August 2016 for reducing water table for stability purpose was also sampled (Pit E4-24).

- Formation of thick ice bridges in the annular space challenged the sampling of two wells (MW-08-02 and MW-08-03). After melting the ice bridge in preparation for sampling operation, there was no water inflow from well MW-08-03. A groundwater sample was retrieved for MW-08-02 in September 2016.

Groundwater chemistry data is used to predict the quality of water accumulating in open pits, and to determine any effects of mining on groundwater quality, particularly with respect to tailings deposition.

Groundwater sampling is carried out on an annual basis. Analytical parameters will comply as per Schedule 1, Table 1, Group 2 of the Meadowbank Water License. Quality Assurance/Quality Control procedures will be implemented during each sampling event.

As groundwater samples show a high degree of variability between years for a same monitoring well, Environment and Climate Change Canada (ECCC) suggested revisiting the groundwater monitoring program design to focus on improving the information for water quality model updates.

Methods to obtain representative groundwater samples and improve well design continue to be investigated. To update the Meadowbank Mine Groundwater Monitoring Plan 2017, a literature review of scientific studies carried out in permafrost environment was done. A section in the Meadowbank Mine Groundwater Monitoring Plan 2017 was dedicated to evaluate best groundwater sampling practice in challenging deep permafrost environment.

Some suggestions include the use of tracer with drilling fluid, the purchase of U-sampler, and a rigorous assessment of sample contamination including collection of blank samples.

A groundwater monitoring report will be submitted by Agnico Eagle Mines Limited to the Nunavut Water Board (NWB) with each Annual Report. This report will include all data from the previous year's results as well as a historical record, dates and methods of sampling, and an assessment of the data obtained with particular regards to salinity parameters and indicators of tailings reclaim water movement, with respect to total cyanide and dissolved copper.

IMPLEMENTATION SCHEDULE

This Plan will be implemented immediately (2017) subject to any modifications proposed by the NWB as a result of the review and approval process.

DISTRIBUTION LIST

AGNICO EAGLE – Geology Superintendent

AGNICO EAGLE – Engineering Superintendent

AGNICO EAGLE – Geotechnical Engineer

AGNICO EAGLE – Environment Superintendent

AGNICO EAGLE – Environmental Coordinator

AGNICO EAGLE – Environmental Technician

DOCUMENT CONTROL

Version	Date (YMD)	Section	Revision
1	08/08/08		Comprehensive plan for Meadowbank Project
2	09/03/31	all	Comprehensive update of plan to include 2008 well installations
3	11/12/14		Update Executive Summary; insert Figure 1; update Table 1; addition of information on wells created in 2011; include well installation section;
4	14/01		Update Executive Summary; update Section 1.2 to reflect current wells; add Section 3.3 and 3.4 (seep and production drill hole sampling methods); update Section 5 (additional reporting on tailings-related parameters)
5	15/04	1.3 and 3.3 2.3	Sampling of pit wall seeps discontinued. Sampling of Goose Pit sump added. Updated with installation information for new well.
6	15/09	4.1 and 4.2	Updated list of analyse parameters. QAQC Section to include Trip and Field Blank Remove Goose Pit sump as monitoring station
7	17/03	Section 1.5, 3, 5 and 6	Add Section5 and 6 and modify section 1.5 and 3

Version 7

Prepared By: Laurie Tremblay, Ph.D. Project Manager SNC-Lavalin

Approved By:

Erika Voyer
Environmental General Supervisor

Jamie Quesnel
Environmental Superintendent Nunavut

TABLE OF CONTENTS

1 INTRODUCTION 1

1.1 Purpose of Groundwater Monitoring 1
1.2 Monitoring Wells 1
1.3 Pit Wall Seeps 2
1.4 Production Drill Holes 2
1.5 future geotechnical investigation holes 2

2 MONITORING WELL INSTALLATION 3

2.1 2008 Well Installation 3
2.1.1 MW-08-02 & MW-08-03 3
2.1.2 Instrumentation 3
2.2 2016 Well Installation 4
2.2.1 MW-16-01 4

3 SAMPLING METHODS 5

3.1 Groundwater Wells MW-08-02 and MW-08-03 5
3.1.1 Well Preparation for Sampling 5
3.1.2 Well Purging 5
3.1.3 Groundwater Sampling 6
3.1.4 Well Close-Down Procedure 6
3.2 Groundwater Wells mw-16-01 6
3.2.1 Well Preparation for Sampling 6
3.2.2 Well Purging 6
3.2.3 Groundwater Sampling 7
3.2.4 Well Close-Down Procedure 7
3.3 Production Drill Holes – pit a, pit e and vault pit 7
3.4 temporary well – pit E4 24 8
3.5 future geotechnical investigation holes 8

4 SAMPLE ANALYSIS 9

4.1 Analysis 9
4.2 Quality Assurance / Quality Control 9
4.2.1 Handling 9
4.2.2 Duplicates, field and trip blank 9

5 DRILLING, WELLS INSTALLATION AND GW SAMPLING IN DEEP PERMAFROST ENVIRONMENT: CHALLENGES AND SOLUTIONS FOR BEST PRATICES 11

6 KEY POINTS AND RECOMMANDATION 16

7 REPORTING 17

8 REFERENCE 18

LIST OF TABLES

Table 1: Protocol review for drilling and well design in permafrost setting 11
Table 2: Protocol review for sampling representative groundwater in permafrost setting.....14

LIST OF APPENDICES

Appendix A – Map of former and existing monitoring wells at Meadowbank
Appendix B – MW-16-01 installation profile
Appendix C – Standard Operating Procedure for Sampling of Groundwater Monitoring Wells
Appendix D – Standard Operation Procedure for Sampling of Production Drill Holes (interim)

1 INTRODUCTION

This document presents the Meadowbank Mine Groundwater Monitoring Plan, Version 7. This version updates the principles and sampling methodology for monitoring wells presented in Version 6 (AEM, 2016). Monitoring well and alternative sampling locations, design characteristics, and the sampling methodology used to recover water samples for chemical analysis are included in this Plan.

This document presents the activities realized on site in 2016, presents the Monitoring Plan for 2017 and reviews methodology and best practices for wells installation and groundwater sampling, especially in the arctic climate.

The annual monitoring plan is a requirement of the Meadowbank Type A Water License No. 2AM-MEA1525 and in continuity of previous annual Monitoring Plans.

1.1 PURPOSE OF GROUNDWATER MONITORING

Groundwater data is used to predict the chemistry of water accumulating in open pits (especially salinity as TDS, conductivity and chloride), and to determine any effects of mining on groundwater quality, particularly with respect to tailings deposition activities. To this end, groundwater monitoring wells have been installed to sample groundwater in open talik areas, where unfrozen ground extends beneath large lakes. No groundwater monitoring wells will be installed at the Vault Deposit, as the Vault Pit will be developed in an area of close talik.

Groundwater sampling has traditionally been conducted using installed monitoring wells, but difficulties in obtaining representative samples by this method prompted the investigation of alternative methods in 2013 and 2014. Based on recommendations by Golder Associates (see 2012 Groundwater Monitoring Report), these included the sampling of pit wall seepages (now discontinued) and production drill holes. Traditional monitoring wells are also used in the monitoring program.

1.2 MONITORING WELLS

Two wells are currently operable (MW-16-01 and MW-08-02). Other wells, drilled in 2003, 2006, 2008, 2011 and 2014, are now inoperable for various reasons at the exception of well MW-08-02. Four monitoring wells were installed at Meadowbank in 2003. Three of these wells (MW-03-02, MW-03-03 and MW-03-04) were damaged by frost action between 2004 and 2006. The fourth (MW-03-01) was operable until 2010 when it was also damaged by frost action. Three defective wells were replaced in 2006 (MW-06-05, MW-06-06 and MW-06-07). Again, these were damaged by frost action. Two were replaced in 2008 with a more robust design (MW-08-02 and MW-08-03). Well MW-11-01 was installed adjacent to the

Goose Island pit location to replace MW-03-01, and well MW-11-02 was installed, at the tailings storage facility to replace MW-06-07; to monitor shallow groundwater below the basin where tailings are deposited. Well MW-11-01 was decommissioned in 2012 after being damaged during site operations. In 2012, well MW-11-02 could not be sampled as it became obstructed by development materials throughout the groundwater monitoring program. Unsuccessful attempts were made in 2013, 2014, and 2015 to remove the material. Therefore, MW-11-02 was replaced in 2014 with a new well, MW-14-01 and again this well was condemned since it was damaged by frost action and replaced by MW-16-01 in 2016. MW-11-02 was decommissioned in 2016 and bentonite was discharged into the well. Well MW-08-03 was blocked with an ice bridge in 2010, 2011 and 2012. Advancements were made in 2013 using a saline solution, and a sample was taken. This sampled was considered unrepresentative after analysis since the salinity of the sample was too elevated when compare to previous samples. In 2014, 2015 and 2016 the blockage was removed, but the well was dry and could not be sampled. The Meadowbank Mine currently has two operating groundwater monitoring wells left: MW-16-01 and MW-08-02.

The locations of each former and existing groundwater wells are provided in appendix A.

1.3 PIT WALL SEEPS

Seepage from pit walls commonly occurs in several locations in both the Portage and Goose pits. It was thought that groundwater samples could be readily obtained directly at the source when sufficient flow occurs. However, samples to date have indicated surface water rather than groundwater flow, so this program has been discontinued.

1.4 PRODUCTION DRILL HOLES

When sufficient groundwater flow from production and preshear drill holes is encountered, sampling using this methodology is feasible. Although wells with sufficient flow rates only occur on occasion, Agnico Eagle is of the opinion that this is a viable method, and will continue attempts to sample drill holes. Since the sampled locations will change each year depending on where flowing groundwater is encountered, drill hole identification numbers and GPS coordinates will be included in each annual report. This source of groundwater has the potential to be viable in determining any mining affects to groundwater, especially in the Portage Pit, as it is directly downstream of the inferred groundwater flow path.

1.5 FUTURE GEOTECHNICAL INVESTIGATION HOLES

Forthcoming field campaigns at Meadowbank, including drilling of new boreholes susceptible to encounter groundwater, will be seen by Agnico Eagle as an opportunity to collect groundwater sample at new locations. Geotechnical holes are made under controlled conditions when compared to production holes, so they represent a good option to obtain representative groundwater samples.

2 MONITORING WELL INSTALLATION

Installation details for existing monitoring wells are provided here. Details for decommissioned wells are presented in the Groundwater Monitoring Report related with the year of installation.

2.1 2008 WELL INSTALLATION

2.1.1 MW-08-02 & MW-08-03

The two boreholes were drilled to replace former monitoring wells MW-06-05, and MW-06-06. The boreholes were drilled using standard PQ and HQ size coring method. Heated water from the Second Portage Lake was used as drilling fluid during drilling. The boreholes were drilled up to 200 meters with a dip of 60 degree. Each borehole was cased to 20 m past the anticipated base of the permafrost using HWT flush-joint casing. For borehole MW-08-02, the first 170 meters were drilled without core recovery; the anticipated depth for the screened interval was cored to confirm the target lithology. For MW-08-03, the borehole was cored and logged. Cores were logged by Agnico Eagle geologists.

2.1.2 Instrumentation

MW-08-02 and MW-08-03 wells were installed with a 1.5-inch diameter, schedule 40 stainless steel pipe and 18 m long and 2 inches diameter stainless steel screen. The annulus between the casing and the monitoring well pipe was sealed at the base of the casing (169 m depth) with a pneumatic packer inflated with propylene glycol (a non-toxic and biodegradable liquid with low freezing point). The packer installed filled the annular space between the borehole casing and the monitoring well pipe and isolate the borehole below the permafrost interval. To minimize frost damage to the monitoring well, a small diameter double valve pump (DPV) driven by inert nitrogen gas was fixed to the outside of the riser pipe. This valve has allows to remove water from the well annulus above the packer to keep the area outside the well pipes dry. Moreover, a smaller diameter stainless steel pneumatic packer was also installed inside the monitoring well pipe directly above the screen interval to prevent freezing inside of the monitoring well pipe throughout the permafrost. After sample collection, the inside packer is inflated and a portable DPV pump is used to evacuate water above this packer to keep the well pipe dry between the sampling events. Finally, outside of the monitoring well pipe, a heating cable was attached through the entire anticipated interval within permafrost. The heating cables prevent water from freezing during sampling, and constitute a back-up system to melt the ice inside the monitoring well in case of a packer failure.

2.2 2016 WELL INSTALLATION

2.2.1 MW-16-01

Well MW-16-01 was installed in November 2016 to replace MW-14-01. See appendix B for details. During drilling and well installation, the water level recorded was from 5 to 6 meters from the surface and remained at this level despite purging the well continuously with air. The borehole was drilled using standard HQ size coring for the installation of the well. The hole is dipping at 70 degrees and the elevation from ground surface is 119.91 m. Fresh water was used as a drilling fluid after being pumped from Third Portage Lake, brought by the mine water truck and stored in a fresh water tank. The borehole was isolated with HW casing through the overburden and into the first few meters of fractured bedrock (from surface to 25.5 meter depth). Metal casing made of steel was installed and anchored in the bedrock to protect the well from material movement. To plug the bottom of the hole, a threaded piece of 1.25 inch SCH 80 8TPI ACME was installed.

The well was constructed with 1.25 inch diameter, 304 stainless steel pipe and 1.25 inch diameter slotted stainless steel screen. Screened depth measured from ground surface is from 88.81 to 101.02 m. Prepack bentonite was installed above the well screen to create a bentonite plug. No grouting was used to fill the annular space between the casings. The material included is the following:

- 4 length of 1.25 in. x 10 ft 304 Stainless Steel Screen 010 slot size, Acme Threads MXF
- 30 length of 1.25 in. x 10 ft 304 Stainless Steel with MXF Acme Threads
- 3 length of 1.25 in. x 5 ft PCV SCH80 bentonite prepack - Acme 8TPI
- 5 pieces of 1.66 in. I.D. X 4 in. O.D. SERIES 200 4 WEB PVC CENTRALIZER SPLIT & GROOVED BOTH ENDS to centralize the screen portion.

Heat tracing were attached all along the casing to allow the melting of ice when sampling is required up to 59 m down the well. Heat trace was tightly taped around 1.25 inch diameter pipe during installation to avoid the heat trace to touch each other and create a shortcut.

3 SAMPLING METHODS

Since monitoring results to date have not indicated any effects of mining activity on groundwater quality, the groundwater sampling program will be performed annually using traditional onsite monitoring wells, as well as production drill holes or investigation drill holes as available. One sample per sampling event will be collected in duplicate and submitted blind (using different reference numbers) to the analytical laboratory. One transport blank and field blank will also be collected each year.

Specific details on sampling methodologies in monitoring wells and production/investigation drill holes are provided here. The collection of samples from production/investigation drill holes will occur when flowing conditions are encountered in order to obtain additional samples to assist in the assessment of any potential impacts of mining activity.

3.1 GROUNDWATER WELLS MW-08-02 AND MW-08-03

3.1.1 Well Preparation for Sampling

At the time of purging and sampling the heat trace cables will be activated to warm the well pipe. Once the new well has been warmed up the pneumatic valve inside the well pipe will be deflated to allow groundwater to flow into the well pipe. Because water is allowed to rise and freeze in place within the well pipe, the heat trace cable activation period will be considerably longer, in the order of 4 to 7 days, to thaw standing water (ice) present in the well pipe. The effective heating cables in the groundwater wells should allow the water present in the well pipe to thaw in a timelier manner.

3.1.2 Well Purging

Once ice is fully thawed purging is initiated by inserting the DVP and tubing at 10 to 20 meters above the screened interval and removing well water by pumping compressed air. Groundwater will be continually pumped from the well until electrical conductivity and pH readings stabilized. This process may require more than 3 well volumes. In consideration of the low hydraulic conductivity of the rock causing a very slow recovery of groundwater level (only a few litres of groundwater can be removed at a time), this process can take up to 4 days to complete.

The well is then purged to remove standing water inside the well and to induce the flow of fresh groundwater from the rock formation. Purging is done by lowering a portable double valve sampling pump (DVP) into the well pipe to approximately 10 to 20 meters above the top of the screened interval and activating the DVP. The pump is activated by pushing compressed air into a ¼ in. Low Density Polyethylene (LDPE) tubing attached to the DVP. Purged water quality is monitored for pH, electrical conductivity, temperature, water clarity and colour (visual observation) during this operation. The in-situ physicochemical parameters are measured with a PCStestr 35 Oakton Probe that was calibrated prior usage. A minimum of 3 well volumes (volume of water between the in-well packer and bottom of screened interval) are to be removed prior sampling or until the monitored parameters stabilize (values remaining within 10% for three consecutive readings).

3.1.3 Groundwater Sampling

Groundwater is to be sampled immediately after purging, by lowering the intake of the DVP tubing to 3 to 5 meters above the screened interval. The same DVP pump and tubing used for purging is to be used for sampling but utilizing compressed air to evacuate water that entered the sampler unit. Chemical parameters are to continue to be measured during sampling.

A groundwater sample is to be collected in clean, laboratory-supplied containers. When required, preservatives will be added to the sample bottles, prior sample collection, to minimize a possible chemical alteration while the sample is transited to the laboratory. Samples analyzed for dissolved metals are going to be filtered through a 45 μm inline filter.

3.1.4 Well Close-Down Procedure

Once the water sample is obtained, the pneumatic valve will be re-inflated and the well water above the valve will be removed using the portable DVP pump. The DVP pump fixed to the outside of the well will also be activated to remove water accumulated in the annulus of the well during purging and sampling (if any). The heating cable will be de-activated and the cap will be replaced on the casing.

3.2 GROUNDWATER WELLS MW-16-01

3.2.1 Well Preparation for Sampling

At the time of purging and sampling the heat trace cables will be activated to warm the well pipe. Once the new well has been warmed up the pneumatic valve inside the well pipe will be deflated to allow groundwater to flow into the well pipe

3.2.2 Well Purging

The well is purged to remove standing water inside the well and to induce the flow of fresh groundwater from the rock formation. Purging is done by lowering a portable double valve sampling pump (DVP) into the well pipe to approximately 10 to 20 meters above the top of the screened interval and activating the DVP. The pump is activated by pushing compressed air into a ¼ in. Low Density Polyethylene (LDPE) tubing attached to the DVP. Purged water quality is monitored for pH, electrical conductivity, temperature, water clarity and colour (visual observation) during this operation. The in situ physicochemical parameters are measured with a PCStestr 35 Oakton Probe that was calibrated prior usage. A minimum of 3 well volumes (volume of water between the in-well packer and bottom of screened interval) are to be removed prior sampling or until the monitored parameters stabilize (values remaining within 10% for three consecutive readings).

3.2.3 Groundwater Sampling

Groundwater sampling will be carried out immediately after well purging, in the same manner as for the 2008 design wells (same equipment, elevation of tube intake for water sample, use of compress air, monitoring of water quality parameters during this process). Groundwater samples are to be collected in clean, laboratory-supplied containers. When required, preservatives will be added to the sample bottles, prior sample collection, to minimize a possible chemical alteration while the sample is transited to the laboratory. Samples analyzed for dissolved metals are going to be filtered through a 45 µm inline filter.

Samples are to be collected in duplicate and submitted as blind duplicates (using different reference numbers) to the analytical laboratory. Duplicate samples are to be analyzed for the same parameters as the original sample specified in Table 1 of Schedule 1 of the Meadowbank Water License. One trip blank and field blank will also be collected each year.

3.2.4 Well Close-Down Procedure

Once the water sample is obtained, the heating cable will be de-activated and the cap will be replaced on the well.

3.3 PRODUCTION DRILL HOLES – PIT A, PIT E AND VAULT PIT

The collection of samples from production drill holes will occur whenever flowing drill holes are encountered and the designed methods will be modified as required based on field testing. Standard methods are provided in Appendix B, and summarized here.

Agnico Eagle's Environmental Department will request that the Blast Supervisor (Mine Dept.) notify them when a flowing production well is encountered during regular production (for blasting) drilling (it is not a regular occurrence). Sampling needs to be conducted prior to addition of any explosive material.

Before sampling, three well volumes will be purged from the flowing hole, when possible. Production wells are usually 0.17 m diameter and 8.5 m deep so approximately 579 L will be removed.

Analysis of field parameters will be used to assist in determining if sufficient purging has occurred. Values are to be stable (within 10%) for three consecutive readings (in accordance with procedures for monitoring wells).

The sample is to be collected in clean, laboratory-supplied containers. When required, preservatives will be added to the sample bottles, prior sample collection, to minimize a possible chemical alteration while the sample is transited to the laboratory. Samples analyzed for dissolved metals are going to be filtered through a 45 mm inline filter. For each sampling location, GPS coordinates and the drill hole number/blast pattern number will be recorded.

3.4 TEMPORARY WELL – PIT E4 24

E Pit 4-24 is a temporary well used in July and August 2016 for reducing water table for slope stability purposes. However, it has not been used since. It is a vertical hole of 6 inches in diameter, and of 65 meters depth. A 3 HP submersible pump was installed at 60 meters depth.

For E PIT 4-24, the water was pump from the bottom of the hole at 60 meters depth, through blue flexible hose and discharged in pit E3. Water was collected directly from the blue hose after purging three times the volume of water from the well. Same sampling procedures from section 1.11 apply.

3.5 FUTURE GEOTECHNICAL INVESTIGATION HOLES

Forthcoming field campaigns at Meadowbank Mine, including drilling of new boreholes susceptible to encounter groundwater, will be seen by Agnico Eagle as an opportunity to collect groundwater sample at new locations. Geotechnical holes are made under controlled conditions when compared to production holes, so they represent a good option to obtain representative groundwater samples.

4 SAMPLE ANALYSIS

4.1 ANALYSIS

For each samples, field parameters will be taken (pH, turbidity, salinity and electrical conductivity). Analytical parameters will include the following, per Schedule 1, Table 1, Group 2 of the Meadowbank Water License: bicarbonate alkalinity, carbonate alkalinity, total alkalinity, calcium, potassium, magnesium, sodium, hardness, ammonia nitrogen, total kjeldahl nitrogen, nitrate, nitrite, ortho-phosphate, total phosphorus, total organic carbon (TOC), total dissolved organic carbon (DOC), reactive silica, chloride, sulphate, total dissolved solids (TDS), total suspended solids (TSS), total and free cyanide and the following total and dissolved metals: aluminum, antimony, arsenic, boron, barium, beryllium, cadmium, copper, chromium, iron, lithium, lead, manganese, mercury, molybdenum, nickel, selenium, strontium, tin, titanium, thallium, uranium, vanadium and zinc.

If total cyanide is detected above 0.05 mg/L in an analysis result for monitoring station in receiving environment; further analysis of Weak Acid Dissociable Cyanide (CN WAD) will be triggered.

4.2 QUALITY ASSURANCE / QUALITY CONTROL

4.2.1 Handling

The following procedures will be followed to provide data quality control:

Measurement of field parameters at selected intervals until stable readings (within 10% of each other);

Minimization of the exposure of the sampled water to the atmosphere;

Use of compressed, gas to evacuate water for sample collection;

In-situ measurement of sensitive chemical parameters (pH, electrical conductivity, dissolved oxygen, alkalinity, where applicable); and

Abiding by sample preservation methods (refrigeration and use of preservatives where needed); and specified holding times.

4.2.2 Duplicates, field and trip blank

A duplicate sample will be collected for one monitoring well per sampling event, and submitted as a blind duplicate to the analytical laboratory. Where both results are higher than five times the method detection limit (MDL), the relative percent difference (RPD) will be calculated as:

RPD = absolute difference in concentration/average concentration x 100

USEPA (1994) indicates that an RPD of 20% or less is acceptable. Where one or both results are less than five times the MDL, a margin of +/- MDL is acceptable.

One field and one trip blank will also be collected once a year.

5 DRILLING, WELLS INSTALLATION AND GW SAMPLING IN DEEP PERMAFROST ENVIRONMENT: CHALLENGES AND SOLUTIONS FOR BEST PRATICES

The first objective of this section is to review the challenges encounter while drilling and for the design and operation of groundwater monitoring well in deep permafrost environment. Based on current knowledge, the second objective is to propose better practices to successfully install long-lasting monitoring wells and retrieve representative groundwater samples at the Meadowbank mine site. Two tables synthetizing the information from different sources are presented. Table 1 documents the challenges encounter while drilling and installing wells. Some tested method to resolve the enumerated problems are listed and promising solutions that could be attempt in the future are presented. Table 2 documents the challenges encounter during groundwater sampling.

Table 1: Protocol review for drilling and well design in permafrost setting

Borehole drilling and well design challenges	**Tested methodology**	**Innovative solution (What could be done)**
Drilling operation in permafrost.	• Advance the boreholes with standard HQ (Golder 2008 a) • Use heated water for drilling fluid (Golder 2008 a) • The fluid remaining in the borehole should have a target temperature of 60°C as water near boiling may freeze more quickly (Statler et al. 2010) • Borehole instrumentation should be on site and ready for installation once drilling is complete (Statler et al. 2010) • Drilling should proceed more slowly, providing the rock surrounding the borehole to warm up and allow a maximum time for installation of bottom hole assembly (Statler et al. 2010) • A bottom hole assembly is 15 m long and is used to isolate the bottom of the hole to allow sampling and monitoring (Statler et al. 2010) (includes pneumatic packer inflated with N_2 head over propylene glycol, a	***Define permafrost and talik location while drilling*** Temperature gauging should be conducted and logged during drilling operation. This information is key decision parameter for heat tracing cable length and elevation of purge and sampling pumps (Franz Environmental Inc. 2009) Pressure, salinity parameters should be taking in consideration to define talik/permafrost zones

	U tube sampling system with a sample reservoir and a temperature sensor line (Freifeld et al. 2008) • Vertical well have less chances of failure. Inclination must be defined accordingly. • When installing bottom hole assembly, the sampling lines and heat tape should be wrapped with insulation to help prevent freezing • Heat tape should be installed with a safety factor i.e. if the highest thermal conductivity expected is 4 W/mK, plan 10 W/mK (Statler et al. 2010) • Heating cables must be attached on the downward side of the well (Franz 2009).	
Breakage of well pipes. Freezing of the standing water exposed to permafrost in the well causing breakage of well pipes or obstruction within the pipes	Use steel instead of PVC. PVC centralizers were used to keep the well centered with boring but PVC centralizer may fail. Using two inflatable packers; one with the borehole annulus and another with the well pipe, to prevent talik water to rise in the permafrost section (Golder 2008). Inflate packers according to their purpose, note status of packers year after year to follow the same procedure and minimize damage potential (Franz 2009).	Use centralizer made of another material than PVC, the objective is to keep the well riser in the center of the borehole and prevent that the riser pipe assembly bends (Franz 2009).
Packer failure. Water bypass packers due to cold temperature-induced contraction of packer, loss of inflation	Insure enough fuel in the generator so it can run continuously during purging so that the heating cable work all the time and both inside and outside packers should be inflated.	
Material damage	Material shipped to the site must be properly package and should arrived	

through shipping. Stainless steel tubing damage during shipping, cause leakage through casing	and be inspected well ahead of the time the material is needed to be used (Franz 2009).	
Well installation. Well installed from 2003 through 2014 failed for various reasons	Install pre-pack bentonite wells (Meeting minute on lessons learned at Meadowbank 2016) 1-1/2'' screen is installed in the hole with a 1-1/2 pipe. Prepack bentonite is installed above the screen to create the bentonite plug. Heat trace is tightly taped around the 1-1/2'' pipe during to installation to avoid the heat trace to touch each other and create a shortcut. Metal casing is installed and anchored in the bedrock in order to protect the well from material movement. No more grouting is used to fill the space between the casing and the pipe as it didn't prevent the hole MW-11-01 from collapsing. Packer was used in the past to replace the bentonite Proper well inclination should be considered for well installation and in the case of an inline well, heating cables must be attached on the downward side of the well (Franz 2009).	Verify if using U-sampler methodology with borehole assembly would be better over this

Table 2: Protocol review for sampling representative groundwater in permafrost setting

GW sampling challenges	Tested methodology	Innovative solution (What should be done)
<u>Unrepresentative groundwater sample because of cross contamination.</u> Groundwater sample contaminated by borehole drilling or well operation Mixing between resident groundwater and brines/drill fluid used for drilling restricts a proper interpretation of groundwater chemistry Potential contamination through borehole operations (drill bit, drill cuttings, packers), sampling equipment, sampling environment or during sample transportation		Contamination of samples with drilling brine should be minimized Use a tracer and analyses salinity of drill fluid. Tracer such as sodium fluorescein (Henkemans 2016) or perfluorocarbon tracer (PFT) with drill fluid (Pfiffner et al. 2008) to define the amount of contamination from drilling fluid from sampled groundwater. At the end of the borehole, block the drill string and perform a "wet" pull to remove as much drill water as possible from the borehole before it froze to the rock surface (Pfiffner et al. 2008). Perform a "wet" pull following borehole drilling to remove as much drilling fluid as possible. To further clean the hole use a bailer (Statler et al. 2010; Pfiffner et al. 2008). Use a sampling system such as: U-Tube (Freifeld 2009) or Thermos bottle concept (Sutphin et al. 2006). Minimize contamination with proper sampling equipment i.e. cleaned pump, sanitized equipment dedicated to borehole, test equipment for contamination, use blank sample and transport blank to verify a potential contamination. Field samples must be immediately preserved using appropriate methods to retain competency for subsequent geochemical analyses (Wilkins et

		al. 2014).
Ice bridge formation within wells. Borehole ice formation freezing of the standing water exposed to permafrost in the well also preclude the collection of more than one set of fluid samples from a given borehole due to post drilling formation.	Heat tracer cables penetrating the permafrost zone were attached to the outside of the well pipe and were activated at the sample collection time. Ensure generator run continuously to energized heat cables. Use a downhole camera if necessary to inspect well damage before proceeding to groundwater sampling.	
Difficulties encounter while well purging and sampling Melted the nylon line of the DVP pump system used to remove water from the well annulus above the casing packers Inoperable pump in the borehole annulus, therefore packers are of no use. Heat cable (energized to keep the well from freezing)	Required activation of the heating cables to melt the ice in the well prior sampling Use stainless steel tubing connected to the DVD pump rather than nylon	Temperature gauging should be conducted and logged during drilling operation. This will allow defining depth of permafrost and talik water location. This information is key decision parameter for heat tracing cable length and elevation of purge and sampling pumps (Franz Environmental Inc. 2009) Pump should be located within unfrozen water at all times is a key factor in avoiding problems due to freezing groundwater during purging/sampling (Franz 2009)
Line of the U-tube sampling system froze	Use an insulated hose encompassing both the sampling lines and the heat trace cable would have prevented the freezing ((Statler et al. 2010; Friefeld et al. 2008).	

6 KEY POINTS AND RECOMMANDATION

- Only a few studies are available on deep permafrost environment. In most study, permafrost is defined by the temperature isotherm zero. However, pressure and salinity will influence the actual freezing point of water and therefore the presence or the absence of ice (Stotler et al. 2010; van Everdigen 1976). Pressure, salinity and the visual absence of ice in cores should be considered in the search for talik zones instead of just relying on temperature data.

- Important to define properly talik zones not only based on temperature gradient. Pressure and salinity will influence freezing temperature and the definition of permafrost/talik zone.
- Drilling methodology is the basis to a proper setting form representative groundwater sampling (many procedures have to be followed)
- Groundwater sample contamination can come from many sources, it is important to minimized and prevent the effect of sample contamination as much as possible (avoid drill/brine fluid, purge well as much as possible, clean purging and sampling equipment before use, installed well properly to avoid leakage of cross-contamination of fluid).

There is always a percentage of drill fluid left in the rock formation, so it is relevant to use a tracer to define the percentage of contamination (Pfiffner et al. 2008). Brine and drill fluid get pushed into fractures and former drill fluid stays in the rock formation and risk to contaminate groundwater samples. This would lead to erroneous groundwater salinity and TDS concentrations. What is suggested is that fresh water be used during the drilling. Cross contamination between layers can occur as brine water from drilling won't freeze as readily as fresh water, heated fresh water would form an icy zone around the borehole and could be removed during the melting and purging procedures of the monitoring well. Some suggestions include the use of tracer with drilling fluid to define the degree of contamination of a groundwater sample, the usage of a U-sampler known for high purity samples for real-time and laboratory analysis, and a rigorous assessment of sample contamination including subsampling of material in contact with the borehole, drilling lubricant, drill cuttings, tools used for groundwater sampling, etc. The collection of blank samples during well and sampling operation is recommended.

- Agnico Eagle will make effort to put in place or use the innovative solutions and best practices when possible to improve the groundwater well installation and sampling program.
- Agnico Eagle will seek new opportunities from forthcoming field campaigns at Meadowbank Mine to collect representative groundwater samples at new locations.

7 REPORTING

An annual groundwater monitoring report will be submitted by Agnico Eagle Mines Limited to the Nunavut Water Board (NWB) with the Meadowbank Annual Report of the following year. This report will include the following information:

- Installation logs for any new monitoring wells;
- Location in UTM coordinates of all groundwater sample locations;
- Description of the working condition of the existing wells;
- Date of groundwater sampling;
- Details of sampling methods;
- Analytical results including: field data, laboratory analytical data and QA/QC information;
- Comparative assessment of data obtained to date to input values used in the Water Quality Model for the site (relevant salinity parameters); and
- Comparative assessment of parameters indicative of mine impacts to groundwater, with particular regard to tailings (total cyanide and dissolved copper);
- Actions taken regarding recommendations for the groundwater sampling program.

8 REFERENCE

Franz T. (2009) Peer Review of Monitoring Well designs to Minimize the Effects of permafrost Damage at Agnico Eagle's Meadowbank Mine in Nunavut. Franz Environmental Inc.

Freifeld B., Perkins E., Underschultz J., Boreham C. (2009) The U-tube sampling methodology and real-time analysis of geofluids. URL: http://escholarship.org/uc/item/4jc2m4g9

Freifeld B.M., Chan E, Onstott T.C., Pratt L.M., Johnson A., Stotler R., Holden B., Frape S. Pfiffner S.M., DiFurio S., Ruskeeniemi T., and Neill I. (2008) Deployment of a Deep Borehole Observatory at the High Lake Project Site, Nunavut, Canada. NINTH INTERNATIONAL CONFERENCE ON PERMAFROST (28 June - 3 July 2008) Fairbanks, Alaska, USA

Henkemans E. (2016) Geochemical Characterization of Groundwaters, Surface Waters and Water-Rock Interaction in an Area of Continuous Permafrost Adjacent to the Greenland Ice Sheet, Kangerlussuaq, Southwest Greenland. Ph.D. Thesis, Waterloo University, 308 p.

Golder, 2007. Meadowbank Gold Project. 2006 Baseline Ground Water Monitoring. August 16, 2007.

Golder (2008a). Technical Memorandum: 2008 Groundwater Monitoring Well Design DRAFT for Client Review Only. May 23, 2008.

Golder (2008b). Technical Memorandum: 2008 Groundwater Monitoring Plan Meadowbank Gold Project. August 1, 2008.

Golder (2009a). 2008 Groundwater Quality Monitoring Program, Meadowbank Mine. January 14, 2009.

Golder (2009b). 2009 Groundwater Quality Monitoring Program, Meadowbank Mine. October 29, 2009.

Pfiffner S.M., Onstott T.C., Ruskeeniemi T., Talikka M., Bakermans C., McGown D., Chan E., Johnson A., Phelps T.J., Le Puil M., Difurio S.A., Pratt L.M., Stotler R., Frape S. Telling J., Sherwood B.L., Neill I., and Zerbin B. (2008) Challenges for Coring Deep Permafrost on Earth and Mars ASTROBIOLOGY Volume 8, Number 3 © Mary Ann Liebert, Inc. DOI: 10.1089/ast.2007.0159

Stotler R.L., Frape S.K., Freifeld B.M., Holden B., Onstott T.C., Ruskeeniemi T, and Chan E. (2010) Hydrogeology, chemical and microbial activity measurement through deep permafrost. Groundwater. DOI: DOI: 10.1111/j.1745-6584.2010.00724.x

Stotler R.L., Frape S.K., Ruskeeniemi T, Ahonen L., Onstott T.C., and Hobbs M.Y. (2009) Hydrogeochemistry of groundwaters in and below the base of thick permafrost at Lupin, Nunavut, Canada. Journal of Hydrology 373: 80–95.

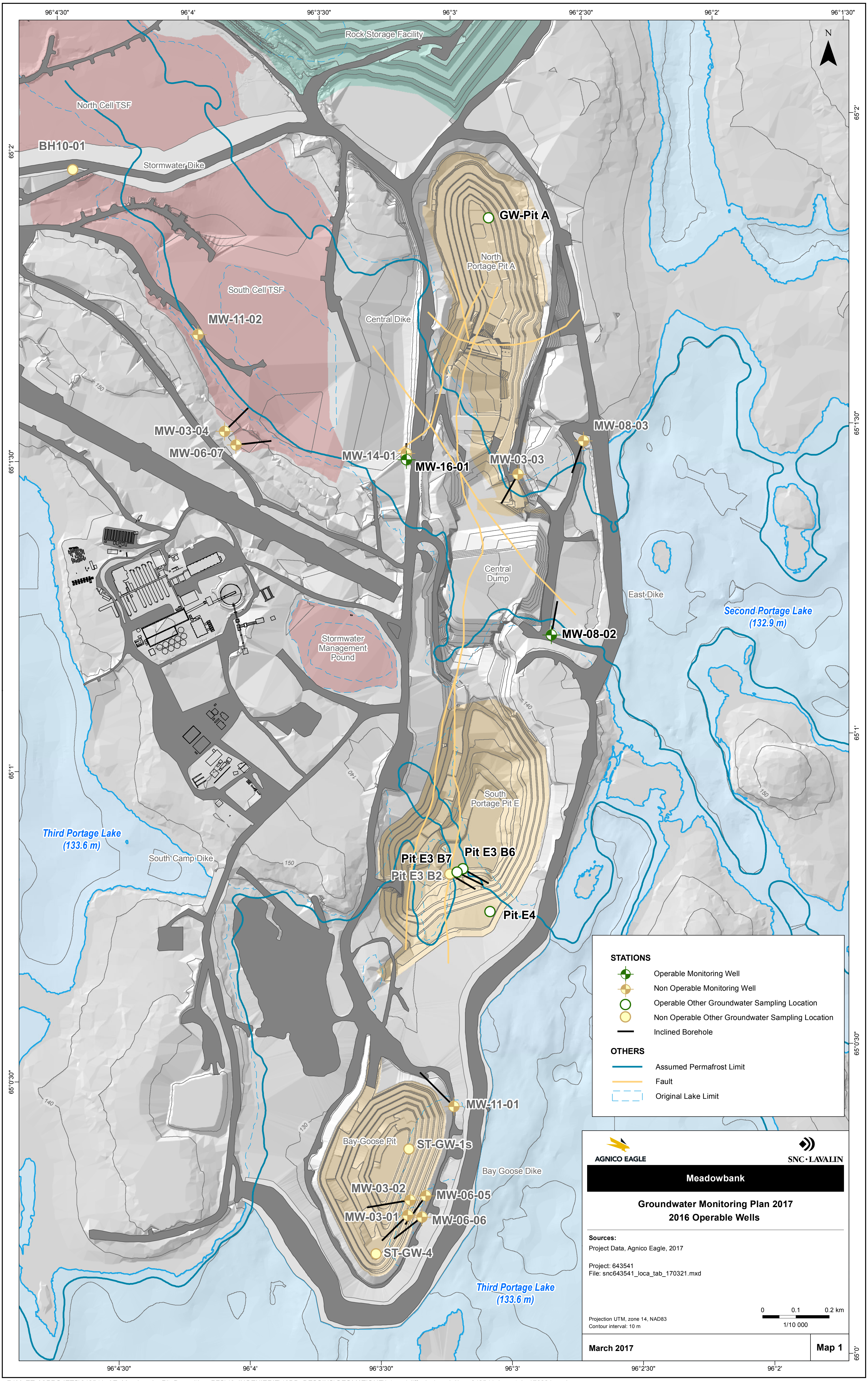
Stotler R.L. (2008) Evolution of Canadian Shield Groundwatersand Gases: Influence of Deep Permafrost. PH.D. Thesis. Waterloo University, 265 p.

Sutphin J.D., Atkinson L.C., and Mahoney J.J., (2016) MONITORING AND SAMPLING OF GROUNDWATER BENEATH DEEP PERMAFROST Sea to Sky Geotechnique 2006 59th Canadian Geotechnical Conference and 7th Joint CGS and IAH-CNC, Vancouver B.C., 1613-1618.

Wilkins MJ, Daly R.A., Mouser P.J., Trexler R., Sharma S., Cole D.R., Wrighton K.C., Biddle J.F., Denis E.H., Fredrickson J.K., Kieft T.L., Onstott T.C., Peterson L., Pfiffner S.M., Phelps T.J. and Schrenk M.O. (2014) Trends and future challenges in sampling the deep terrestrial biosphere. Frontiers in Microbiology, perspective article. DOI: 10.3389/fmicb.2014.00481

APPENDIX A

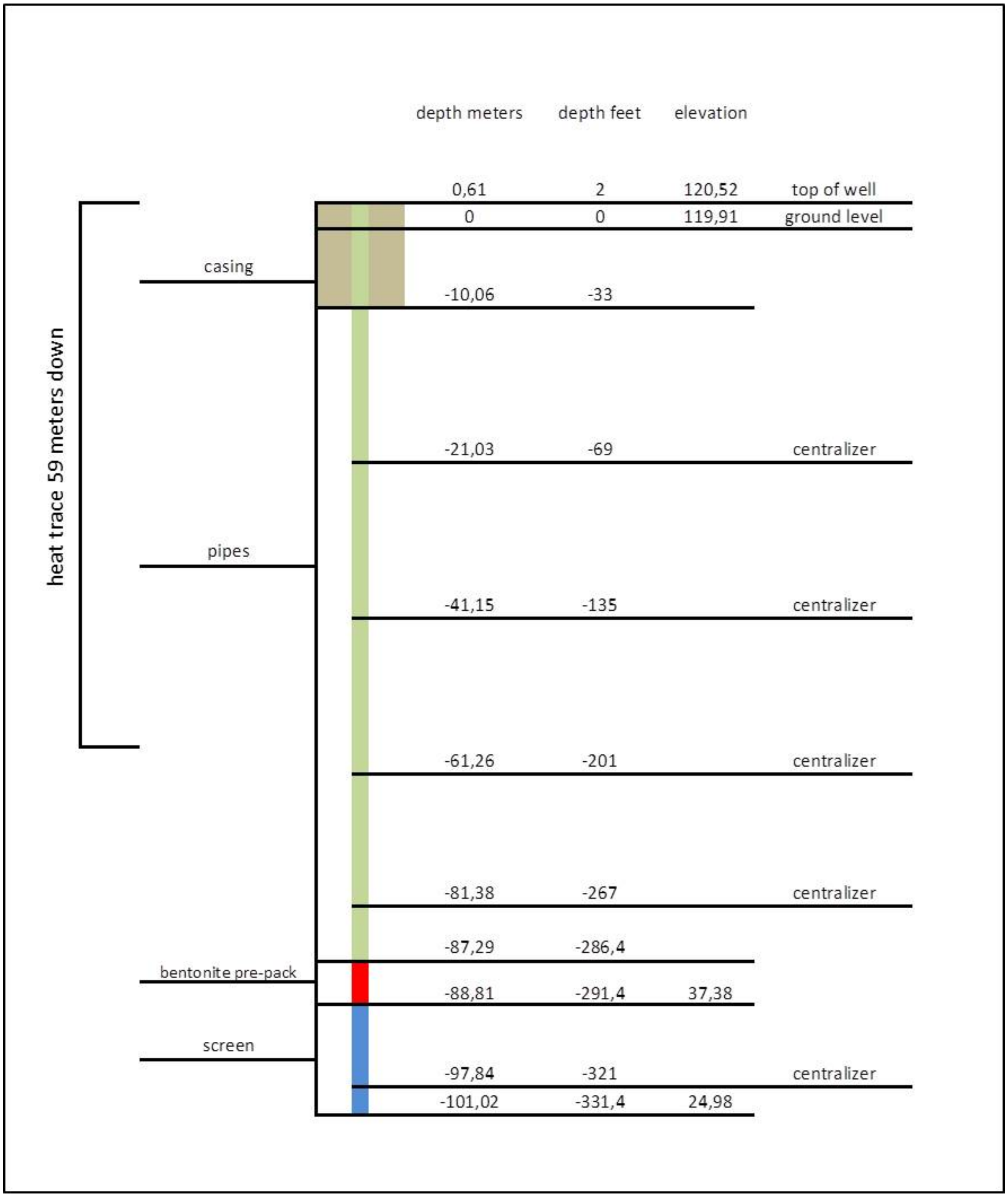
Map of former and existing groundwater monitoring stations at Meadowbank



R:\M_ET_M\PROJETS\643541_AE_Meadow_In_Pit_Deposition_PFS\40_INGENIERIE\40DD_DESSINS\GEOMATIQUE\interne\diffusion\produit\snc643541_loca_tab_170321.mxd

APPENDIX B

MW-16-01 Installation profile


depth meters
depth feet
elevation
0,61
2
120,52
top of well
0
0
119,91
ground level
casing
-10,06
-33
heat trace 59 meters down
-21,03
-69
centralizer
pipes
-41,15
-135
centralizer
-61,26
-201
centralizer
-81,38
-267
centralizer
-87,29
-286,4
bentonite pre-pack
-88,81
-291,4
37,38
screen
-97,84
-321
centralizer
-101,02
-331,4
24,98

APPENDIX C

Standard Operating Procedure for Sampling of Groundwater Monitoring Wells

WORK INSTRUCTION

Purpose:

This procedure is used to ensure that groundwater (GW) sampling is conducted in a safe and orderly manner. All samples need to be taken in the same manner to provide continuity of samples regardless of who is taking the samples. The Environment Department is required to conduct a GW sampling program to determine if there are any mining impacts to the local GW regime. This is in accordance with both our NWB and NIRB permits. In 2013 AEM environment staff will conduct the GW sampling program at Meadowbank.

Groundwater Sampling SOP:

GW sampling consists of measuring field parameters and collecting GW samples within the designated bottles.

Material needed:

Waterra 1 inch
Waterra ¼ inch
2 Genset (Atlas Copco, QAS 30) (GEN 30 and 34)
1 compressor (environment compressor)
3 Nitrogen tanks (JDE number 134720)
Nitrogen regulator
Solinst pump
Clean pails
Cond./pH/Temperature probe (PCStestr 35 or multi-parameter probe)
Water level probe
Control box
Red hose for NO2
Black hose with moisture trap for NO2
Adaptor, Fitting, Ring, Tools
Sampling bottle and syringe

Procedures to be done in 2013 for existing GW Wells

MW-11-02

In accordance with the 2012 Golder Groundwater Technical Memorandum Env Dept staff needs to retrieve a melted waterra that has plugged this well at a depth of 28 meters. This will require the use of at least a 30 meter RW drill rod with a fitting containing external thread. Orbit Gallant will conduct this drilling to remove the blockage (Ask Orbit to drill with size A casing).

Also there is a short on the heat trace cable in this well so the electrician must be informed prior to plug the heat trace to avoid overheating.

MW-08-03

This well has been determined to have an ice blockage, below the existing heat trace, at a depth of 150 meters. To melt the ice, Carlon tubing HDPE is required (about 200 meters).Orbit Garant will thaw the blockage below the heat trace cable with hot water. Once the ice melts we can push the tubing down to continue the purge and characterization of the water prior to obtain a sample. Temperature of the heated water shouldn't exceed 60 ^{o}C

MW-08-02

Nothing special. This well was sampled last year using regular unthawing and purging techniques.

Thaw and Purge Procedures

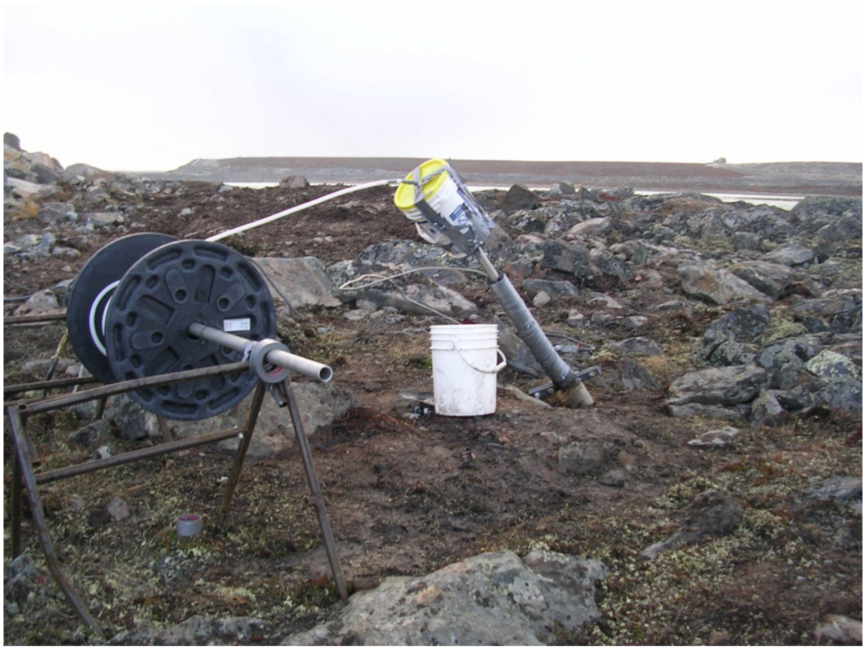
A) Melt the ice in the monitoring well

1- Measure the depth of the ice in the well – use existing well logs to document all activity. This is important for report preparation.
2- Ask for an electrician to plug the heat trace to the generator (Atlas Copco, QAS 30)

3- Monitor the ice and water depth every twelve hours or so.
4- Once the ice level has been melted to a depth of over 150 meters, we can start to purge.

B) <u>Purge the water in the well</u>

1- Place a pail upside down on top of the well to avoid having water flow all over and place an additional pail on the ground underneath to collect the purged water (see photo below).

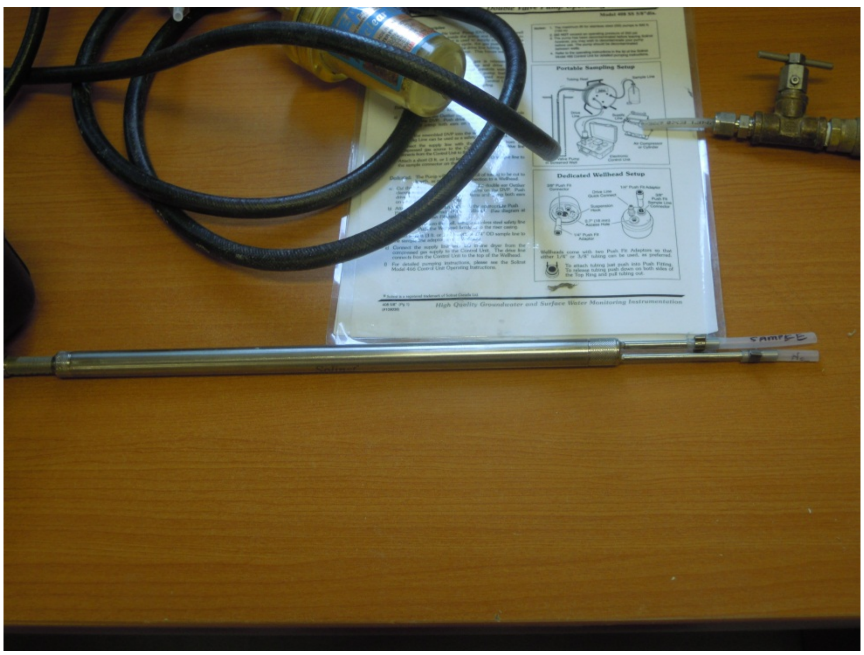


2- Place the 1 inch Waterra into the well to about 30 meters below the water level.
3- Place the rings (the smaller one first and then larger one after) onto the tubing and screw the fitting on the Waterra.
4- Connect the fitting to the red hose and then connect the red hose to the compressor.
5- Plug the compressor into the generator (make sure that the valves are close).

6- Once the compressor reaches 125 psi, open the valve and wait for the water to flow out (can take between 30 seconds to 2 minutes).
7- Once there is no water flowing, close the valve, measure the pH, conductivity, temperature, amount of water purge (by number of pails), level of the water and then, lower the waterra, wait for 10 minutes and start over. This will equal one volume purged.
8- At the end of the day, take the waterra of the well and take the water level.
9- Once you purge 3 times the amount of water in the well and parameters are stabilized (all results within +/-10%), you can sample the well

C) Sample the water in the well

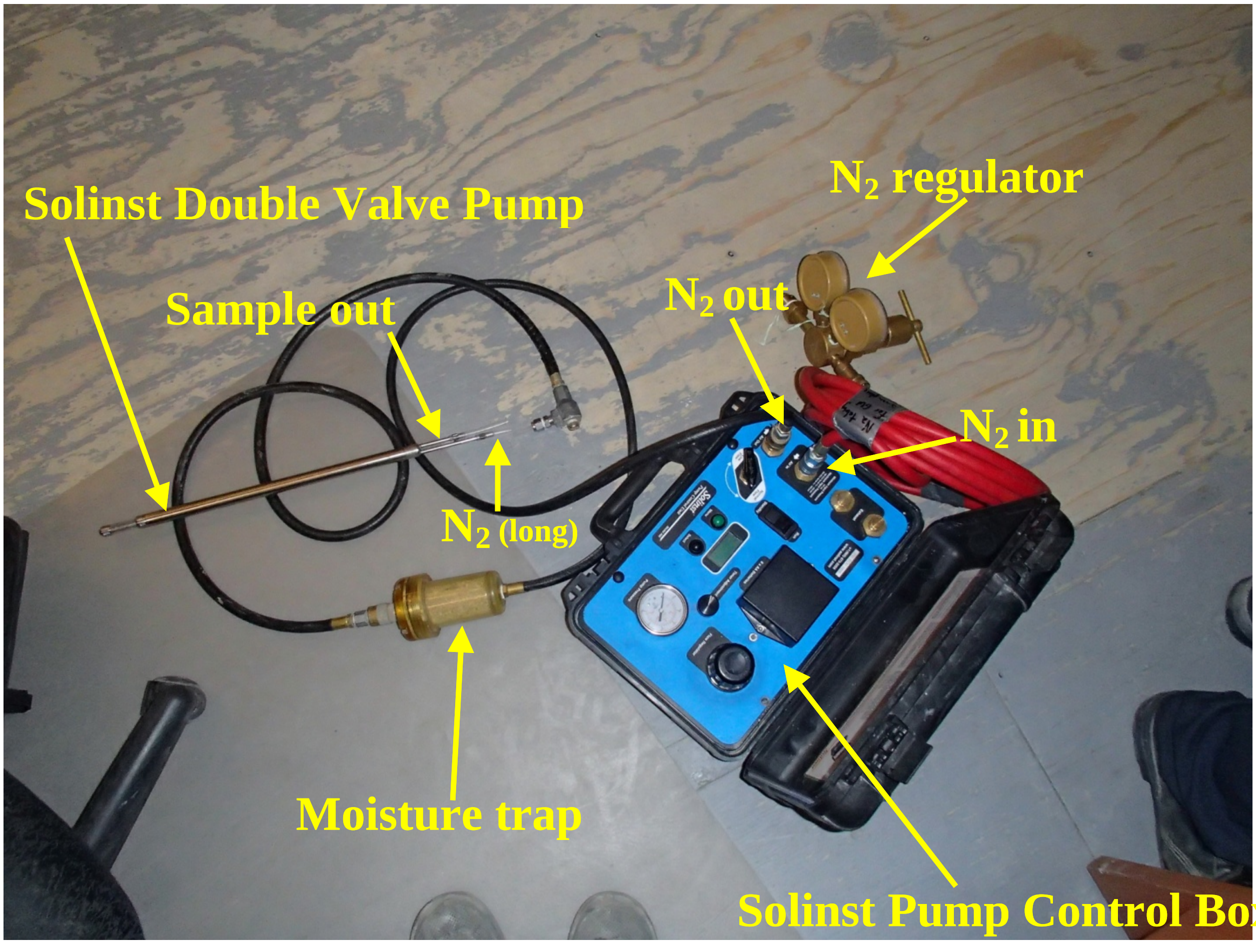
1- Place the ¼ inch double waterra line on the Solinst double valve pump.
2- Tighten the waterra with the rings



3- One Waterra line will be bring the sample water and one will send Nitrogen to the pump. Make sure to identify which line is the one for Nitrogen and which one is the line for water (longest metal tale on the pump is for nitrogen) (see photos).
4- On the nitrogen waterra line, place 2 rings and a bolt and place it on the 90˚adapter and the black hose with the moisture trap.

5- Connect the black hose to the Nitrogen control box (AIR OUT)
6- Plug the red hose to the control box (AIR IN).
7- Plug the other end of the red hose to the ``T`` regulator with the gauge.

8- Connect the regulator to the nitrogen tank and slowly open the Nitrogen tank to a pressure of140 PSI.
9- On the control box press RUN than put the menu on AUTO mode.
10- With the SELECT button adjust the pressure so that when it's pumping the pressure is at 140 PSI and when it's venting, it goes back to 0 PSI.
11- This should take about 5 minutes before there is a water flow.
12- Let it run for 10 to 15 minutes, measure parameters with the PCSTestr 35 or the multi-parameter probe and sample the water. Record all field parameters results.
13- For filtering, place the pumped GW in a clean container, rinse 3 times and use a syringe to sample.



Solinst Double Valve Pump
N_2 regulator
Sample out
N_2 out
N_2 in
N_2 (long)
Moisture trap
Solinst Pump Control Box

Control box

8 AA batteries
250 ECU 5655
+1 (905) 873-2255
www.solinst.com
Exhaust
N2 in, connected to N2 regulator
Minimum Input Pressure
Maximum Input Pressure
8 x AA Batteries
Pressure fluctuates between 0 and 140 psi between drive and purge cycles
Flow Regulator
Timer Adjustment
Air In
Standby
Drive – 12s
Normal Flow
Normal flow
Menu
Select
Pump Pressure
Air Out
Solinst
N2 out, connected to ¼ tubing attached to Solinst Double Valve Pump (long stainless steel tube)

Control box

Valve and Ring

Take a triplicate for every sample, send 2 to the lab and keep a backup sample.

Follow the SOP for the shipping request..\Shipping\Shipping Samples SOP.doc

Author:		
Environmental Technician	Martin Theriault	
Print Title	Print Name	Signature

Approval:		
Environmental Coordinator	Jeffrey Pratt	
Print Title	Print Name	Signature

APPENDIX D

Standard Operating Procedure for Sampling of Production Drill Holes (Interim)

Procedure for Groundwater Sampling from Flowing Production Drill Holes/Wells

Purpose:

This procedure is to ensure that groundwater (GW) sampling from flowing production drill holes/wells is conducted in a safe and orderly manner. Production holes are drilled to place explosives for blasting. All samples need to be taken in the same manner to provide continuity of samples regardless of who is taking the samples. Using the Environment Department PCSTestr 35 conductivity and salinity readings are to be taken from flowing production wells, when notification is received, and compared to results from previous GW sampling events conducted by Golder (see chart below). If these parameters are determined to be similar we can conclude that the water is representative of area GW.A sample can then be taken. The drilling of production wells involves the use of freshwater and this water will be purged when a flowing well is encountered. It is important to ensure that this water is purged prior to taking a sample (which is why the meter is used – to take continuous samples until it is determined that the water is GW).

Groundwater sampling from production holes SOP:

GW sampling from production holes consists of measuring field parameters (conductivity, TDS and salinity) with the PCSTestr 35 and comparing the results with past results (Golder) from the GW wells. If the results are similar in chemistry to previous results then a sample is collected using the designated sample bottles prior to the addition and use of explosives in the hole. The location, time, depth of hole and procedural notes are documentation that will be required from each sampling event.

Material needed for the job:

Calibrated Multi-parameter PCSTestr 35
Watch
Clean Pail
Sampling gloves
Sampling bottles
GPS
Camera

Procedures to be done in 2013

1- Senior Environmental Technician or Coordinator will request that the Blast supervisor (Mine Dept) notify Env staff when a flowing production well is drilled (it is not a regular occurrence). We need to make sure no explosive material is added to the hole before sampling. Env Dept should have equipment ready and proceed to site upon notification if possible.

2- Before sampling, make sure that 3 well volumes have been purged from the flowing hole. Production wells are usually 0.17 meter diameter and 8.5 meters deep so approximately 579L needs to have been discharged. It will not always be possible to determine the purged volume due to the time it takes to travel to the location. In field sampling will assist in determining if the GW is representative of the area GW.

3- Calculate the amount of time needed before sampling according to the flow.

4- Take at least 3 readings during the purging with the multi-parameter probe (conductivity, TDS and salinity) and compare your results with Golder's results (see table below). Parameters need to be stable (within 10% of each other).

5- If results are similar, once the purge is completed, put on the nitrile gloves and sample the hole with the appropriate bottles. For filtering, let the water flow into a clean container, rinse 3 times and use a syringe to sample.

6- Take the GPS coordinates and the identification of the hole (blast pattern) of the sampling location and also take some pictures of the overflowing hole.

Golder's results for TDS, Conductivity and Salinity

Golder - GW monitoring - Doc - 1212210081 1211_12 TM 2012 GW Monitoring and Results - MB Ver 0 Rev3.pdf - Adobe Acrobat Pro

measured are summarized in Table 1.

Table 1: Concentration of Constituents that Relate to Groundwater Salinity

Location	Monitoring Well	Lithology	Sample Year	TDS[1] (mg/L)	Conductivity (µS/cm)	Chloride (mg/L)
Goose Island	MW03-01	Ultramafic	2003	793	*1,855*	626
			2004	1,335	2,900	845
			2006	315*	460*	81*
			2007	389	588	126
			2008	1,100	3,200	950
			2009	1,900*	3,350*	970*
			2010	340	335*	5.7
	MW11-01	Intermediate Volcanic	2011	14,840	*3,999*	10,271
Third Portage	MW08-02	Intermediate Volcanic	2008	510*	*808**	160
			2009	520*	705*	160*
			2010	450	*690**	160
			2011	523	*782**	169
			2012	307**	*616**	111
South basin of Second Portage Arm	BH10-01	Intermediate Volcanic	2010	670*	935*	17
	MW11-02	Intermediate Volcanic	2011	263	*400**	20.9

Notes: [1] Laboratory measurement except for in 2011 which reported values as dissolved solids
* Average value
** TDS value calculated from laboratory measured values of dissolved constituents
Italic - field measured value

4/7

Golder Associates

Follow the SOP for the shipping request..\Shipping\Shipping Samples SOP.doc

Author:		
Environmental Technician	Martin Theriault	
Print Title	Print Name	Signature

AGNICO EAGLE MINES: MEADOWBANK DIVISION

FISH HABITAT OFFSETTING PLAN:
PHASER LAKE

NOVEMBER, 2016

TABLE OF CONTENTS

EXECUTIVE SUMMARY IV

SECTION 1 • INTRODUCTION 5

1.1 Goal 5
1.2 Phaser Lake Water Quality 5

SECTION 2 • HABITAT EVALUATION PROCEDURE 8

2.1 HEP Model 8
2.1.1 Habitat Type Area (HT_{1-10}) 9
2.1.2 Habitat Suitability Index ($HSI_{sp,nu,fo,ow}$) 9
2.1.3 Life Function Weight 10
2.1.4 Species Weight 10
2.1.5 Access Factor 11
2.1.6 Habitat Co-factor 12

SECTION 3 • HABITAT LOSSES 13

3.1.1 HU Calculation 13

SECTION 4 • HABITAT GAINS 18

4.1 Re-flooding of Dewatered Phaser Lake, with Access for Arctic Char 18
4.1.1 Description 18
4.1.2 HU Calculation 21
4.2 Research Funding 24
4.3 Unmapped area 24
4.4 Timeline, Design and Construction of the Offsetting Measures 25
4.5 Monitoring 25

SECTION 5 • DISCUSSION AND CONCLUSIONS 26

5.1 Summary 26
5.2 Allotment of Gains 26

REFERENCES 27

LIST OF FIGURES

Figure 3-1. Footprint of mining activities in the Vault Lake Area. 15
Figure 3-2. Baseline substrate and depth zones for the Vault Lake Area. 16
Figure 3-3. Baseline habitat types for the Vault Lake Area. 17
Figure 4-1. Substrate and depth zones for Phaser Lake following re-flooding. 22
Figure 4-2. Habitat types for Phaser Lake following re-flooding. 23

LIST OF TABLES

Table 1-1. Water quality in Phaser Lake; September and October, 2013. 6
Table 2-1. Physical characteristics of the habitat types proposed for the Phaser Lake HEP. Note that habitat type 10 is applied to all non-backfilled pit areas, independent of depth and substrate characteristics. 9
Table 2-2. HSI values for the Meadowbank region fish species (sp=spawning, nu=nursery, fo=foraging, ow=overwintering). *Habitat type 10 is applied to all non-backfilled pit areas. 10
Table 2-5. Access factor theoretically applied to each species for habitat loss and gain calculations, based on presence/absence (or anticipated presence/absence, for offsetting projects). 11
Table 2-6. Access factor values used for each species in Phaser Lake for habitat loss and gain calculations. 12
Table 2-7. Habitat co-factor for various pre- and post-compensation scenarios, according to Minns, 2012. 12
Table 3-1. Baseline, or lost habitat type areas (ha) and habitat units (HUs) for Phaser Lake. *HT 10 is applied only to pit areas in offsetting calculations. 14
Table 4-1. Mine-related features of Phaser Lake and details of the changes and assumptions used to determine habitat type for each area, following re-flooding.....20
Table 4-2. Habitat units (HUs) gained through re-flooding in Phaser Lake. *HT 10 refers to non-backfilled pit habitat. 21
Table 4-5. Total area of each mine feature in Phaser Lake and area for which habitat units could not be mapped. 25

LIST OF APPENDICES

Appendix A – HU Summary, Subtotals and Totals by Species

Appendix B – Summary of Phaser Lake eDNA Study

EXECUTIVE SUMMARY

This offsetting plan is presented as an addendum to Meadowbank's No-Net-Loss plan (NNLP; AEM, 2012). It characterizes the anticipated serious harm to fish that would be associated with the development of Phaser Pit and BB Phaser Pit, and identifies Agnico Eagle's proposed offsetting measures.

Although the 2012 NNLP quantified serious harm to fish associated with the dewatering of Phaser Lake as a result of development of the Phaser Pit, Agnico Eagle did not apply to DFO for a Fisheries Authorization for Phaser Lake at that time. Since then, development of an additional pit area in Phaser Lake (BB Phaser Pit) has been proposed, and changes to Fisheries Act legislation have occurred. Following discussions with DFO throughout 2015 and 2016, this addendum presents the updated habitat offsetting calculations for Phaser Lake.

Losses and gains in fish habitat were quantified using the Habitat Evaluation Procedure (HEP) approach applied in the 2012 NNLP, with a few adjustments to certain parameters, based on DFO feedback. Development of both Phaser and BB Phaser pits will require dewatering of Phaser Lake, following a fish-out program, resulting in losses to fish habitat. Baseline habitat units for Phaser Lake were calculated to be 9.49 HUs. These are the losses to fish habitat that will occur due to dewatering Phaser Lake if no offsets are implemented. Onsite offsets are planned to include re-flooding of the de-watered Phaser Lake following habitat improvement measures such as substrate changes, partial backfilling of Phaser Pit, and access enhancements for Arctic char. A total of 14.53 HUs are gained through these measures. In addition to onsite offsetting measures, Agnico Eagle also proposes to provide a portion of the offsetting costs for research funding (10% on top of estimated costs of constructed offsetting), with a planned focus on aquatic research such as eDNA and/or remote fish tracking to confirm habitat usage. Assuming this project is equivalent to 10% of the onsite habitat gains, the overall gains: losses ratio for the Phaser Lake project is 1.68:1.

Re-flooding of Phaser Lake will occur in the relatively near term (estimated to re-fill naturally by summer of 2027) and fish introduction will be allowed once monitoring indicates the lake is hydraulically and chemically stable and suitable for aquatic biota.

SECTION 1 • INTRODUCTION

In 2012, Agnico Eagle developed a revised No-Net-Loss Plan (NNLP) for the Meadowbank site to account for habitat alterations, disruptions or destructions (HADD) that were planned to occur in Second Portage Lake, Third Portage Lake, Vault Lake and Phaser Lake. Based on this plan, DFO authorizations (NU-03-0191.3 and NU-03-0191.4) were issued under Paragraph 35(2)(b) of the Fisheries Act for works in Second Portage Lake, Third Portage Lake and Vault Lake.

In July 2014, Agnico Eagle applied for a DFO authorization for Phaser Lake. However, since 2012, changes have been made to the footprint of planned development in Phaser Lake, and to Fisheries Act legislation. This offsetting plan is therefore presented as an addendum to Agnico Eagle's 2012 No-Net-Loss-Plan, and aims to characterize the residual harm to fish and fish habitat that will occur throughout the mine development and operational phase of pits in Phaser Lake, and the offsetting measures that will be implemented.

Phaser Lake is located to the north of the main minesite area at Meadowbank. It is adjacent to Vault Lake, where dewatering has already occurred and Vault pit development is underway. Phaser Lake is relatively small and isolated, with a surface area of 27 ha and a maximum depth of 4-5 m. For further descriptions of the Meadowbank site, ecological setting, fish species, their habitat preferences, and history of the NNLP at Meadowbank, refer to the 2012 NNLP (AEM, 2012).

1.1 GOAL

The main goal of this plan is to characterize the residual serious harm to fish that will occur as a result of mining activities in Phaser Lake at the Meadowbank mine, and to select and quantify offsetting measures. This plan supports Agnico Eagle's application to DFO for an authorization for works in Phaser Lake under Paragraph 35(2)(b) of the Fisheries Act.

Offsetting (at the time, "compensation") options were previously proposed for losses associated with Phaser Pit (and other areas) in the 2012 NNLP after researching techniques and projects implemented at other northern mines, holding workshops and site visits with the local Hunter's and Trapper's Organization, Kivalliq Inuit Association and the DFO Habitat and Science & Research Departments, and reviewing the literature for information on effectiveness of compensation techniques in the north.

1.2 PHASER LAKE WATER QUALITY

Water quality in Phaser Lake was analyzed on three dates in September and October, 2013. Parameters included total and dissolved metals, cyanide, hardness, alkalinity, ammonia, sulfate, nitrate and nitrite. Results of these analyses are provided in Table 1-1. As with other lakes in the area, Phaser Lake is considered to be ultraoligotrophic, and the majority of parameters were below limits of detection.

Table 1-1. Water quality in Phaser Lake; September and October, 2013.

Parameter	Units	10/09/2013	23/09/2013	02/10/2013
Alkalinity	mg $CaCO_3$/L	49	49	45
Ammonia nitrogen (NH3-NH4)	mg N/L	0.08	0.32	<0.01
TDS	mg/L	36	36	36
CN total	mg/L	0.007	<0.005	<0.005
CN Free	mg/L	<1	<1	<1
pH (field)		6.83	7.12	7.57
Conductivity (field)		37	56.2	60.1
Turbidity (field)	NTU	0.7	0.68	0.56
Chloride	mg/L	1.2	0.8	1.1
Fluoride	mg/L	0.15	0.03	0.12
Hardness	mg $CaCO_3$/L	26	19	23
Nitrate	mg/L	0.03	0.07	0.15
Nitrite	mg/L	<0.01	<0.01	<0.01
Sulphate	mg/L	3.9	8.3	4.2
Dissolved Aluminium (Al)	mg/L	<0.006	<0.006	<0.006
Dissolved Arsenic (As)	mg/L	<0.0005	<0.0005	0.0006
Dissolved Barium (Ba)	mg/L	0.002	0.0019	0.0026
Dissolved Cadmium (Cd)	mg/L	<0.00002	<0.00002	<0.00002
Dissolved Copper (Cu)	mg/L	0.0006	<0.0005	<0.0005
Dissolved Iron (Fe)	mg/L	<0.01	<0.01	<0.01
Dissolved Lead (Pb)	mg/L	<0.0003	<0.0003	<0.0003
Dissolved Manganese (Mn)	mg/L	<0.0005	<0.0005	<0.0005
Dissolved Mercury (Hg)	mg/L	<0.0001	<0.0001	<0.0001
Dissolved Molybdenum (Mo)	mg/L	<0.0005	<0.0005	<0.0005
Dissolved Nickel (Ni)	mg/L	<0.0005	<0.0005	<0.0005
Dissolved Selenium (Se)	mg/L	<0.001	<0.001	<0.001
Dissolved Silver (Ag)	mg/L	<0.001	<0.001	<0.0001
Dissolved Thallium (Tl)	mg/L	<0.005	<0.005	
Dissolved Zinc (Zn)	mg/L	<0.001	<0.001	
Aluminium (Al)	mg/L	0.023	<0.006	<0.006
Antimony (Sb)	mg/L	<0.0001	<0.0001	<0.0001
Arsenic (As)	mg/L	<0.0005	<0.0005	0.0022
Boron (B)	mg/L	<0.01	<0.01	<0.01
Barium (Ba)	mg/L	0.0024	0.0019	0.0029
Beryllium (Be)	mg/L	<0.0005	<0.0005	<0.0005
Cadmium (Cd)	mg/L	<0.00002	<0.00002	<0.00002
Copper (Cu)	mg/L	<0.0005	<0.0005	<0.0005
Chromium (Cr)	mg/L	<0.0006	<0.0006	<0.0006

Cobalt (Co)	mg/L	<0.0005	<0.0005	<0.0005
Iron (Fe)	mg/L	<0.01	<0.01	0.04
Lithium (Li)	mg/L	<0.005	<0.005	<0.005
Manganese (Mn)	mg/L	<0.0005	<0.0005	0.0006
Mercury (Hg)	mg/L	<0.00001	<0.00001	<0.00001
Molybdenum (Mo)	mg/L	<0.0005	<0.0005	<0.0005
Nickel (Ni)	mg/L	<0.0005	<0.0005	0.0005
Lead (Pb)	mg/L	<0.0003	<0.0003	<0.0003
Selenium (Se)	mg/L	<0.001	<0.001	<0.001
Tin (Sn)	mg/L	<0.001	<0.001	<0.001
Strontium (Sr)	mg/L	0.026	0.027	0.032
Titanium (Ti)	mg/L	<0.01	<0.01	<0.01
Thallium (Tl)	mg/L	<0.005	<0.005	<0.005
Uranium (U)	mg/L	<0.001	<0.001	<0.001
Vanadium (V)	mg/L	<0.0005	<0.0005	<0.0005
Zinc (Zn)	mg/L	<0.001	<0.001	0.001

SECTION 2 • HABITAT EVALUATION PROCEDURE

The habitat evaluation procedure (HEP) that was used to quantify habitat losses and offsets for Phaser Lake in this report is nearly identical to the procedure used for the 2012 NNL assessment, with adjustments to a number of parameters. Losses and gains in fish habitat were quantified using the Habitat Evaluation Procedure (HEP) approach applied in the 2012 NNLP, with a few adjustments to certain model parameters based on DFO feedback during the Nunavut Impact Review Board (NIRB) review process, which began in 2014, and subsequent discussions with DFO during the authorization stage of the project which continued to the end of 2016. A summary of the HEP is provided below, and further rationale is available in the 2012 document.

The HEP involves the multiplication of each affected area (in hectares) by a habitat suitability index (HSI) and series of weights in order to derive a value in habitat units (HUs) that describes both the quality and quantity of habitat. In the first stage of the habitat evaluation, pre-construction (natural, or baseline) habitat units are calculated for all areas where residual harm to fish habitat will occur. The offsets for this loss to fish habitat are then described, and quantified using the same procedure.

The net HUs will depend on the habitat types (10 groups, by substrate and depth) that are lost and gained, and the suitability of each habitat type for each fish species. Suitability of each habitat type is ranked between 0-1 for each life stage of each fish species (spawning, nursery, foraging, overwintering).

For each minesite feature (e.g. pits, dikes, roads) where losses or gains are expected to occur, HUs are calculated by multiplying the area of each habitat type in that feature by the HSI allotted to each life function of each fish species, multiplied by the species weight and life function weight, and summed. This subtotal is then multiplied by an access factor, which represents the accessibility of the area to each species (or their estimated presence/absence), and a habitat co-factor which describes changes in hydrological, thermal or chemical water quality. The HEP model is described in further detail below, and an example calculation is provided in Appendix A of the 2012 NNLP.

2.1 HEP MODEL

The HEP model used here can be described, for each fish species (spp 1-n) as:

$$\mathbf{HU}_{spp\ 1\text{-}n} = \sum_{HT\ 1\text{-}10} \left(\sum_{sp,nu,fo,ow} (\mathbf{HT}_{1\text{-}10} \times \mathbf{HSI}_{sp,nu,fo,ow} \times \textbf{life function weight} \times \textbf{species weight})] \right) \times \textbf{access factor} \times \textbf{habitat co-factor}$$

Where $HT_{1\text{-}10}$ = area (ha) of habitat types 1 through 10

$HSI_{sp,nu,fo,ow}$ = habitat suitability index for each life function:

sp = spawning use
nu = nursery use
fo = foraging use
ow = overwintering use

2.1.1 Habitat Type Area (HT_{1-10})

The foundation of the HEP is the delineation of "habitat types" – the method by which habitat areas are grouped, and thereby mapped. The Meadowbank HEP model for Phaser Lake uses 10 habitat types, which are based on various combinations of substrate and depth. Habitat types 1-9 are applied to natural habitat for various combinations of substrate type and depth zone. Habitat type 10 is included in the HEP in recognition of potentially reduced habitat quality in deep pit areas. It is proposed that in cases where pits are planned to be backfilled to depths occurring naturally in surrounding lakes, habitat types 1-9 may be applied for the pit area. Substrate and depth zones associated with each habitat type are shown in Table 2-1.

Note that habitat types for pit areas have been changed from the 2012 NNLP, which identified type 10 for use in pit areas for which stratification was expected to occur, and type 11 for pit areas with complete mixing and suitable water quality for aquatic biota.

Table 2-1. Physical characteristics of the habitat types proposed for the Phaser Lake HEP. Note that habitat type 10 is applied to all non-backfilled pit areas, independent of depth and substrate characteristics.

Habitat Type	Depth Zone	Substrate
1	0-2 m	Fine
2	0-2 m	Mixed
3	0-2 m	Coarse
4	2-4 m	Fine
5	2-4 m	Mixed
6	2-4 m	Coarse
7	>4 m	Fine
8	>4 m	Mixed
9	>4 m	Coarse
10*	mixolimnion	Coarse

*Habitat type 10 is applied to all non-backfilled pit areas independent of depth, and carries a habitat value of 0. Substrate in pits is assumed to be coarse. Although the current water quality model indicates full mixing of the Phaser Pits, a chemocline may develop and is therefore conservatively assumed. While the mixolimnion may provide suitable pelagic fish habitat, the value of this habitat is conservatively assumed to be 0 in this habitat model (see Section 2.1.2). However, habitat monitoring after re-flooding will confirm the value of habitat type 10.

In order to calculate the extents of each habitat type, depth zones and substrate were mapped for the entire Meadowbank site, for baseline and post-closure scenarios. Maps for Phaser Lake were updated during this assessment to include BB Phaser Pit. The area (in ha) for each habitat type was then determined by overlaying depth and substrate layers. All habitat type area calculations and mapping were completed by Dougan and Associates, and methods are described in further detail in the 2012 NNLP.

2.1.2 Habitat Suitability Index ($HSI_{sp,nu,fo,ow}$)

The habitat suitability term represents the relative quality of each habitat type for each life function of each fish species present in the region. In the case of this HEP, the life functions spawning, nursery, foraging and overwintering were considered. Habitat suitability for each life function is indicated through a ranking of 0, 0.25, 0.5, 0.75 or 1. HSIs for all fish species and habitat types used in this HEP are shown in Table 2-2, and their derivation is further described in AEM (2012).

Note that the habitat suitability for habitat type 10 (non-backfilled pit areas) has been adjusted to 0 following recent discussions with DFO. This is in recognition of the unknown value of pit areas within lakes as fish habitat.

Table 2-2. HSI values for the Meadowbank region fish species (sp=spawning, nu=nursery, fo=foraging, ow=overwintering). *Habitat type 10 is applied to all non-backfilled pit areas.

Habitat Type	Depth	Substrate	Arctic Char				Lake Trout				Round Whitefish			
			SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
1	<2 m	Fines	0	0.25	0.25	0	0	0.25	0.25	0	0	0.25	0.75	0
2	<2 m	Mixed	0	0.25	0.25	0	0	0.5	0.5	0	0	0.75	0.5	0
3	<2 m	Coarse	0	0.5	0.5	0	0	1	0.75	0	0	0.75	0.5	0
4	2-4 m	Fines	0	0.5	0.5	0.75	0	0.5	0.5	0.75	0	0.25	1	0.75
5	2-4 m	Mixed	0.5	0.75	0.75	0.75	0.5	0.75	0.75	0.75	0.5	0.75	0.75	0.75
6	2-4 m	Coarse	1	1	1	0.75	1	1	1	0.75	1	1	0.75	0.75
7	>4 m	Fines	0	0.25	0.5	1	0	0.25	0.5	1	0	0.25	1	1
8	>4 m	Mixed	0.5	0.5	0.75	1	0.5	0.5	0.75	1	0.25	0.25	0.5	1
9	>4 m	Coarse	1	0.5	1	1	1	0.5	1	1	0.75	0.5	0.5	1
10*	mixolimnion	Coarse	0	0	0	0	0	0	0	0	0	0	0	0
Habitat Type	**Depth**	**Substrate**	**Burbot**				**Slimy Sculpin**				**Ninespine Stickleback**			
			SP	**NU**	**FO**	**OW**	**SP**	**NU**	**FO**	**OW**	**SP**	**NU**	**FO**	**OW**
1	<2 m	Fines	0	0.25	0.25	0	0	0	0.25	0	1	1	1	0
2	<2 m	Mixed	0	0.75	0.5	0	0.25	0.25	0.5	0	0.5	0.5	0.75	0
3	<2 m	Coarse	0	1	0.5	0	1	1	1	0	0	0.25	0.75	0
4	2-4 m	Fines	0	0.25	0.25	0.75	0	0	0.25	0.75	0	0	0.5	0.75
5	2-4 m	Mixed	1	0.5	0.75	0.75	0.25	0.25	0.5	0.75	0	0	0.25	0.75
6	2-4 m	Coarse	0.75	0.5	1	0.75	0.75	0.75	1	0.75	0	0	0.25	0.75
7	>4 m	Fines	0	0	0.25	1	0	0	0	1	0	0	0	1
8	>4 m	Mixed	1	0	0.75	1	0	0	0.25	1	0	0	0	1
9	>4 m	Coarse	0.75	0.25	1	1	0.5	0.5	0.5	1	0	0	0	1
10	mixolimnion	Coarse	0	0	0	0	0	0	0	0	0	0	0	0

2.1.3 Life Function Weight

This HEP values all life functions equally, with a weight of 0.25 each assigned for spawning, nursery, foraging and overwintering.

2.1.4 Species Weight

In the 2012 NNLP, Agnico Eagle used a fishery value and an estimated biomass value to derive species weights for eight species present regionally. However, as recommended in DFO's "Review of Habitat Evaluation Procedure (HEP) Input Parameters and Model Results for the Meadowbank Gold Mine Project" (Canadian Science Advisory Secretariat, Science Response 2016/038) and as discussed with DFO by conference call on September 30, 2016, the HEP has been amended to include equal species weights for this assessment.

Further, the list of species has been reduced to those six identified or assumed to be present in the project lake and predicted to have improved habitat as a result of proposed offsetting measures (lake trout, Arctic char, round whitefish, burbot, ninespine stickleback, and slimy sculpin).

2.1.5 Access Factor

In a workshop conducted in February, 2012 (The Basic Concepts of No Net Loss Accounting - February, 2012) Dr. Charles K. Minns suggested the use of an access factor when fish assemblages are expected to change in the offsetting scenario. According to this concept, the access factor is 1 for any species present in the habitat area, and 0 for any species not present. Each species receives an access factor in both the loss and gain calculations. Therefore, the opening of access to a habitat area for a specie (that did not have access pre-construction), results in an increase of habitat units. Similarly, the loss of access results in a loss of habitat units. These gains or losses may be complete (affect all species, e.g. conversion to a tailings storage facility), or partial (only some species are affected). Note that presence or absence of a species in loss calculations is based on surveys in the affected habitat area, whereas presence or absence in the offsetting scenario is anticipated (to be confirmed after access is altered as part of compensation monitoring – see Section 4.6).

Table 2-3. Access factor theoretically applied to each species for habitat loss and gain calculations, based on presence/absence (or anticipated presence/absence, for offsetting projects).

Scenario	Access Factor	
	Losses	Gains
Species Present	1	1
Species Not Present	0	0

For Phaser Lake, access factors applied are shown in Table 2-6, based on noted presence/absence of each species in the 2016 fishout. This lake was found to contain populations of lake trout, burbot and round whitefish. As described previously, few small-bodied species (slimy sculpin and ninespine stickleback) have been caught in fish surveys to date, however they were conservatively assumed to be present (access factor of 1) as they have commonly been found in stomach contents in area lakes. The rationale for use of an access factor of 1 for gains for Arctic char is further described in Section 4. In the 2012 NNLP, burbot, ninespine stickleback, and slimy sculpin were excluded from habitat calculations in Phaser Lake (access factor of 0 was applied for loss and gain calculations). They were added into calculations here.

Table 2-4. Access factor values used for each species in Phaser Lake for habitat loss and gain calculations.

Species	Access Factor	
	Losses	Gains
Arctic char	0	1
Lake trout	1	1
Round whitefish	1	1
Burbot	1	1
Slimy sculpin	1	1
Ninespine stickleback	1	1

2.1.6 Habitat Co-factor

The habitat co-factor represents any changes to non-mapped habitat quality (thermal, hydrological, biological or chemical regimes) that will occur in the fish habitat in question as a result of impacts or offsetting. The use of this factor is suggested by Dr. Ken Minns, and his suggested values as presented in a workshop for DFO in February, 2012 (see Section 2.1.5), are shown in Table 2-7.

Table 2-5. Habitat co-factor for various pre- and post-compensation scenarios, according to Minns, 2012.

Change in regime	Description	Baseline conditions factor	Post-closure factor
Degradation (expected)	Thermal, hydrologic, chemical and/or biological regime shifts away from preferred state for fish habitat	1	> 0 and < 1
No change	-	1	1
Enhancement (anticipated or proposed)	Thermal, hydrologic, chemical and/or biological regime expected to shift towards preferred state for fish habitat	> 0 and < 1	1

The habitat co-factor is an appropriate weighting to apply when degradation is expected to occur, or remediation of non-pristine lakes is proposed as offsetting. When there is no change in habitat quality pre- and post-mining, the weighting is 1 for both loss and gain calculations (as applied in this plan). This factor is therefore not an integral part of any offsetting calculation that does not affect water quality. Since fish will not be allowed to populate Phaser Lake until monitoring indicates water quality is suitable for aquatic biota and meets conditions of the Type A Water License, no habitat co-factor is applied in this assessment.

SECTION 3 • HABITAT LOSSES

Following the authorization by DFO, Phaser Lake was dewatered in the summer 2016 to allow development of Phaser and BB Phaser Pits. This section presents the calculation of habitat units for the baseline scenario in Phaser Lake, which represents the losses to fish habitat that will occur if no offsets are implemented. Impacts to habitat in Phaser Lake were quantified in the 2012 NNLP as a component of the Vault Lake Area. Since complete dewatering of Phaser Lake was planned at that time, there are no changes to the total impacted area (ha lost). However, a number of changes to the habitat model, as described above, have resulted in an adjustment to the baseline HUs in Phaser Lake.

It should also be noted that as discussed in the 2012 NNLP, and similar to calculations for Vault Lake, resolution differences between substrate maps and base maps for Phaser Lake were found to produce an un-mapped zone of 2.23 ha over several pockets of the lake, for which HUs could not be calculated (losses or gains). Impacts of this unmapped area on habitat calculations are further described in Section 4.

The footprint of planned mining activities for Phaser Lake is shown in Figure 3-1, including the location of pits, roads and dikes.

3.1.1 HU Calculation

Substrate zones (fines, mixed, coarse) for Phaser Lake under baseline conditions are shown in Figure 3-2a. The majority of substrate is fine grained, with coarse and mixed-grain substrate typically occurring around the shoreline.

The depth zones in Phaser Lake considered for the baseline scenario are shown in Figure 3-2b. Baseline depths are shallow, compared to the Main Minesite Area lakes (Second Portage and Third Portage Lakes). Phaser Lake reaches a maximum depth of 4-5 m.

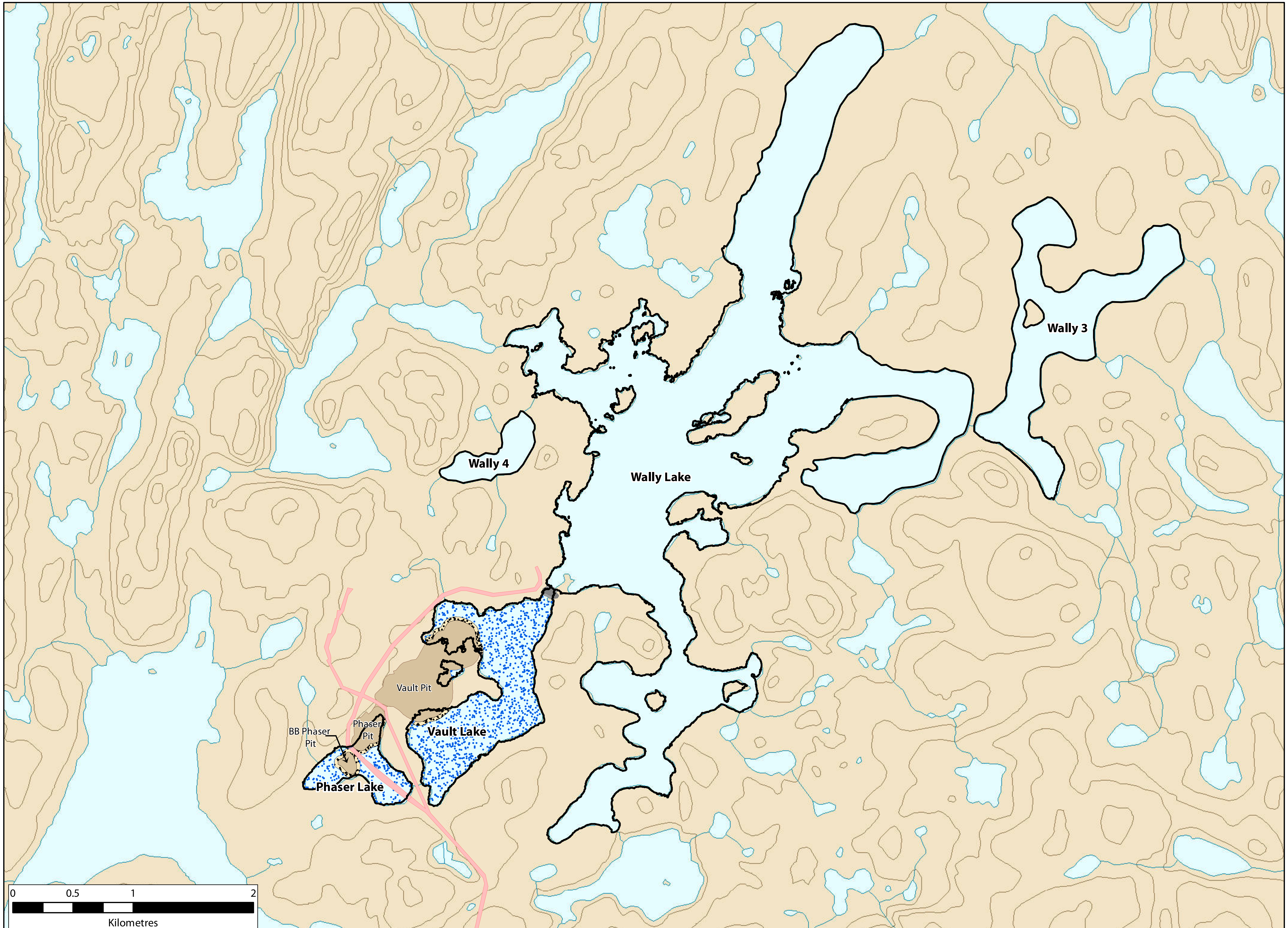
The extents of habitat types 1-9 were calculated by overlaying substrate and depth maps. Habitat types for Phaser Lake are shown in Figure 3-3. This area consists of a relatively mixed proportion of habitat types.

A summary of the total habitat type areas and habitat units, calculated as described in Section 2, are shown in Table 3-1. The HU subtotal and total by species and minesite feature are provided in Appendix A.

Table 3-1. Baseline, or lost habitat type areas (ha) and habitat units (HUs) for Phaser Lake. *HT 10 is applied only to pit areas in offsetting calculations.

Habitat Type	Area (ha)	HUs
1	0.86	0.19
2	5.44	1.42
3	16.19	5.73
4	1.03	0.31
5	1.72	0.81
6	1.21	0.73
7	0.52	0.16
8	0.20	0.08
9	0.11	0.06
10*	-	-
Total	27.29	9.49

Impacted aquatic habitat for Phaser Lake totals 27.29 hectares, or 9.49 HUs. This includes 2.23 ha of Phaser Lake that could not be mapped (see Section 4.3).



Legend

- Study Lakes
- Dike
- Dike Base
- Roads
- Pit
- Pit Cap
- Lake Basin

Features
Vault Lake Area

DOUGAN & ASSOCIATES
ECOLOGICAL CONSULTING & DESIGN
77 Wyndham Street South • Guelph ON N1E 5R3
T 519.822.1609 • F 519.822.5389 • www.dougan.ca

PROJECT: DA11-062-06

CLIENT: Agnico-Eagle Mines Ltd., Meadowbank Div.

N
W E
S
UTM Zone 14 NAD83

DATE: JUNE 2015

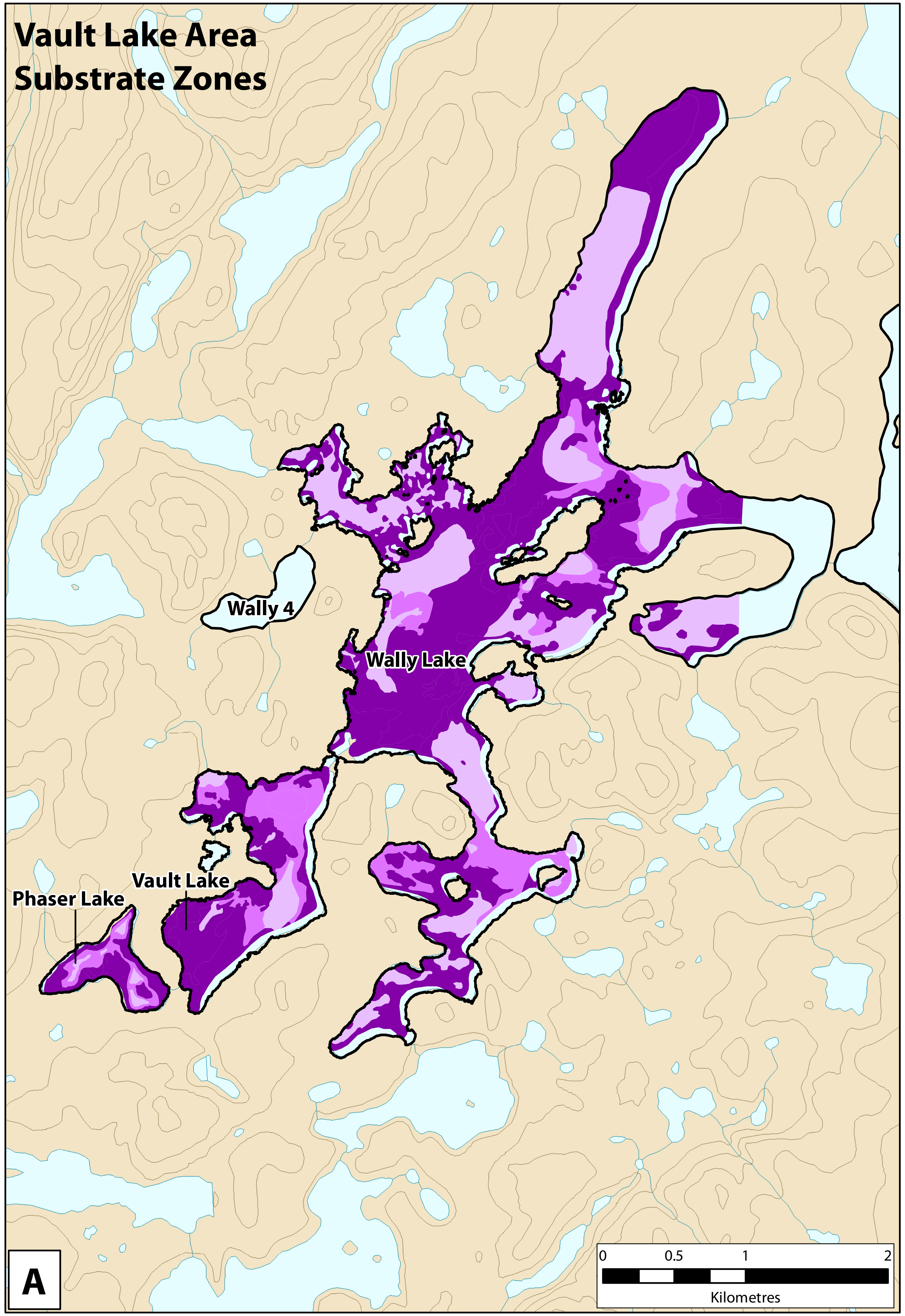
SCALE: 1:29,531

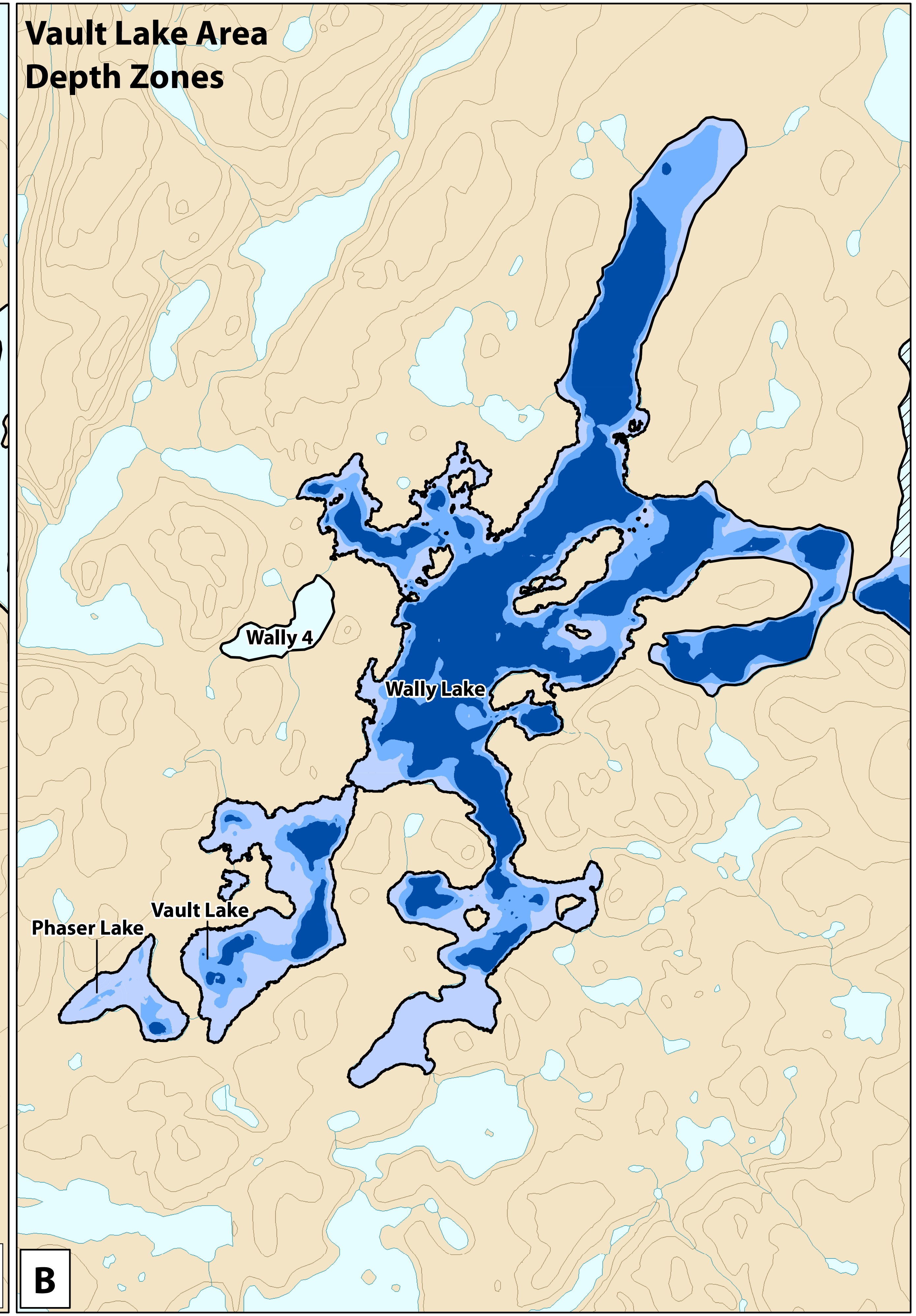
DRAWN BY: LC

CHECKED BY:

FIGURE:

3-1





Legend

Study Lakes

Substrate Zone

- Fines
- Mixed
- Coarse

Depth Zone

- <2m
- 2-4m
- >4m
- N/A

Substrate and Depth Zones

Pre-Construction

DOUGAN & ASSOCIATES
ECOLOGICAL CONSULTING & DESIGN
77 Wyndham Street South • Guelph ON N1E 5R3
T 519.822.1609 • F 519.822.5389 • www.dougan.ca

PROJECT: DA11-062-02

CLIENT: Agnico-Eagle Mines Ltd., Meadowbank Div.

N W E S
UTM Zone 14 NAD83

DATE: FEBRUARY 2016

SCALE: 1:35,000

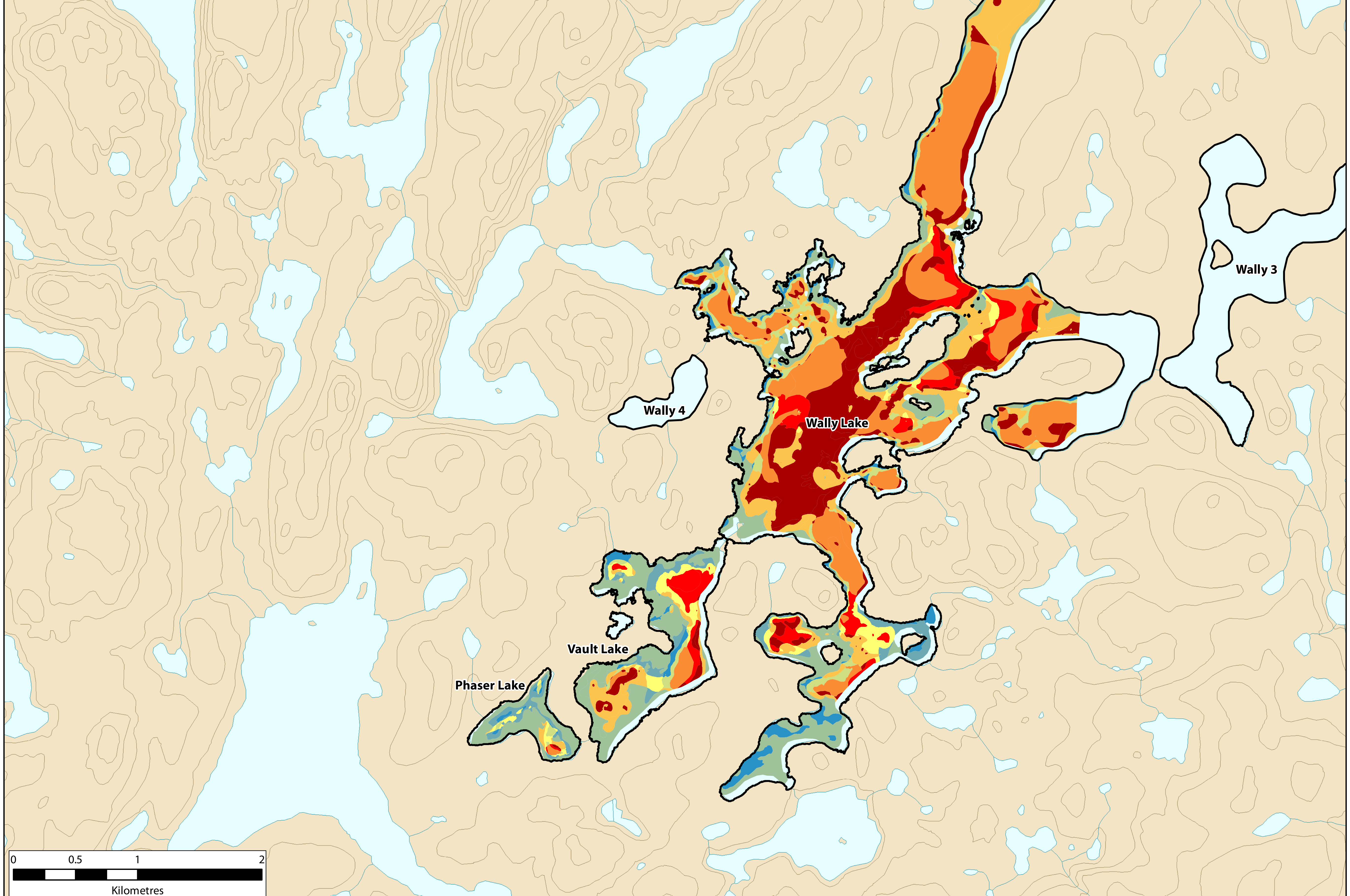
DRAWN BY: LC

CHECKED BY:

FIGURE:

3-2

Vault Lake Area Habitat Type



Legend

Study Lakes

Habitat Type

1
2
3
4
5
6
7
8
9

Habitat Type	Criteria	
	Depth Zone	Substrate
1	<2 m	Fines
2	<2 m	Mixed
3	<2 m	Coarse
4	2-4 m	Fines
5	2-4 m	Mixed
6	2-4 m	Coarse
7	>4 m	Fines
8	>4 m	Mixed
9	>4 m	Coarse

Habitat Types
Pre-Construction

DOUGAN & ASSOCIATES
ECOLOGICAL CONSULTING & DESIGN
77 Wyndham Street South • Guelph ON N1E 5R3
T 519.822.1609 • F 519.822.5389 • www.dougan.ca

PROJECT: DA11-062-02

CLIENT: Agnico-Eagle Mines Ltd., Meadowbank Div.

N W E S
UTM Zone 14 NAD83

DATE: FEBRUARY 2016

SCALE: 1:30,000

DRAWN BY: LC

CHECKED BY:

FIGURE:

3-3

SECTION 4 • HABITAT GAINS

Habitat gains to offset losses in Phaser Lake will be obtained from re-flooding of the dewatered lake following the construction of habitat improvement features such as boulder gardens, reefs and shoals. The addition of Arctic char to Phaser Lake through access improvements also contributes to habitat unit gains. In addition, funding for research is proposed as a complementary measure, amounting to 10% on top of the construction costs associated with other habitat offsetting. The details of each offsetting feature for Phaser Lake and the calculation of gained habitat units are described below.

4.1 RE-FLOODING OF DEWATERED PHASER LAKE, WITH ACCESS FOR ARCTIC CHAR

4.1.1 Description

In accordance with DFO authorizations NU-03-0191.3 and NU-03-0191.4, the major fish habitat offsetting or compensation measures currently authorized for the Meadowbank site focus on the re-flooding of dewatered basins and associated pits following mining activities (see 2012 NNLP, Section 2.2.1). In order to recover the greatest number of HUs and ultimately re-establish a natural fish population, considerations for improving fish habitat have been incorporated into the natural basin and pit designs (e.g. boulder gardens, backfilling of deep pits). Following discussions with DFO (January, 2016), AEM has agreed to adjust habitat suitability indices and remove the non-backfilled pit areas in Phaser Lake from offsetting calculations. However, the restoration of the remainder of the natural Phaser Lake basin, as well as backfilled pit areas will provide fish habitat following re-flooding.

After mining, Vault Pit will connect Vault and Phaser Lakes. Once these lakes are reflooded, hydraulically and chemically stable, water quality is considered suitable for aquatic biota and meets conditions of the Type A Water License, the Vault Dike will be removed, allowing fish from Wally Lake access to Vault and Phaser Lakes.

Alterations to fish habitat in Vault and Phaser Lakes will result from construction of pits, pit caps, roads and dikes (as seen in Figure 3-1). Both lakes will be expanded as a result of land-to-lake conversion in the Vault and Phaser pits. Backfilling the Phaser pit to a depth that is within the range of local natural lakes (est. 20 – 40 m maximum) will maximize habitat value, and provide deep water habitat which is lacking in Phaser Lake naturally. Further habitat improvements in these lakes will be made through development of shoals and areas of mixed substrate from temporary haul roads that will be re-contoured as necessary. A description of how each mine-related feature of Phaser Lake is converted to fish habitat following re-flooding is provided in Table 4-1.

In addition to these habitat alterations, the creation of access for Arctic char to Phaser Lake will occur. This species was not identified in baseline studies in Phaser Lakes, and the absence of Arctic char was confirmed during the Phaser Lake fishout. It was predicted that the absence of Arctic char is due to historical isolation and the lack of deep-water habitat, which is generally recognized as niche habitat required by this species when landlocked. Pit development in Phaser and Vault Lakes will provide a significant quantity (approximately 47 ha) of this deep-water habitat.

Table 4-1. Mine-related features of Phaser Lake and details of the changes and assumptions used to determine habitat type for each area, following re-flooding.

Feature Name	Description of Feature	Description of Habitat
Basin	Area in Phaser Lake that is not covered by other features	Placement of coarse material for temporary roads will result in mixed substrate throughout basin area at depths based on pre-construction contours
BB Phaser Pit	Smaller pit entirely within Phaser Lake	Pit will not be backfilled; assumed to provide no habitat value (HT 10)
BB Phaser Pit Cap	Cap around outside of Baby Phaser Pit (assumed 30 m width)	Cap area provides coarse substrate shoal habitat; no change in depth
Phaser Pit – In-water portion	Portion of Phaser Pit that overlays Phaser Lake	Pit backfilled to an estimated 20-40 m to provide increased habitat suitability; all substrate is coarse (HT 9)
Phaser Pit - Land-to-Lake	Portion of Phaser Pit that overlays land	Pit backfilled to an estimated 20-40 m to provide increased habitat suitability; all substrate is coarse (HT 9)
Phaser Pit Cap	Cap around outside of Phaser Pit (assumed 30 m width)	Cap area provides coarse substrate shoal habitat; no change in depth
Roads	Haul road to run north-south across Phaser Lake	Simulated coarse substrate reef habitat at pre-construction depth

4.1.2 HU Calculation

Substrate zones (fines, mixed, coarse) for Phaser Lake following re-flooding, as determined by the method described in Section 2.1, and incorporating the changes detailed in Table 4-1, above, are shown in Figure 4-1a. Changes to substrate occur through pit and road development, creating areas of coarse and mixed sediment in previously fine-grained basins.

The extents of the depth zones for Phaser Lake following re-flooding, calculated as described in Section 2.1, are shown in Figure 4-1b. The partially backfilled Phaser Pit will provide enhanced overwintering habitat, which is not abundant in this area.

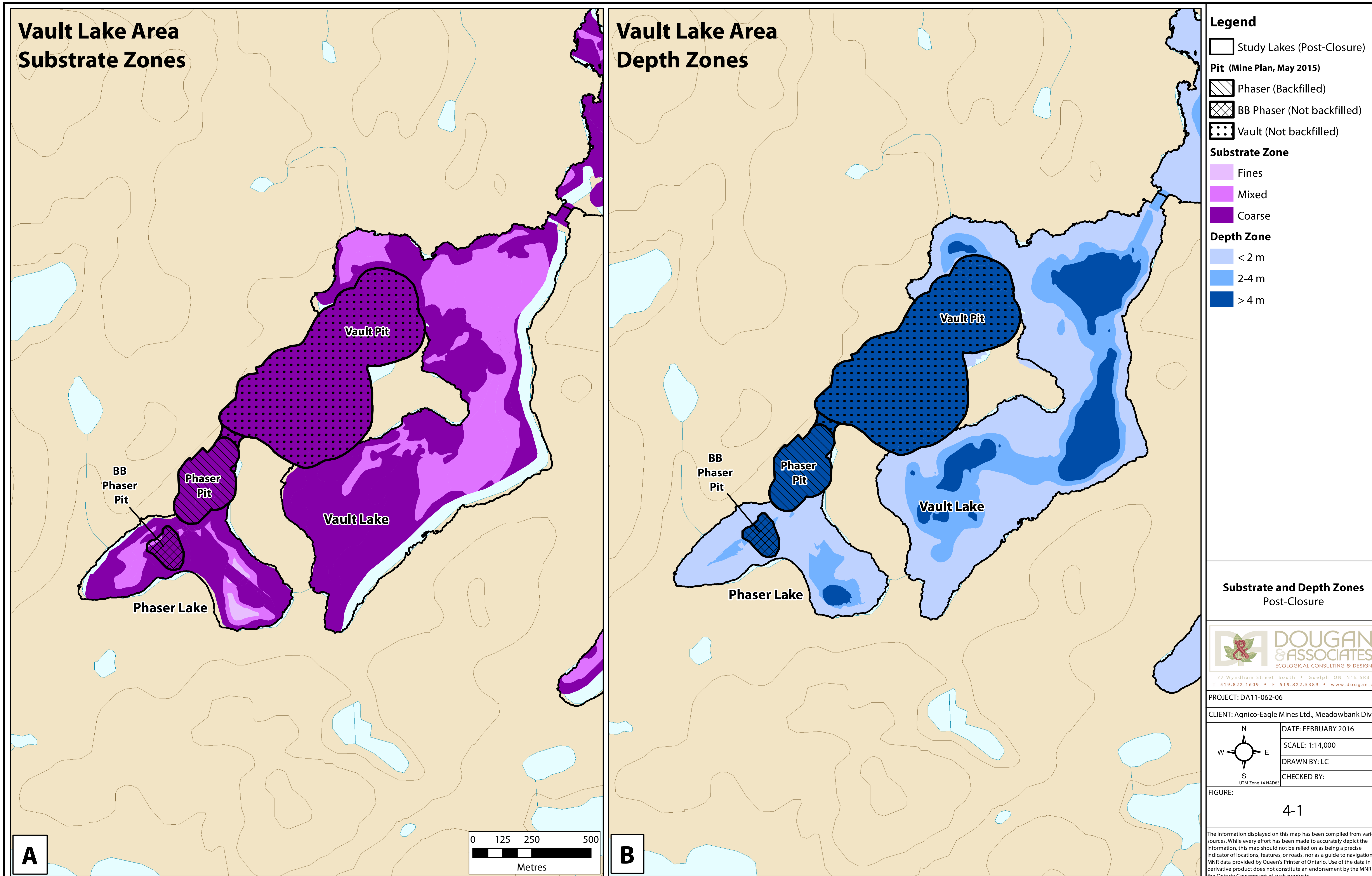
The extent of habitat types 1-10, as described in Section 2.1, were calculated by overlaying substrate and depth maps. Habitat types for Phaser Lake are shown in Figure 4-2. Habitat type 10 is assigned to non-backfilled pit areas independent of estimated depth or substrate characteristics.

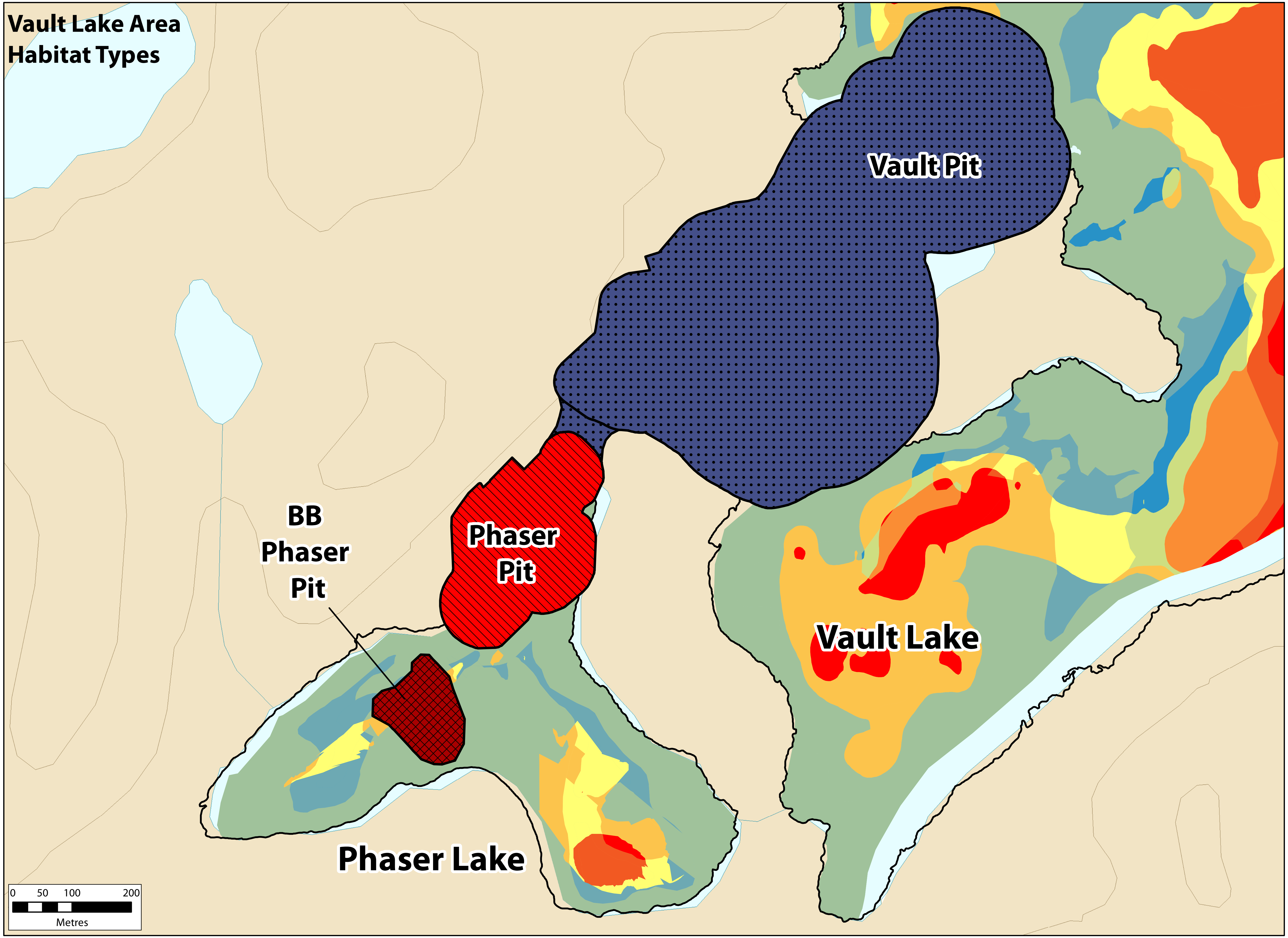
In addition, the access factor for Arctic char increases from 0 in the pre-construction scenario, to 1 in the post-construction scenario.

A summary of the total habitat type areas and habitat units, calculated as described in Section 2 are shown in Table 4-2. The HU subtotal and total by species and minesite feature are provided in Appendix A.

Table 4-2. Habitat units (HUs) gained through re-flooding in Phaser Lake. *HT 10 refers to non-backfilled pit habitat.

Habitat Type	Hectares	Habitat Units
1	0.00	0.00
2	2.57	0.72
3	15.24	6.03
4	0.00	0.00
5	1.49	0.87
6	1.83	1.39
7	0.00	0.00
8	0.71	0.37
9	7.60	5.14
10*	1.79	0.00
Total	31.23	14.53


Vault Lake Area
Substrate Zones
Vault Pit
BB
Phaser
Pit
Phaser
Pit
Vault Lake
Phaser Lake
A
0 125 250 500
Metres
Vault Lake Area
Depth Zones
Vault Pit
BB
Phaser
Pit
Phaser
Pit
Vault Lake
Phaser Lake
B
Legend
Study Lakes (Post-Closure)
Pit (Mine Plan, May 2015)
Phaser (Backfilled)
BB Phaser (Not backfilled)
Vault (Not backfilled)
Substrate Zone
Fines
Mixed
Coarse
Depth Zone
< 2 m
2-4 m
> 4 m
Substrate and Depth Zones
Post-Closure
DOUGAN & ASSOCIATES
ECOLOGICAL CONSULTING & DESIGN
77 Wyndham Street South • Guelph ON N1E 5R3
T 519.822.1609 • F 519.822.5389 • www.dougan.ca
PROJECT: DA11-062-06
CLIENT: Agnico-Eagle Mines Ltd., Meadowbank Div.
N
W
E
S
UTM Zone 14 NAD83
DATE: FEBRUARY 2016
SCALE: 1:14,000
DRAWN BY: LC
CHECKED BY:
FIGURE:
4-1
The information displayed on this map has been compiled from various sources. While every effort has been made to accurately depict the information, this map should not be relied on as being a precise indicator of locations, features, or roads, nor as a guide to navigation. MNR data provided by Queen's Printer of Ontario. Use of the data in any derivative product does not constitute an endorsement by the MNR or the Ontario Government of such products.



Legend

Study Lakes (Post-Closure)

Pit (Mine Plan, May 2015)

- Phaser (Backfilled)
- BB Phaser (Not backfilled)
- Vault (Not backfilled)

Habitat Type

1
2
3
4
5
6
7
8
9
10

Habitat	Criteria	
Type	Depth Zone	Substrate
1	<2 m	Fines
2	<2 m	Mixed
3	<2 m	Coarse
4	2-4 m	Fines
5	2-4 m	Mixed
6	2-4 m	Coarse
7	> 4 m	Fines
8	> 4 m	Mixed
9	> 4 m	Coarse
10	mixolimnion	Coarse

Habitat Types
Post-Closure

DOUGAN & ASSOCIATES
ECOLOGICAL CONSULTING & DESIGN
77 Wyndham Street South • Guelph ON N1E 5R3
T 519.822.1609 • F 519.822.5389 • www.dougan.ca

PROJECT: DA11-062-06

CLIENT: Agnico-Eagle Mines Ltd., Meadowbank Div.

N
W E
S
UTM Zone 14 NAD83

DATE: FEBRUARY 2016

SCALE: 1:6,000

DRAWN BY: LC

CHECKED BY:

FIGURE:

4-2

The information displayed on this map has been compiled from various sources. While every effort has been made to accurately depict the information, this map should not be relied on as being a precise indicator of locations, features, or roads, nor as a guide to navigation. MNR data provided by Queen's Printer of Ontario. Use of the data in any derivative product does not constitute an endorsement by the MNR or the Ontario Government of such products.

4.2 RESEARCH FUNDING

In 2013, Agnico Eagle re-assessed the No Net Loss Plan costs for the Meadowbank site (AEM, 2013). The originally estimated cost to construct access to Phaser Lake was $462,611.12 using Reclaim V 6.0 software (AEM, 2013). Under the provisions of the DFO Fisheries Productivity Investment Policy: A proponent's guide to offsetting (DFO, 2013), as a complementary measure for offsetting the serious harm to fish associated with dewatering Phaser Lake, Agnico Eagle proposes to fund research projects using an estimated 10% ($46,261) on top of the cost of constructing onsite Phaser Lake offsetting works. This may include both direct and in-kind contributions.

Agnico Eagle has been working with researchers at the University of Guelph and University of Alberta to understand aquatic and terrestrial foodwebs in the region, and have begun working with researchers at the University of Guelph on an eDNA study using Phaser Lake. Although the project is in early phases, all parties agree that this is considered a unique opportunity for such a study. Since Phaser Lake is a small, isolated lake with low biodiversity, that is has been dewatered following a fish-out program, biomass and/or species composition estimated through eDNA methods may be able to be compared to fishout data. This information will continue to contribute to an improved understanding of northern aquatic ecosystems and methods for habitat assessment. A summary of research questions, project activities to date and objectives is included as Appendix B. Communication of study results will be determined by the research team.

A second opportunity for research related to Phaser Lake is proposed in conjunction with Phaser Lake re-flooding. There are many questions related to fish habitat utilization that could begin to be answered during this project phase using fish tagging and telemetry. Agnico Eagle will work with academic researchers and contracted biologists to implement a study tracking fish habitat use in a lake basin which incorporates natural former lake bed, backfilled pit, as well as non-backfilled pit areas.

4.3 UNMAPPED AREA

As described in Section 3, resolution differences between substrate maps and base maps for Phaser Lake were found to produce an un-mapped zone of 2.23 ha around the northern perimeter of the lake, for which HUs could not be calculated for losses or gains.

The total area for which habitat units could not be calculated, associated with each mine feature within Phaser Lake (in-water area only) are shown in Table 4-5. Based on adjacent habitat types, all unmapped areas fall within the HT 3 zone (<2 m, coarse; see Figure 3-2). Since the Phaser Pit will be partially backfilled, and all substrate in impacted areas will remain coarse substrate post-construction, no significant changes in habitat quality in the unmapped areas is anticipated. In accordance with DFO's "Review of Habitat Evaluation Procedure (HEP) Input Parameters and Model Results for the Meadowbank Gold Mine Project" (Canadian Science Advisory Secretariat, Science Response 2016/038), the unmapped 2.23 ha of HT 3 was included in the total lost and gained habitat area in Phaser Lake.

Table 4-3. Total area of each mine feature in Phaser Lake and area for which habitat units could not be mapped.

Phaser Lake Feature	Total Area (ha)	Mapped Area (ha)	Unmapped Area (ha)
Phaser Pit	3.55	2.78	0.76
Phaser Pit Cap	0.66	0.66	0.00
Phaser Lake Basin	16.84	15.41	1.43
Roads	2.76	2.71	0.04
BB Phaser Pit	1.79	1.79	0
BB Phaser Pit Cap	1.69	1.69	0
Total	**27.29**	**25.05**	**2.23**

4.4 TIMELINE, DESIGN AND CONSTRUCTION OF THE OFFSETTING MEASURES

The duration of impacts to fish and fish habitat in Phaser Lake will extend from the initiation of dewatering and the fishout (July 2016), until re-flooding and fish introduction is complete. Phaser Lake is estimated to begin re-filling naturally from watershed run-off inflows during operations, and be completely re-flooded by natural inflows by 2027. No active pumping is planned at this time for Phaser Lake. Fish from Wally Lake will be transferred or the Vault Dike breached to allow fish access in consultation with DFO following re-flooding.

Phaser Pit and BB Phaser Pit operations will begin and will be completed in 2017; these operations will take place concurrent with Vault Operations, which are expected to finish in 2018.

Construction of in-basin mine-related features including roads, pit caps, and pit backfilling is based on mine construction requirements and, depending on the feature, will be re-contoured to promote mixed habitat types. While in-basin features will be constructed prior to re-flooding, offsets in fish habitat for onsite options will not be realized until fish are re-introduced and criteria for success are met through monitoring (see Section 4.5).

The proposed eDNA research project began in spring 2016, in anticipation of the limited opportunity for sampling prior to dewatering and the fish-out. Activities to date are detailed in Appendix B. The proposed study using fish tagging and telemetry to track habitat use is planned to occur when fish are re-introduced to Phaser Lake following re-flooding (date to be determined based on water quality monitoring).

4.5 MONITORING

Monitoring to confirm that offsetting measures have been properly implemented and are effectively counterbalancing the serious harm to fish occurring in Phaser Lake will be conducted as described in Agnico Eagle's Habitat Compensation Monitoring Plan. The duration and type of monitoring will allow for demonstration of full ecological functionality of the system (i.e. growth, reproduction and survival).

SECTION 5 • DISCUSSION AND CONCLUSIONS

5.1 SUMMARY

A total of 9.49 HUs are lost through the dewatering and mining of Phaser Pit and BB Phaser Pit in Phaser Lake. Implementation of the onsite offsetting measures proposed here results in a total gain of 14.53 HUs. These measures include re-flooding of the de-watered Phaser Lake, while creating access for Arctic char. In addition, Agnico Eagle is proposing to fund $46,261 for research directly associated with Phaser Lake. Assuming this research funding is equivalent to a 10% increase in gained HUs, the total offsets for Phaser Lake are 15.98 HUs, or a 1.68:1 ratio of gains to losses.

5.2 ALLOTMENT OF GAINS

The DFO Fisheries Act Authorization NU-03-0191.4 was issued to AEM in 2013 for the dewatering of Vault Lake (losses of 27.73 HU), adjacent to Phaser Lake. At that time, Phaser Pit was planned not to be developed, so authorization was only sought for Vault Lake. However, NU-03-0191.4 included habitat gains associated with a variety of projects across the minesite, including a portion of the gains from re-flooding Vault Lake and Phaser Lake (total gains were 65.32 HU). I.e., in 2013, a Fisheries Act Authorization was not applied for or issued for the dewatering of Phaser Lake, but the offsets associated with re-flooding it were erroneously counted in the Vault Lake Fisheries Act Authorization. AEM communicated this to DFO at the time and will ensure the issue is equitably resolved.

REFERENCES

Cumberland, 2005. Meadowbank Gold Project – Water Quality Predictions. Cumberland Resources Ltd. October, 2005.

AEM, 2012. AEM Meadowbank Division – No Net Loss Plan. October 15, 2012.

AEM, 2013. Meadowbank Mine – Draft No Net Loss Plan Implementation Cost Estimate and Construction Schedule. Version 2. May 2013.

AEM, 2016. Meadowbank Gold Project – Habitat Compensation Monitoring Plan. AEM Meadowbank Division. Version 3. February, 2016.

Azimuth Consulting Group, 2005. Meadowbank Gold Project – Baseline Aquatic Ecosystem Report. Prepared for Cumberland Resources Ltd. October 2005.

DFO, 2013. Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting. Ecosystem Programs Policy, Fisheries and Oceans Canada. Ottawa, Ontario. November, 2013. ISBN: 978-1-100-22930-0

Golder Associates, 2004. Fish Habitat Compensation Plan for the Northwest Peninsula of the De Beers Snap Lake Diamond Project. Prepared for De Beers Canada Mining Inc. May 2004.

Golder Associates, 2007. Doris North Project No Net Loss Plan – Revision 6. Final Report. Prepared for Miramar Hope Ltd. December 2007.

Mainstream Aquatics Ltd. 2004. Fish Habitat No Net Loss Plan – Jericho Project. Prepared for Tahera Diamond Corporation. December 2004.

Appendix A –

HU Summary, Subtotals, and Totals by Species

TOTAL BY FEATURE - Summary | **HU LOSSES - Species Totals** | **HU GAINS - Species Totals**

Phaser Lake

Phaser Pit	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.23		0.05	0.00
2	1.23		0.32	0.00
3	1.80		0.64	0.00
4	0.19		0.06	0.00
5	0.09		0.04	0.00
6	0.01		0.01	0.00
7			0.00	0.00
8			0.00	0.00
9		3.54	0.00	2.40
10			0.00	0.00
Total	3.54	3.54	1.11	2.40

HU LOSSES – HU total per species x access weight

Species >>	ARCH	LKTR	RNWH	BURB	SLSC	NNST
Access >>	0	1	1	1	1	1
1	0.00	0.00	0.01	0.00	0.00	0.03
2	0.00	0.05	0.06	0.06	0.05	0.09
3	0.00	0.13	0.09	0.11	0.22	0.07
4	0.00	0.01	0.02	0.01	0.01	0.01
5	0.00	0.01	0.01	0.01	0.01	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.21	0.19	0.20	0.29	0.21

HU GAINS – HU total per species x access weight

Species >>	ARCH	LKTR	RNWH	BURB	SLSC	NNST
Access >>	1	1	1	1	1	1
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00
9	0.52	0.52	0.41	0.44	0.37	0.15
10	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.52	0.52	0.41	0.44	0.37	0.15

Phaser Lake

Phaser Pit Land-to-Lake	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1			0.00	0.00
2			0.00	0.00
3			0.00	0.00
4			0.00	0.00
5			0.00	0.00
6			0.00	0.00
7			0.00	0.00
8			0.00	0.00
9		3.94	0.00	2.67
10			0.00	0.00
Total	0.00	3.94	0.00	2.67

HU LOSSES – HU total per species x access weight

Species >>	ARCH	LKTR	RNWH	BURB	SLSC	NNST
Access >>	0	1	1	1	1	1
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00

HU GAINS – HU total per species x access weight

Species >>	ARCH	LKTR	RNWH	BURB	SLSC	NNST
Access >>	1	1	1	1	1	1
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00
9	0.57	0.57	0.45	0.49	0.41	0.16
10	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.57	0.57	0.45	0.49	0.41	0.16

Phaser Lake

Phaser Pit Cap	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.02		0.00	0.00
2	0.26		0.07	0.00
3	0.36	0.64	0.13	0.25
4			0.00	0.00
5	0.03		0.01	0.00
6		0.03	0.00	0.02
7			0.00	0.00
8			0.00	0.00
9			0.00	0.00
10			0.00	0.00
Total	0.67	0.67	0.21	0.28

HU LOSSES – HU total per species x access weight

Species >>	ARCH	LKTR	RNWH	BURB	SLSC	NNST
Access >>	0	1	1	1	1	1
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.01	0.01	0.01	0.01	0.02
3	0.00	0.03	0.02	0.02	0.05	0.02
4	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.04	0.04	0.04	0.06	0.04

HU GAINS – HU total per species x access weight

Species >>	ARCH	LKTR	RNWH	BURB	SLSC	NNST
Access >>	1	1	1	1	1	1
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00
3	0.03	0.05	0.03	0.04	0.08	0.03
4	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.03	0.05	0.04	0.04	0.08	0.03

TOTAL BY FEATURE - Summary				
Phaser Lake				
BB Phaser Pit	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.12		0.03	0.00
2	0.72		0.19	0.00
3	0.57		0.20	0.00
4			0.00	0.00
5	0.37		0.17	0.00
6	0.00		0.00	0.00
7			0.00	0.00
8			0.00	0.00
9			0.00	0.00
10		1.79	0.00	0.00
Total	1.79	1.79	0.59	0.00

HU LOSSES - Species Totals						
HU total per species x access weight						
Species >>	ARCH	LKTR	RNWH	BURB	SLSC	NNST
Access >>	0	1	1	1	1	1
1	0.00	0.00	0.01	0.00	0.00	0.02
2	0.00	0.03	0.04	0.04	0.03	0.05
3	0.00	0.04	0.03	0.04	0.07	0.02
4	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.04	0.04	0.05	0.03	0.02
6	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.12	0.11	0.12	0.13	0.11

HU GAINS - Species Totals						
HU total per species x access weight						
Species >>	ARCH	LKTR	RNWH	BURB	SLSC	NNST
Access >>	1	1	1	1	1	1
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00

Phaser Lake				
BB Phaser Pit Cap	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.14		0.03	0.00
2	0.44		0.11	0.00
3	0.99	1.57	0.35	0.62
4	0.02		0.01	0.00
5	0.10		0.05	0.00
6	0.00	0.12	0.00	0.09
7			0.00	0.00
8			0.00	0.00
9			0.00	0.00
10			0.00	0.00
Total	1.69	1.69	0.55	0.72

HU total per species x access weight						
Species >>	ARCH	LKTR	RNWH	BURB	SLSC	NNST
Access >>	0	1	1	1	1	1
1	0.00	0.00	0.01	0.00	0.00	0.02
2	0.00	0.02	0.02	0.02	0.02	0.03
3	0.00	0.07	0.05	0.06	0.12	0.04
4	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.01	0.01	0.01	0.01	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.11	0.09	0.10	0.15	0.10

HU total per species x access weight						
Species >>	ARCH	LKTR	RNWH	BURB	SLSC	NNST
Access >>	1	1	1	1	1	1
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00
3	0.07	0.11	0.08	0.10	0.20	0.07
4	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00
6	0.02	0.02	0.02	0.02	0.02	0.01
7	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.08	0.13	0.10	0.11	0.21	0.07

Phaser Lake				
Basin	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.29		0.06	0.00
2	2.29	2.57	0.60	0.72
3	11.08	11.08	3.92	4.38
4	0.51		0.15	0.00
5	0.98	1.49	0.46	0.87
6	0.87	0.87	0.53	0.66
7	0.52		0.16	0.00
8	0.20	0.71	0.08	0.37
9	0.11	0.11	0.06	0.08
10			0.00	0.00
Total	16.84	16.84	6.02	7.09

HU total per species x access weight						
Species >>	ARCH	LKTR	RNWH	BURB	SLSC	NNST
Access >>	0	1	1	1	1	1
1	0.00	0.01	0.01	0.01	0.00	0.04
2	0.00	0.10	0.12	0.12	0.10	0.17
3	0.00	0.81	0.58	0.69	1.38	0.46
4	0.00	0.04	0.04	0.03	0.02	0.03
5	0.00	0.11	0.11	0.12	0.07	0.04
6	0.00	0.14	0.13	0.11	0.12	0.04
7	0.00	0.04	0.05	0.03	0.02	0.02
8	0.00	0.02	0.02	0.02	0.01	0.01
9	0.00	0.02	0.01	0.01	0.01	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	1.27	1.07	1.14	1.74	0.80

HU total per species x access weight						
Species >>	ARCH	LKTR	RNWH	BURB	SLSC	NNST
Access >>	1	1	1	1	1	1
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.05	0.11	0.13	0.13	0.11	0.19
3	0.46	0.81	0.58	0.69	1.38	0.46
4	0.00	0.00	0.00	0.00	0.00	0.00
5	0.17	0.17	0.17	0.19	0.11	0.06
6	0.14	0.14	0.13	0.11	0.12	0.04
7	0.00	0.00	0.00	0.00	0.00	0.00
8	0.08	0.08	0.06	0.08	0.04	0.03
9	0.02	0.02	0.01	0.01	0.01	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.92	1.32	1.08	1.22	1.77	0.78

Phaser Lake				
Roads	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.05		0.01	0.00
2	0.50		0.13	0.00
3	1.40	1.96	0.50	0.77
4	0.31		0.09	0.00
5	0.16		0.08	0.00
6	0.32	0.80	0.20	0.61
7			0.00	0.00
8			0.00	0.00
9			0.00	0.00
10			0.00	0.00
Total	2.75	2.75	1.00	1.38

HU total per species x access weight						
Species >>	ARCH	LKTR	RNWH	BURB	SLSC	NNST
Access >>	0	1	1	1	1	1
1	0.00	0.00	0.00	0.00	0.00	0.01
2	0.00	0.02	0.03	0.03	0.02	0.04
3	0.00	0.10	0.07	0.09	0.17	0.06
4	0.00	0.02	0.03	0.02	0.01	0.02
5	0.00	0.02	0.02	0.02	0.01	0.01
6	0.00	0.05	0.05	0.04	0.04	0.01
7	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.22	0.19	0.19	0.27	0.14

HU total per species x access weight						
Species >>	ARCH	LKTR	RNWH	BURB	SLSC	NNST
Access >>	1	1	1	1	1	1
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00
3	0.08	0.14	0.10	0.12	0.24	0.08
4	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00
6	0.12	0.12	0.12	0.10	0.11	0.03
7	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.21	0.27	0.22	0.22	0.35	0.11

TOTAL BY FEATURE - Summary

Phaser Lake

Phaser Pit	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.23		0.05	0.00
2	1.23		0.32	0.00
3	1.80		0.64	0.00
4	0.19		0.06	0.00
5	0.09		0.04	0.00
6	0.01		0.01	0.00
7			0.00	0.00
8			0.00	0.00
9		3.54	0.00	2.40
10			0.00	0.00
Total	3.54	3.54	1.11	2.40

HU LOSSES -Species Sub-Totals

Habitat type area x HSI x species weight x life function weight

Species >>	ARCH				LKTR				RNWH				BURB				SLSC				NNST			
Life Function >>	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00
2	0.00	0.01	0.01	0.00	0.00	0.03	0.03	0.00	0.00	0.04	0.03	0.00	0.00	0.04	0.03	0.00	0.01	0.01	0.03	0.00	0.03	0.03	0.04	0.00
3	0.00	0.04	0.04	0.00	0.00	0.07	0.06	0.00	0.00	0.06	0.04	0.00	0.00	0.07	0.04	0.00	0.07	0.07	0.07	0.00	0.00	0.02	0.06	0.00
4	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.06	0.06	0.01	0.00	0.11	0.09	0.01	0.00	0.10	0.08	0.01	0.00	0.12	0.07	0.01	0.09	0.09	0.11	0.01	0.04	0.05	0.11	0.01

Phaser Lake

Phaser Pit Land-to-Lake	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1			0.00	0.00
2			0.00	0.00
3			0.00	0.00
4			0.00	0.00
5			0.00	0.00
6			0.00	0.00
7			0.00	0.00
8			0.00	0.00
9		3.94	0.00	2.67
10			0.00	0.00
Total	0.00	3.94	0.00	2.67

Habitat type area x HSI x species weight x life function weight

Species >>	ARCH				LKTR				RNWH				BURB				SLSC				NNST			
Life Function >>	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Phaser Lake

Phaser Pit Cap	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.02		0.00	0.00
2	0.26		0.07	0.00
3	0.36	0.64	0.13	0.25
4			0.00	0.00
5	0.03		0.01	0.00
6		0.03	0.00	0.02
7			0.00	0.00
8			0.00	0.00
9			0.00	0.00
10			0.00	0.00
Total	0.67	0.67	0.21	0.28

Habitat type area x HSI x species weight x life function weight

Species >>	ARCH				LKTR				RNWH				BURB				SLSC				NNST			
Life Function >>	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.00
3	0.00	0.01	0.01	0.00	0.00	0.02	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.02	0.01	0.00	0.02	0.02	0.02	0.00	0.00	0.00	0.01	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.01	0.01	0.00	0.00	0.02	0.02	0.00	0.00	0.02	0.01	0.00	0.00	0.02	0.01	0.00	0.02	0.02	0.02	0.00	0.01	0.01	0.02	0.00

TOTAL BY FEATURE - Summary

Phaser Lake

BB Phaser Pit	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.12		0.03	0.00
2	0.72		0.19	0.00
3	0.57		0.20	0.00
4			0.00	0.00
5	0.37		0.17	0.00
6	0.00		0.00	0.00
7			0.00	0.00
8			0.00	0.00
9			0.00	0.00
10		1.79	0.00	0.00
Total	1.79	1.79	0.59	0.00

HU LOSSES -Species Sub-Totals

Habitat type area x HSI x species weight x life function weight

Species >>	ARCH				LKTR				RNWH				BURB				SLSC				NNST			
Life Function >>	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00
2	0.00	0.01	0.01	0.00	0.00	0.02	0.02	0.00	0.00	0.02	0.02	0.00	0.00	0.02	0.02	0.00	0.01	0.01	0.02	0.00	0.02	0.02	0.02	0.00
3	0.00	0.01	0.01	0.00	0.00	0.02	0.02	0.00	0.00	0.02	0.01	0.00	0.00	0.02	0.01	0.00	0.02	0.02	0.02	0.00	0.00	0.01	0.02	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.01	0.03	0.03	0.01	0.01	0.05	0.05	0.01	0.01	0.05	0.04	0.01	0.02	0.06	0.04	0.01	0.04	0.04	0.05	0.01	0.02	0.03	0.05	0.01

Phaser Lake

BB Phaser Pit Cap	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.14		0.03	0.00
2	0.44		0.11	0.00
3	0.99	1.57	0.35	0.62
4	0.02		0.01	0.00
5	0.10		0.05	0.00
6	0.00	0.12	0.00	0.09
7			0.00	0.00
8			0.00	0.00
9			0.00	0.00
10			0.00	0.00
Total	1.69	1.69	0.55	0.72

Habitat type area x HSI x species weight x life function weight

Species >>	ARCH				LKTR				RNWH				BURB				SLSC				NNST			
Life Function >>	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00
2	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.00
3	0.00	0.02	0.02	0.00	0.00	0.04	0.03	0.00	0.00	0.03	0.02	0.00	0.00	0.04	0.02	0.00	0.04	0.04	0.04	0.00	0.00	0.01	0.03	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.03	0.03	0.00	0.00	0.06	0.05	0.00	0.00	0.05	0.04	0.00	0.00	0.06	0.03	0.00	0.05	0.05	0.05	0.00	0.02	0.03	0.05	0.00

Phaser Lake

Basin	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.29		0.06	0.00
2	2.29	2.57	0.60	0.72
3	11.08	11.08	3.92	4.38
4	0.51		0.15	0.00
5	0.98	1.49	0.46	0.87
6	0.87	0.87	0.53	0.66
7	0.52		0.16	0.00
8	0.20	0.71	0.08	0.37
9	0.11	0.11	0.06	0.08
10			0.00	0.00
Total	16.84	16.84	6.02	7.09

Habitat type area x HSI x species weight x life function weight

Species >>	ARCH				LKTR				RNWH				BURB				SLSC				NNST			
Life Function >>	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00
2	0.00	0.02	0.02	0.00	0.00	0.05	0.05	0.00	0.00	0.07	0.05	0.00	0.00	0.07	0.05	0.00	0.02	0.02	0.05	0.00	0.05	0.05	0.07	0.00
3	0.00	0.23	0.23	0.00	0.00	0.46	0.35	0.00	0.00	0.35	0.23	0.00	0.00	0.46	0.23	0.00	0.46	0.46	0.46	0.00	0.00	0.12	0.35	0.00
4	0.00	0.01	0.01	0.02	0.00	0.01	0.01	0.02	0.00	0.01	0.02	0.02	0.00	0.01	0.01	0.02	0.00	0.00	0.01	0.02	0.00	0.00	0.01	0.02
5	0.02	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.04	0.02	0.03	0.03	0.01	0.01	0.02	0.03	0.00	0.00	0.01	0.03
6	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.03	0.04	0.04	0.03	0.03	0.03	0.02	0.04	0.03	0.03	0.03	0.04	0.03	0.00	0.00	0.01	0.03
7	0.00	0.01	0.01	0.02	0.00	0.01	0.01	0.02	0.00	0.01	0.02	0.02	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02
8	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.07	0.35	0.36	0.11	0.07	0.60	0.50	0.11	0.06	0.50	0.39	0.11	0.08	0.58	0.37	0.11	0.53	0.53	0.58	0.11	0.06	0.17	0.46	0.11

Phaser Lake

Roads	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.05		0.01	0.00
2	0.50		0.13	0.00
3	1.40	1.96	0.50	0.77
4	0.31		0.09	0.00
5	0.16		0.08	0.00
6	0.32	0.80	0.20	0.61
7			0.00	0.00
8			0.00	0.00
9			0.00	0.00
10			0.00	0.00
Total	2.75	2.75	1.00	1.38

Habitat type area x HSI x species weight x life function weight

Species >>	ARCH				LKTR				RNWH				BURB				SLSC				NNST			
Life Function >>	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.02	0.01	0.00	0.00	0.02	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.02	0.00
3	0.00	0.03	0.03	0.00	0.00	0.06	0.04	0.00	0.00	0.04	0.03	0.00	0.00	0.06	0.03	0.00	0.06	0.06	0.06	0.00	0.00	0.01	0.04	0.00
4	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01
5	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
6	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.02	0.06	0.06	0.02	0.02	0.09	0.08	0.02	0.02	0.08	0.07	0.02	0.02	0.09	0.06	0.02	0.08	0.08	0.09	0.02	0.01	0.03	0.07	0.02

TOTAL BY FEATURE - Summary

HU GAINS -Species Sub-Totals

Phaser Lake				
Phaser Pit	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.23		0.05	0.00
2	1.23		0.32	0.00
3	1.80		0.64	0.00
4	0.19		0.06	0.00
5	0.09		0.04	0.00
6	0.01		0.01	0.00
7			0.00	0.00
8			0.00	0.00
9		3.54	0.00	2.40
10			0.00	0.00
Total	**3.54**	**3.54**	**1.11**	**2.40**

Habitat type area x HSI x species weight x life function weight																								
Species >>	ARCH				LKTR				RNWH				BURB				SLSC				NNST			
Life Function >>	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.15	0.07	0.15	0.15	0.15	0.07	0.15	0.15	0.11	0.07	0.07	0.15	0.11	0.04	0.15	0.15	0.07	0.07	0.07	0.15	0.00	0.00	0.00	0.15
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.15**	**0.07**	**0.15**	**0.15**	**0.15**	**0.07**	**0.15**	**0.15**	**0.11**	**0.07**	**0.07**	**0.15**	**0.11**	**0.04**	**0.15**	**0.15**	**0.07**	**0.07**	**0.07**	**0.15**	**0.00**	**0.00**	**0.00**	**0.15**

Phaser Lake				
Phaser Pit Land-to-Lake	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1			0.00	0.00
2			0.00	0.00
3			0.00	0.00
4			0.00	0.00
5			0.00	0.00
6			0.00	0.00
7			0.00	0.00
8			0.00	0.00
9		3.94	0.00	2.67
10			0.00	0.00
Total	**0.00**	**3.94**	**0.00**	**2.67**

Habitat type area x HSI x species weight x life function weight																								
Species >>	ARCH				LKTR				RNWH				BURB				SLSC				NNST			
Life Function >>	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.16	0.08	0.16	0.16	0.16	0.08	0.16	0.16	0.12	0.08	0.08	0.16	0.12	0.04	0.16	0.16	0.08	0.08	0.08	0.16	0.00	0.00	0.00	0.16
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.16**	**0.08**	**0.16**	**0.16**	**0.16**	**0.08**	**0.16**	**0.16**	**0.12**	**0.08**	**0.08**	**0.16**	**0.12**	**0.04**	**0.16**	**0.16**	**0.08**	**0.08**	**0.08**	**0.16**	**0.00**	**0.00**	**0.00**	**0.16**

Phaser Lake				
Phaser Pit Cap	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.02		0.00	0.00
2	0.26		0.07	0.00
3	0.36	0.64	0.13	0.25
4			0.00	0.00
5	0.03		0.01	0.00
6		0.03	0.00	0.02
7			0.00	0.00
8			0.00	0.00
9			0.00	0.00
10			0.00	0.00
Total	**0.67**	**0.67**	**0.21**	**0.28**

Habitat type area x HSI x species weight x life function weight																								
Species >>	ARCH				LKTR				RNWH				BURB				SLSC				NNST			
Life Function >>	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.01	0.01	0.00	0.00	0.03	0.02	0.00	0.00	0.02	0.01	0.00	0.00	0.03	0.01	0.00	0.03	0.03	0.03	0.00	0.00	0.01	0.02	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.00**	**0.01**	**0.01**	**0.00**	**0.00**	**0.03**	**0.02**	**0.00**	**0.00**	**0.02**	**0.01**	**0.00**	**0.00**	**0.03**	**0.01**	**0.00**	**0.03**	**0.03**	**0.03**	**0.00**	**0.00**	**0.01**	**0.02**	**0.00**

TOTAL BY FEATURE - Summary				
Phaser Lake				
BB Phaser Pit	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.12		0.03	0.00
2	0.72		0.19	0.00
3	0.57		0.20	0.00
4			0.00	0.00
5	0.37		0.17	0.00
6	0.00		0.00	0.00
7			0.00	0.00
8			0.00	0.00
9			0.00	0.00
10		1.79	0.00	0.00
Total	1.79	1.79	0.59	0.00

HU GAINS -Species Sub-Totals																								
Habitat type area x HSI x species weight x life function weight																								
Species >>	ARCH				LKTR				RNWH				BURB				SLSC				NNST			
Life Function >>	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Phaser Lake				
BB Phaser Pit Cap	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.14		0.03	0.00
2	0.44		0.11	0.00
3	0.99	1.57	0.35	0.62
4	0.02		0.01	0.00
5	0.10		0.05	0.00
6	0.00	0.12	0.00	0.09
7			0.00	0.00
8			0.00	0.00
9			0.00	0.00
10			0.00	0.00
Total	1.69	1.69	0.55	0.72

Habitat type area x HSI x species weight x life function weight																								
Species >>	ARCH				LKTR				RNWH				BURB				SLSC				NNST			
Life Function >>	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.03	0.03	0.00	0.00	0.07	0.05	0.00	0.00	0.05	0.03	0.00	0.00	0.07	0.03	0.00	0.07	0.07	0.07	0.00	0.00	0.02	0.05	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.01	0.04	0.04	0.00	0.01	0.07	0.05	0.00	0.01	0.05	0.04	0.00	0.00	0.07	0.04	0.00	0.07	0.07	0.07	0.00	0.00	0.02	0.05	0.00

Phaser Lake				
Basin	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.29		0.06	0.00
2	2.29	2.57	0.60	0.72
3	11.08	11.08	3.92	4.38
4	0.51		0.15	0.00
5	0.98	1.49	0.46	0.87
6	0.87	0.87	0.53	0.66
7	0.52		0.16	0.00
8	0.20	0.71	0.08	0.37
9	0.11	0.11	0.06	0.08
10			0.00	0.00
Total	16.84	16.84	6.02	7.09

Habitat type area x HSI x species weight x life function weight																								
Species >>	ARCH				LKTR				RNWH				BURB				SLSC				NNST			
Life Function >>	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.03	0.03	0.00	0.00	0.05	0.05	0.00	0.00	0.08	0.05	0.00	0.00	0.08	0.05	0.00	0.03	0.03	0.05	0.00	0.05	0.05	0.08	0.00
3	0.00	0.23	0.23	0.00	0.00	0.46	0.35	0.00	0.00	0.35	0.23	0.00	0.00	0.46	0.23	0.00	0.46	0.46	0.46	0.00	0.00	0.12	0.35	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.03	0.05	0.05	0.05	0.03	0.05	0.05	0.05	0.03	0.05	0.05	0.05	0.06	0.03	0.05	0.05	0.02	0.02	0.03	0.05	0.00	0.00	0.02	0.05
6	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.03	0.04	0.04	0.03	0.03	0.03	0.02	0.04	0.03	0.03	0.03	0.04	0.03	0.00	0.00	0.01	0.03
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.01	0.01	0.02	0.03	0.01	0.01	0.02	0.03	0.01	0.01	0.01	0.03	0.03	0.00	0.02	0.03	0.00	0.00	0.01	0.03	0.00	0.00	0.00	0.03
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.09	0.36	0.37	0.11	0.09	0.62	0.51	0.11	0.08	0.52	0.38	0.11	0.12	0.59	0.39	0.11	0.53	0.53	0.59	0.11	0.05	0.17	0.45	0.11

Phaser Lake				
Roads	Hectares		HU	
Habitat Type	Losses	Gains	Losses	Gains
1	0.05		0.01	0.00
2	0.50		0.13	0.00
3	1.40	1.96	0.50	0.77
4	0.31		0.09	0.00
5	0.16		0.08	0.00
6	0.32	0.80	0.20	0.61
7			0.00	0.00
8			0.00	0.00
9			0.00	0.00
10			0.00	0.00
Total	2.75	2.75	1.00	1.38

Habitat type area x HSI x species weight x life function weight																								
Species >>	ARCH				LKTR				RNWH				BURB				SLSC				NNST			
Life Function >>	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.04	0.04	0.00	0.00	0.08	0.06	0.00	0.00	0.06	0.04	0.00	0.00	0.08	0.04	0.00	0.08	0.08	0.08	0.00	0.00	0.02	0.06	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.03	0.02	0.00	0.00	0.01	0.02
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.03	0.07	0.07	0.02	0.03	0.11	0.09	0.02	0.03	0.09	0.07	0.02	0.02	0.10	0.07	0.02	0.11	0.11	0.11	0.02	0.00	0.02	0.07	0.02

Appendix B –

Phaser Lake eDNA Study Summary

Summary Report-eDNA analysis for Phaser Lake, Meadowbank
Date: October 5, 2016

The objective of this study is to conduct a preliminary test of eDNA measurement methods in a small Arctic lake, and to explore potential relationships between eDNA and physical fish counts.

One set of water samples for preliminary eDNA analysis was collected by Agnico Eagle technicians on May 16, 2016, according to SOP-1 provided below. The preliminary water samples were received at the University of Guelph on May 19th. These samples were filtered (in aliquots of 0.5 L, 1 L, 2 L, and 4 L for both frozen and refrigerated samples) and DNA extracted using a Qiagen DNeasy Blood and Tissue Kit. The samples were stored at -80°C until the PCR was performed.

Results from the preliminary analysis indicated only a faint band for the 4 L refrigerated sample. As such, for the second set of water samples, 2 sites were sampled on August 17, 2016 (~12 L per site; see SOP-2 provided below) and the samples were refrigerated. The samples were received at the University of Guelph on August 19th and were filtered (using a smaller pore size of 0.5 µm) in 2 L aliquots the same day and stored at -20°C until extraction. The samples have been extracted and are now being stored at -80°C. Preliminary PCR will be performed shortly. The second PCR settings may also be modified to increase detection chances.

Primers were selected using the Primer Database in BOLD (http://www.boldsystems.org/index.php/Public_Primer_PrimerSearch). Primers used were VR1_t1 and VF2_t1, which amplify a 655 bp segment of the 5' region of the mitochondrial cytochrome *c* oxidase I (COI) gene (Ivanova et al. 2007; Ward et al. 2005). These primers were found to be suitable for all fish species (lake trout, round whitefish, Arctic char, burbot, ninespine stickleback, slimy sculpin) however no reference tissue for slimy sculpin was available for the first round of samples.

Provided there is successful detection of fish DNA in the second round of water samples, the products can be sequenced to determine what specific fish have been amplified. This would be carried out either at the in-house sequencing facility at the University of Guelph School of Environmental Sciences, or in conjunction with the Biodiversity Institute. At that point, the molecular tests could be compared to physical fish counts. However, it is noted that shedding/degradation rates will not be known.

References:

Ivanova, N. V., Zemlak, T. S., Hanner, R. H., & Hebert, P. D. N. (2007). Universal primer cocktails for fish DNA barcoding. *Molecular Ecology Notes*, *7*(4), 544–548. http://doi.org/10.1111/j.1471-8286.2007.01748.x

Ward, R. D., Zemlak, T. S., Innes, B. H., Last, P. R., & Hebert, P. D. N. (2005). DNA barcoding Australia's fish species. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, *360*(September), 1847–1857. http://doi.org/10.1098/rstb.2005.1716

Standard Operating Procedure for Preliminary Sampling (SOP-1)

Prepared by: Dylan Bowes
Reviewed by: Dr. Paul Sibley

Date: 2016-03-16
Date: 2016-03-19
Last Revised: 2015-05-16

eDNA collection protocol for Phaser Lake, Meadowbank

Sample Collection Protocol (Rees et al. 2014)

Sampling Summary

For the purposes of the preliminary analysis, we will sample water from mid-column, roughly 1 meter below the surface of the ice. Agnico will be provided with 1 cooler containing 4 L DNA-free sample bottles. A total volume of 20 L will be collected. Half of the samples will be frozen and half will be refrigerated to determine the impact of freezing on DNA detection capabilities.

Materials:

- 6 x labelled, 4 L autoclaved or DNA-free polypropylene screw-top bottles (supplied)
- 10% bleach solution
- Water pump and tubing
- Coolers and ice packs
- Field GPS
- Freezer (-20°C) and Refrigerator (4°C)
- Laboratory gloves (latex)

Sample Collection

1. To prevent contamination, all equipment used to sample and process the water should be sterilized using a 10-minute exposure to 10% bleach solution (Jerde et al. 2011). Sterilized gloves (sprayed with bleach) should be used during sampling collection and processing (Olson et al. 2012). In order to sterilize tubing, a sterilization circulation can be set-up using a bucket with bleach solution. Following sterilization and prior to taking samples, a large volume of water (i.e. roughly 10x volume of sterilization solution used) from the lake to be sampled should be pumped through the tubing to remove the bleach solution.
2. At the site, record sampling location using GPS.
3. Collect a total of 20 L of water from mid-column in DNA-free screw-top bottles by pumping water from approximately 1 meter below the surface of the lake using gloved hands (Olson et al. 2012).
4. When filling the bottle, leave a small (4 cm) headspace to allow for expansion during freezing.
5. During transport to field lab, keep the samples in the large coolers with ice packs to slow DNA degradation.
6. Place half of the samples (3 x 4 L bottles) in a freezer and the remaining half of the samples in a refrigerator until shipping. Ship samples in coolers with ice packs to the University of Guelph for analysis.

References

Jerde, C. L., Mahon, A. R., Chadderton, W. L., & Lodge, D. M. (2011). “Sight-unseen” detection of rare aquatic species using environmental DNA. *Conservation Letters*, *4*(2), 150–157. http://doi.org/10.1111/j.1755-263X.2010.00158.x

Olson, Z. H., Briggler, J. T., & Williams, R. N. (2012). An eDNA approach to detect eastern hellbenders (Cryptobranchus a. alleganiensis) using samples of water. *Wildlife Research*, *39*(7), 629–636. http://doi.org/10.1071/WR12114

Rees, H. C., Maddison, B. C., Middleditch, D. J., Patmore, J. R. M., & Gough, K. C. (2014). The detection of aquatic animal species using environmental DNA–a review of eDNA as a survey tool in ecology. *Journal of Applied Ecology*.

Standard Operating Procedure for eDNA Sampling (SOP-2)

Prepared by: Dylan Bowes
Reviewed by: Dr. Paul Sibley

Date: 2016-03-16
Date: 2016-03-19
Last Revised: 2016-07-30

eDNA collection protocol for Phaser Lake, Meadowbank

Sample Collection Protocol (Rees et al. 2014)

Sampling Summary

Based on the results of the preliminary analysis, large sample volumes are required and refrigerating samples will be preferred over freezing. We will sample water from mid-column, roughly 1 meter below the surface of the water. Agnico will be provided with 1 cooler containing 4 L DNA-free sample bottles. A total volume of 24 L will be collected.

Materials:

- 6 x labelled, 4 L autoclaved or DNA-free polypropylene screw-top bottles (supplied)
- 10% bleach solution
- Water pump and tubing
- Coolers and ice packs
- Field GPS
- Refrigerator (4°C)
- Laboratory gloves (latex)

Sample Collection

1. To prevent contamination, all equipment used to sample and process the water should be sterilized using a 10-minute exposure to 10% bleach solution (Jerde et al. 2011). Sterilized gloves (sprayed with bleach) should be used during sampling collection and processing (Olson et al. 2012). In order to sterilize tubing, a sterilization circulation can be set-up using a bucket with bleach solution. Following sterilization and prior to taking samples, a large volume of water (i.e. roughly 10x volume of sterilization solution used) from the lake to be sampled should be pumped through the tubing to remove the bleach solution.
2. At the site, record sampling location using GPS.
3. Collect a total of 24 L of water from mid-column in DNA-free screw-top bottles by pumping water from approximately 1 meter below the surface of the lake using gloved hands (Olson et al. 2012).
4. During transport to field lab, keep the samples in the large coolers with ice packs to slow DNA degradation.
5. Place samples in a refrigerator until shipping. Ship samples in coolers with ice packs to the University of Guelph for analysis.

References

Jerde, C. L., Mahon, A. R., Chadderton, W. L., & Lodge, D. M. (2011). "Sight-unseen" detection of rare aquatic species using environmental DNA. *Conservation Letters*, *4*(2), 150–157. http://doi.org/10.1111/j.1755-263X.2010.00158.x

Olson, Z. H., Briggler, J. T., & Williams, R. N. (2012). An eDNA approach to detect eastern hellbenders (Cryptobranchus a. alleganiensis) using samples of water. *Wildlife Research*, *39*(7), 629–636. http://doi.org/10.1071/WR12114

Rees, H. C., Maddison, B. C., Middleditch, D. J., Patmore, J. R. M., & Gough, K. C. (2014). The detection of aquatic animal species using environmental DNA–a review of eDNA as a survey tool in ecology. *Journal of Applied Ecology*.

AGNICO EAGLE

Meadowbank Mine Site

Blast Monitoring Program

Prepared by:

Agnico-Eagle Mines Limited – Meadowbank Division

Version 2

March 2017

EXECUTIVE SUMMARY

The Guidelines for the Use of Explosives In or Near Canadian Waters (Wright and Hopky, 1998) as modified by the DFO for use in the North mention the following requirements that are applicable to the Meadowbank Mine:

- No explosive is to be detonated in or near fish habitat that produces, or is likely to produce, an instantaneous pressure change (i.e. overpressure) greater than 100 kPa in the swim bladder of a fish.
- No explosive is to be detonated that produces, or is likely to produce, a peak particle velocity greater than 13 mm/sec in a spawning bed during the period of egg incubation.

As a result of testing and monitoring in the NWT that indicates the limit of 100 kPa was not protective to fish, DFO has recommended to AEM to use 50 kPa as the threshold for instantaneous pressure change.

Every blast is monitored with an Instantel Minimate Blaster to ensure that vibrations generated by blasting are less than 13 mm/sec and the overpressure is under 50 KPa. The blasts are monitored from three locations; one station is located near the northern end of Portage Pit, the second near the south end of Portage Pit and the other one at the north of Vault Pit. The results of blast monitoring are systematically analyzed by the Engineering department within the 24 hours following the blasting operation. The blast monitoring results are interpreted and a blast mitigation plan is implemented immediately if the vibrations or the overpressure exceed the guidelines. A retro analysis is conducted to determine what caused the higher than expected results.

The following factors are considered in controlling vibration intensity:

- The confinement of the charges
- The coupling of the explosives charges to the rock affects how much energy is transferred to the rock
- The spatial (geometric) distribution of the explosives affects the character and intensity of the ground vibrations
- The charge weight per delay (8ms intervals)
- The blast direction

The following factors are considered in controlling overpressure:

- Depth of burial
- Insufficient burden on the first row of holes, this can cause air blast and generate fly rocks
- Charges placed in open seams, clay filled seams, and highly fractured zones where gases could be vented
- The charge weight per delay (8ms intervals), especially for pre-shear blasting

The blast monitoring reports are systematically archived and relevant information entered into a database. The blast monitoring data will be submitted for regulatory review annually in the Meadowbank Annual Report.

IMPLEMENTATION SCHEDULE

This Plan is implemented immediately (March 2017)

DISTRIBUTION LIST

AEM – Environment Superintendents
AEM – Environmental Coordinators
AEM – Engineering Superintendents
AEM – Engineering Coordinators

Version	Date (YMD)	Section	Page	Revision
1	May 2010	All Section		Comprehensive plan for Meadowbank Project
2	March 2017	All Section		Update of the original plan

Approved by: ______________________

Pierre McMullen

Assistant Engineering Superintendent

TABLE OF CONTENTS

EXECUTIVE SUMMARY 2

IMPLEMENTATION SCHEDULE 4

DISTRIBUTION LIST 4

TABLE OF CONTENTS 6

LIST OF TABLES 7

LIST OF FIGURES 7

1. Introduction 8

2. Blasting standard and criteria 9

3. Blast monitoring plan 10

3.1. Blast monitoring equipment 10

3.2. Equipment installation 12

3.3. Blast monitoring stations 15

3.4. Blast monitoring report 17

4. Blast mitigation plan 18

5. Conclusion 20

6. References 21

LIST OF TABLES

Table 1 : Set back distance (m) from center of detonation of a confined explosive to spawning habitat to achieve 13mm/sec guideline criteria for all types of substrate (Wright and Hopkins, 1998).. 10
Table 2 : Set back distance (m) from center of detonation of a confined explosive to fish habitat to achieve 100 KPa guideline criteria for various substrate. 10
Table 3: Main Factors Influencing Blast Vibration Intensity (ISEE, 1998) 18
Table 4: Main Factors Influencing Overpressure (ISEE, 1998).. 18

LIST OF FIGURES

Figure 1: Instantel Minimate Blaster Unit 11
Figure 2: Sensor Orientation (Instantel, 2016)... 11
Figure 3: 3/8 inch bolt anchored in the rock 12
Figure 4: Transducer tightened with a nut 13
Figure 5: Final Set-up with the Microphone in the direction of the blast 13
Figure 6: General view of the Portage South monitoring station.. 14
Figure 7: Localizations of the two blast monitoring stations at Portage Pit 15

1. Introduction

Agnico-Eagle Mines Limited – Meadowbank Division (AEM) has developed this Blasting Monitoring Program for the control of blasting vibrations at the Portage Pit in accordance with Condition 85 of Project Certificate No.004 issued by the Nunavut Impact Review Board (NIRB).

AEM had developed a detailed blasting program to minimize the effects of blasting on fish and fish habitat, water quality, and wildlife and terrestrial VECs. The Blasting Program has been developed in consultation with the Department Of Fisheries and Oceans (DFO) and the Government of Nunavut (GN), and shall:

a) Comply with the Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky, 1998) as modified by the DFO for use in the north;

b) Include a monitoring and mitigation plan to be developed in consultation with the DFO, and obtain DFO approval of the blasting program prior to the commencement of blasting;

c) Restrict blasting when migrating caribou, or sensitive local carnivores or birds may be negatively affected; and

d) Minimize the use of ammonium nitrate to reduce the effects of blasting on receiving water quality

The Blasting Monitoring Program will continue to be implemented during the operation phases of the Meadowbank Project.

2. Blasting standard and criteria

The effects of blasting are typically assessed in terms of Peak Particle Velocity (PPV). The US Bureau of Mines has established that the peak particle velocity is related to the scaled distance by the following relationship:

$$PPV = k * (R/W^{0.5})^{-b}$$

Where:

PPV	= Peak Particle Velocity, mm/s
R	= Distance from blast to point of concern, m
W	= Charge weight per delay, kg
k	= confinement factor – specific to site
b	= site factor

This formula can be used to estimate PPV and determine if the PPV will surpass the given limits before the blast occurs.

The Guidelines for the Use of Explosives In or Near Canadian Waters (Wright and Hopky, 1998) as modified by the DFO for use in the North mention the following requirements that are applicable to the Meadowbank Project:

"8. No explosive is to be detonated in or near fish habitat that produces, or is likely to produce, an instantaneous pressure change (i.e. overpressure) greater than 100 kPa (14.5 psi) in the swim bladder of a fish.

9. No explosive is to be detonated that produces, or is likely to produce, a peak particle velocity greater than 13 mm/sec in a spawning bed during the period of egg incubation."

As a result of testing and monitoring in the NWT that indicates the limit of 100kpa was not protective to fish, DFO has recommended to AEM to use 50KPA as the threshold for instantaneous pressure change.

To keep PPV under the 13 mm/sec guideline Wright and Hopky (1998) suggests the setback distances shown in table 1.

Table 1 : Set back distance (m) from center of detonation of a confined explosive to spawning habitat to achieve 13mm/sec guideline criteria for all types of substrate (Wright and Hopkins, 1998)

	Weight of Explosive Charges (kg)						
	0.5	1	5	10	25	50	100
Setback distance (m)	10.7	15.1	33.7	47.8	75.5	106.7	150.9

Concerning the instantaneous pressure change (i.e. overpressure), Wright and Hopky (1998) suggest the following setback distances to keep it under the 100 kPa guideline.

Table 2 : Set back distance (m) from center of detonation of a confined explosive to fish habitat to achieve 100 KPa guideline criteria for various substrate.

	Weight of Explosive Charges (kg)							
Substrate Type	0.5	1	2	5	10	25	50	100
Rock	3.6	5.0	7.1	11.0	15.9	25.0	35.6	50.3
Sfrozen Soil	3.3	4.7	6.5	10.4	14.7	23.2	32.9	46.5
Ice	3.0	4.2	5.9	9.3	13.2	20.9	29.5	41.8
Saturated Soil	3.0	4.2	5.9	9.3	13.2	20.9	29.5	41.8
Rock	2.0	2.9	4.1	6.5	9.2	14.5	20.5	29.0

The Meadowbank Engineering team is also referring to the vibration and overpressure historical data to assess certain blast pattern closer to lakes. 8 years of historical data are archived in the Meadowbank database and they are often used as case study for delicate blasting operations.

3. Blast monitoring plan

3.1. Blast monitoring equipment

Every blast is monitored to ensure that vibrations generated by blasting are less than 13 mm/sec and the overpressure is under 50 KPa. The instrument used for blast monitoring is an Instantel Minimate Blaster which is fully compliant with the international Society of Explosives and Engineers performance specification for blasting seismographs (Instantel, 2005).

The Minimate Blaster has three main parts: a monitor, a standard transducer (geophone) and a microphone (figure 1). The monitor contains the battery and electronic components of the instrument. It also checks the two sensors to be sure that they work properly. The transducer measures ground vibration with a mechanism called a geophone.

Figure 1: Instantel Minimate Blaster Unit

The transducer has three geophones that measure the ground vibrations in terms of particle velocity. They measure transverse, vertical and longitudinal ground vibrations (figure 2). Transverse ground vibrations agitate particles in a side to side motion. Vertical ground vibrations agitate particles in an up and down motion. Longitudinal ground vibrations agitate particles in a back and forth motion progressing outward from the event site (Instantel, 2016).

The microphone measures the PSP (Peak Sound Pressure) also referred as to the PAO (Peak Air Overpressure). The instrument checks the entire event waveform and displays the largest sound pressure in Pa unit.

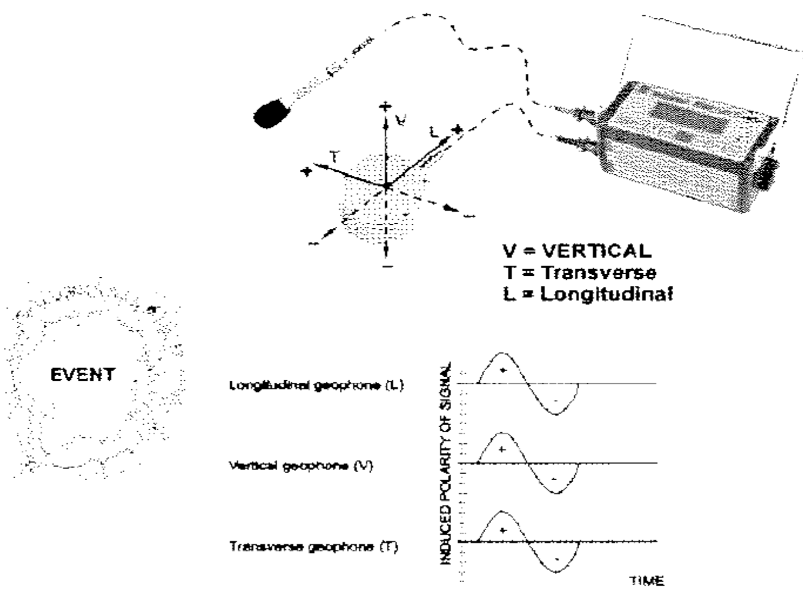


Figure 2: Sensor Orientation (Instantel, 2016)

The Minimate Blaster (Instantel) calculates the PPV for each geophone and calculates the vector sum of the three axes.

The final result is the PVS (Peak Vector Sum) and it is the resultant particle velocity magnitude of the event:

$$PVS = \sqrt{(T^2 + V^2 + L^2)}$$

Where:

T = particle velocity along the transverse plane

V = particle velocity along the vertical plane

L = particle velocity along the longitudinal plane

3.2. Equipment installation

The transducer is installed on a hard surface, which in this case is rock. A 3/8 inch bolt is anchored in the rock (figure 3) and the transducer is tightened with a nut (figure 4). The arrow on the top of the standard transducer must be pointed in the direction of the event to ensure the geophone sensors, located inside the standard transducer, remains in their natural axis (Instantel, 2016). The trigger level of the instrument is set to 1 mm/s and the transducer will start recording an event automatically when the ground vibrations are greater than or equal to 1 mm/s. The recording time is 4 seconds, which is sufficient considering that the blast timing is rarely more than 2 seconds at Meadowbank. The instrument is protected with a box and the microphone is oriented in the direction of the blast.

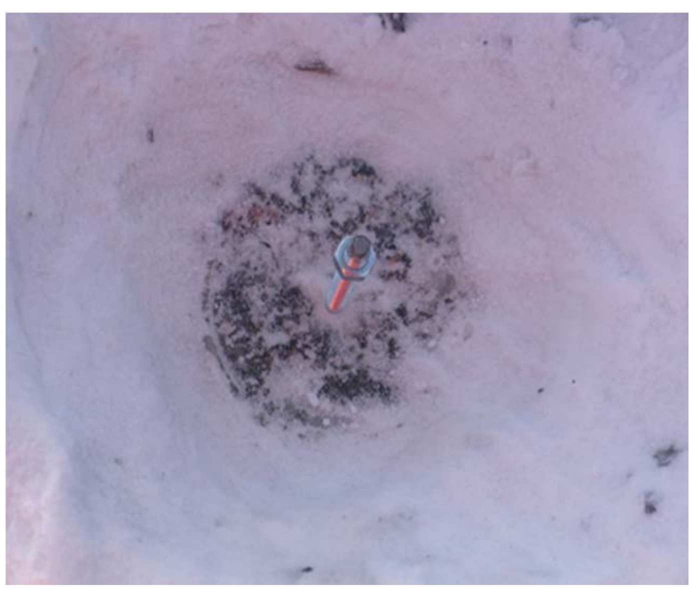


Figure 3: 3/8 inch bolt anchored in the rock

Figure 4: Transducer tightened with a nut

Figure 5: Final Set-up with the Microphone in the direction of the blast

Figure 6: General view of the Portage South monitoring station

3.3. Blast monitoring stations

The blasts are monitored from three different locations. The locations were chosen to have the optimal distance between the blasts and the water (fish habitat). One station is located near the northern end of Portage pit and the other near the south end of Portage pit (figure 7). The third station is located at the complete northern of the Vault Pit (Figure 8).

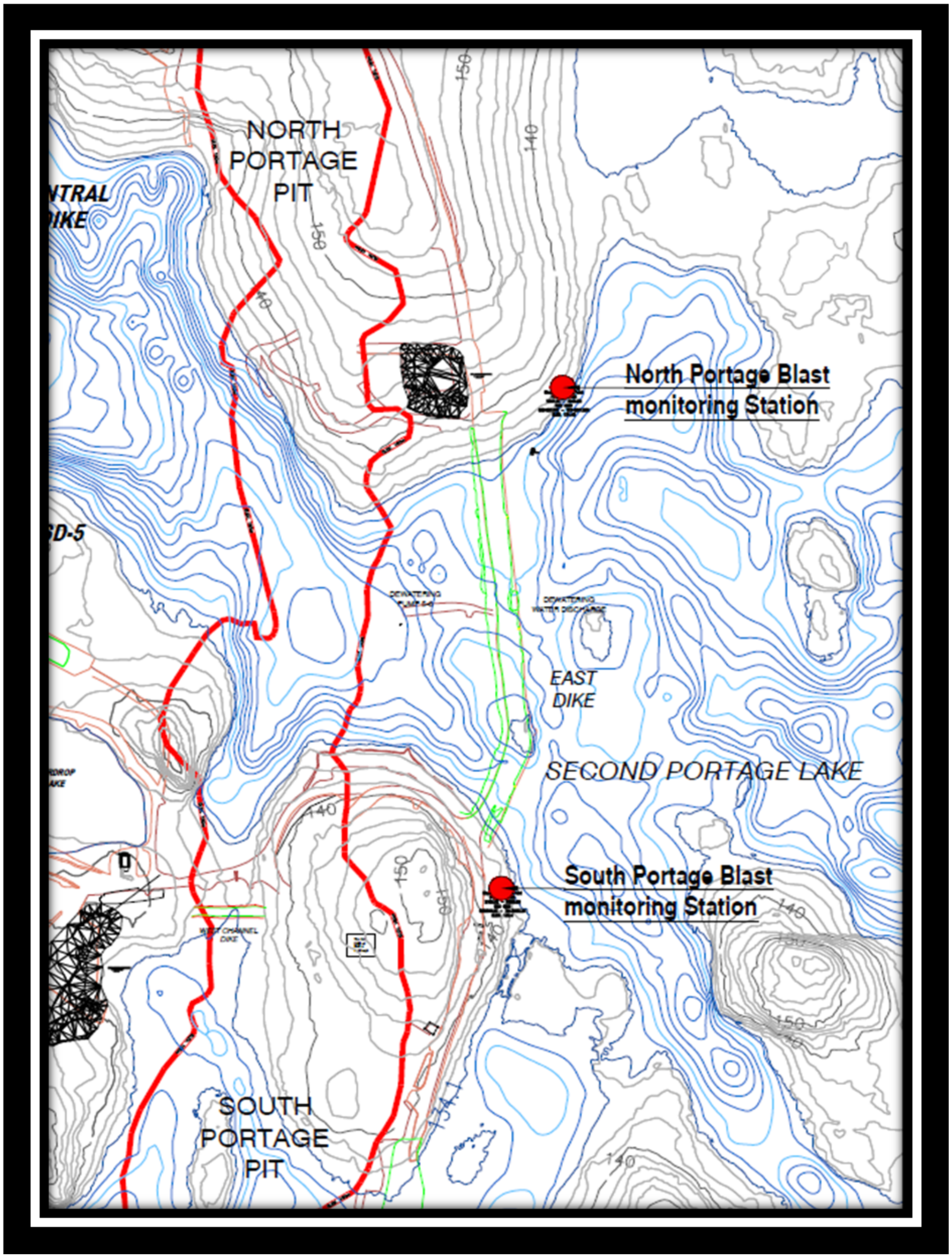


Figure 7: Localizations of the two blast monitoring stations at Portage Pit

.

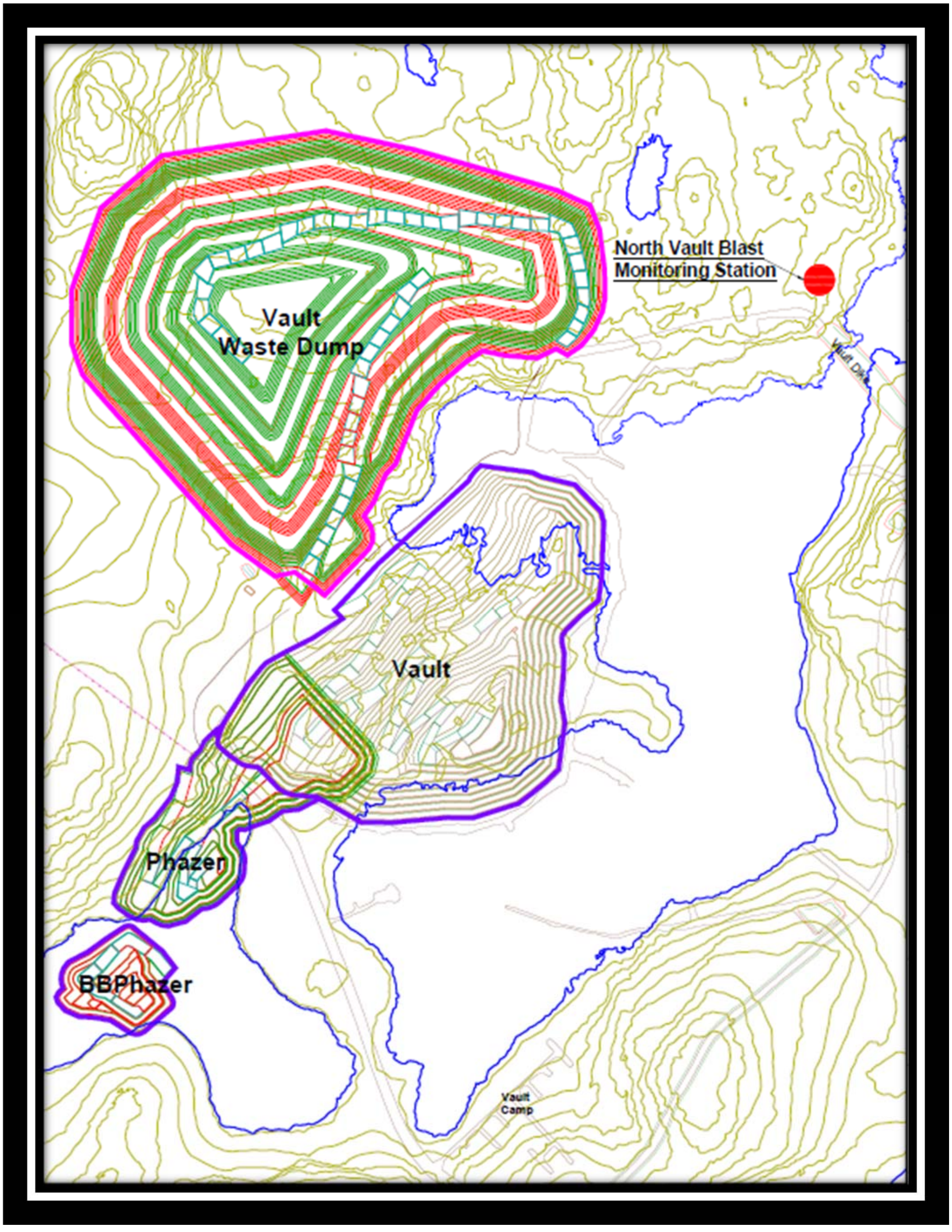
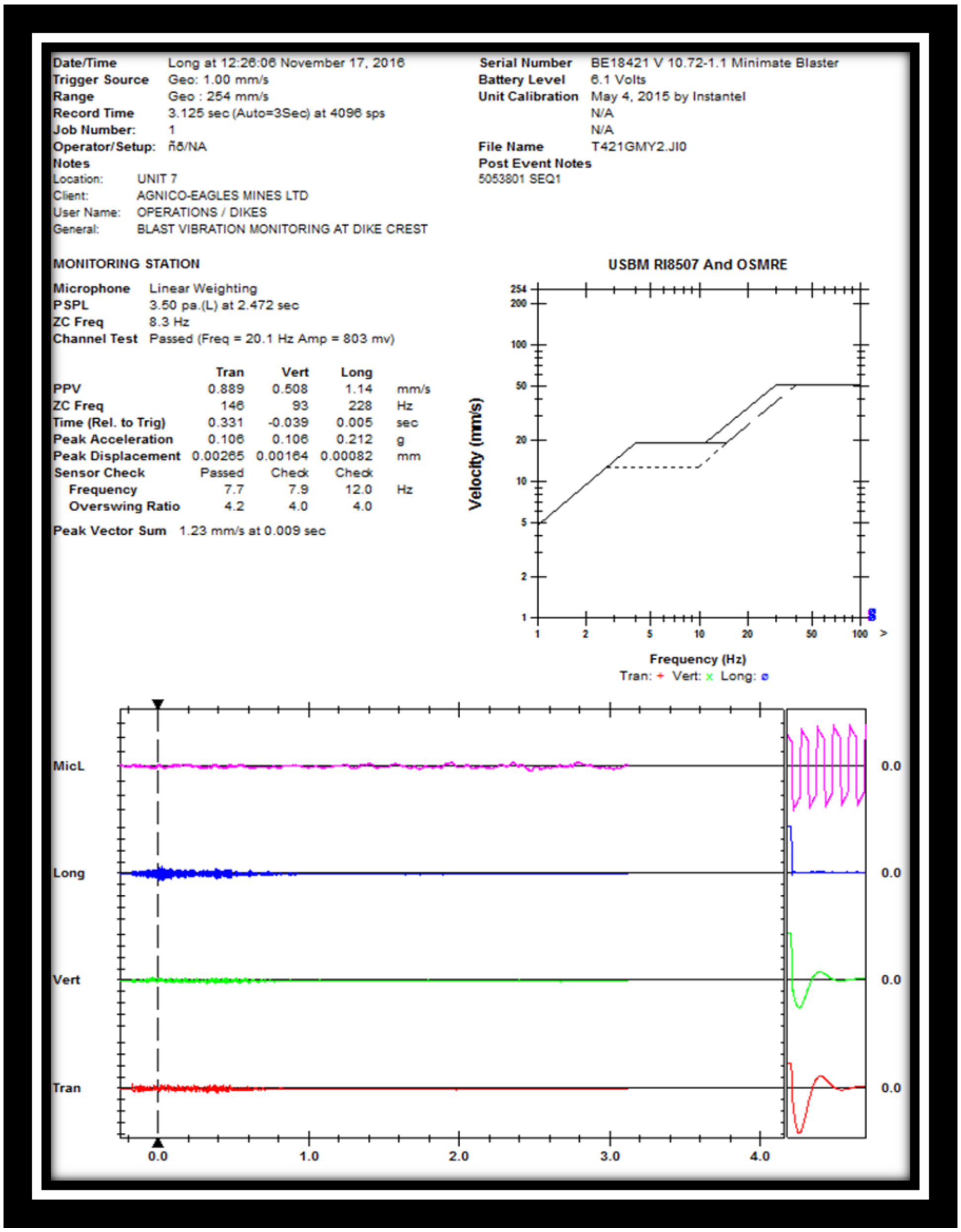


Figure 8: Localization of the blast monitoring station at Vault pit

3.4. Blast monitoring report

After each blast, the results are stored in a database and the report saved in the library for future reference. The blast monitoring results are interpreted and a blast mitigation plan is implemented immediately if the vibrations or the overpressure exceed the permitted limit (see section 4). The data will be submitted to DFO, GN, NIRB, Environment Canada, and the Nunavut Water Board annually in the Meadowbank Annual Report.



4. Blast mitigation plan

If the vibrations or the overpressure approach or exceed the permitted limit, it is possible to conduct a retro analysis and find the factors that may have caused higher than desired results. It is important to consider the main factors influencing blast vibration intensity (table 3) or overpressure (table 4) in order to prevent such results (ISEE, 1998).

Table 3: Main Factors Influencing Blast Vibration Intensity (ISEE, 1998)

Main Factors Influencing Blast Vibration Intensity
Maximum charge weight detonating at one time
True distance (distance the waves must travel)
Geological conditions
Confinement
Physical properties of the rock
Coupling
Spatial distribution
Detonator timing scatter
Time of energy release
Type of Explosive

Table 4: Main Factors Influencing Overpressure (ISEE, 1998)

Main Factors Influencing Overpressure
Maximum charge weight per delay
Depth of burial of charges
Exposed surface detonation material
Atmospheric conditions
Wind
Temperature gradients
Topography
Volume of displaced rock
Delay interval and orientation
Type of Explosive

Geological conditions and rock properties are site specific and cannot be changed but there are several controllable factors that may reduce blast vibration intensity. AEM takes the following factors into consideration at Meadowbank to reduce vibration intensity:

I. The confinement of the charges affects the vibration intensity. If a charge is deeply buried with no free face nearby, the rock is not displaced and more of the energy goes into seismic waves (ISEE, 1998). The engineering department carefully plans pre-shear blasting that may have excessive burden in the first row of holes.

II. The coupling of the explosives charges to the rock affects how much energy is transferred to the rock and hence the intensity of the vibrations. If smaller-diameter charges are placed in large-diameter holes, the charges are decoupled and less energy is transferred (ISEE, 1998). Using bulk products increases the coupling. In specific cases, like pre-splitting blast, it is a better idea to use packaged products that have a small diameter.

III. The spatial (geometric) distribution of the explosives affects the character and intensity of the ground vibrations. A reduction in vibration is often found when there are many small charges per delay, widely distributed. There is a practical limit to the number of small charges that can reinforce each other, and the more there are, the less effective their reinforcement. A charge per delay composed of 100 charges of 1lb each will not generate the same intensity of vibration as a single charge of 100 lbs. (ISEE, 1998).

IV. The main factor that is used to prevent high intensity vibration is the charge weight per delay. The 8-ms criterion is applied to prevent short delay times from overlapping or causing constructive reinforcement (addition) of two or more pulses (ISEE, 1998), which could cause higher vibrations. In every blast connection plan designed by the engineering department, this fact is taken into consideration. Timing is designed to minimize the number of holes that overlap in an 8 ms delay.

V. The blasting direction of a blast pattern is another key element to minimize vibration once blasting besides areas close to lakes.

Mitigation techniques used to reduce overpressures are as follows:

I. Depth of burial affects the overpressure. Improperly stemmed or insufficient collar will allow blast holes energy to be vented upwards. The quality of the stemming is also important: angular, coarse stemming material (3/4’’) is necessary to be efficient.

II. Avoid having insufficient burden on the first row of holes. This can cause air blast and generate fly rocks. Leaving muck piles from the previous blast in front of the free face (choke blasting) can reduce the amount of air blast generated and minimize the chance fly rocks.

III. Avoid placing charges in open seams, clay filled seams, and highly fractured zones where gases could be vented.

IV. Controlling the charge weight per delay especially for the pre-shear drilling. A limited number of kg per delay is in effect at Portage pit to avoid overpressure.

5. Conclusion

Blast monitoring process will continue to ensure that blast vibrations do not cause harm to aquatic life at Meadowbank. The results are used to find a more accurate confinement factor of the site. The data collected helps to correlate different factors that could influenced vibration intensity and will be taken into consideration in the future to guarantee a constant improvement in controlling blast vibrations.

We have overall successfully managed to keep our vibrations below the limit authorized. AEM is committed to monitoring all blasts in order to fully comply with the regulation.

6. References

INSTANTEL INC. 2005, MINIMATE BLASTER OPERATOR MANUAL

INTERNATIONAL SOCIETY OF EXPLOSIVE ENGINEERS (ISEE) (1998). BLASTERS' HANDBOOK (17TH ED.). CLEVELAND: INTERNATIONAL SOCIETY OF EXPLOSIVE ENGINEERS..

WRIGHT, D.G., AND G.E. HOPKY. (1998) GUIDELINES FOR THE USE OF EXPLOSIVES IN OR NEAR CANADIAN

FISHERIES WATERS. CAN. TECH. REP. FISH. AQUAT. SCI. 2107: IV + 34P.

OIL HANDLING FACILITY
OIL POLLUTION EMERGENCY PLAN

For
Meadowbank Mine Fuel Farm in Baker Lake

May 2016
Version 7

EXECUTIVE SUMMARY

This document presents the Oil Pollution Emergency Plan for Agnico Eagle Mines Limited (Agnico) Meadowbank Division. This plan is pursuant to the Canada Shipping Act 2001; and all the subtending regulations.

Oil Pollution Emergency Plan (OPEP) designates lines of authority, responsibility, establishes proper reporting and details plans of action in the event of a spill. This plan applies to the operational phase of the fuel transfer which takes place at Agnico Eagle Ltd.'s Baker Lake Marshaling Facilities and Oil Handling Facility located at latitude 64°18'36"N and longitude 95°58'04"W.

A hard copy of the OPEP will be available at the Baker Lake Marshalling facility during the transfer operations.

ACRONYMS

Agnico	Agnico Eagle Mines Limited
ECC	Emergency Control Center
ERT	Emergency Response Team
ERP	Emergency Response Plan
Fuel	P50 Arctic Grade diesel fuel and/or Jet-A aviation fuel
IMO	International Maritime Organization
MARPOL	*The International Convention for the Prevention of Pollution from Ships,* 1973, and the *Protocols* of 1978 and 1997, as amended from time to time
OHF	Oil Handling Facility
OPEP	Oil Pollution Emergency Plan
SCP	Spill Contingency Plan
SOPEP	Ship Oil Pollution Emergency Plan
SMP	Spill Management Plan
TEU	Twenty-foot equivalent unit

DISTRIBUTION LIST

Agnico - Environmental Superintendent

Agnico – General Mine Manager

Agnico – Health and Safety Superintendent

Agnico – Energy and Infrastructures Superintendent

Agnico – General Services Superintendent

Agnico – ERT Emergency Measures Councilor

Baker Lake – Baker Lake Hamlet Office

Baker Lake – Fire Department

Coastal Shipping Limited – General Manager

Transport Canada – Marine Pollution Officer

Canadian Coast Guard Environmental Response

DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
0	12/09/02	All	All	Comprehensive plan for Agnico's Baker Lake Fuel Farm Facilities
1	12-09-17		10, 12, 13	P10: Tide and Currents reference change; P12: Rephrasing of the last paragraph title; P13: in INITIAL SPILL RESPONSE PRIORITIES table into Section 2 RESPOND SAFELY, rewording to show only diesel fuel actions.
2	13-03-30	6 & App. D	10	Oil Handling Facility Declaration; 2013 Jet-A to start being stored at OHF
			12	Adequate lighting required during fuel transfer
		9	20 21	Item list on inside door of each Sea can. Internal Contacts Updated
		10 & App. C	23	Update to Agnico site spill training & Location of training records
		13	29	Major Failure At Helicopter Island
		14 & App. E	30	In-situ Burning
		16	32	New for 2013
3	January 2014	ALL		Comprehensive Review
4	July 2014	ALL		Comprehensive Review after Transport Canada Assessment
5	November 2014	ALL		Comprehensive Review following non-compliance letter received from Transport Canada
6	July 2015			Annual Comprehensive Review
		Sec 1	1	Update Declaration
		Fig 5	18	Update Pager numbers
		Table 5,6,7	26&27	Update Contact numbers
		Footnote 3	35	Contact date for JJ Brickett with CCG
		Table 8	44	Update Training Dates
7	May 2016	Sec 1	1	Update Declaration
		Fig 5	18	Update Pager number
		Tables 5,6,7	26-28	Update Contact numbers
		Table 8	45	Update Training Dates

		Appendix A		Update Contact numbers
		Appendix D		Update Meeting Minutes

Prepared By: ______________________________

Erika Voyer
Senior Environmental Coordinator - Interim

Approved by:

Jamie Quesnel
Nunavut Environment Superintendent

Table of Contents

SECTION 1. Oil Handling Facility Declaration 1
SECTION 2. General Introduction 2
2.1 Fundamental Principles 2
2.2 Legislative Requirements 2
2.3 Related Documents 3
2.4 Meadowbank Mine Oil Pollution Emergency Plan 3
SECTION 3. Planning Standards 4
3.1 Facility Category 4
3.2 General Planning Guidelines 4
3.2.1 Response Time Standards 4
3.2.2 On-Water Recovery 4
3.2.3 Dedicated Facility Spill Response Equipment 5
3.2.4 Transfer Conduit 5
3.2.5 MBK-ENV-0013: OHF / Ship to Shore Fuel Discharge Procedure 5
SECTION 4. Baker Lake Marshalling Area and Fuel Storage Facility 6
4.1 General Overview and Site Description 6
4.2 Fuel Storage Facilities Infrastructure 7
4.2.1 P-50 Fuel Tanks 7
4.2.2 Jet-A Fuel 8
4.3 Baker Lake Shoreline and Marine Characteristics 9
4.3.1 Topography 9
4.3.2 Geology 9
4.3.3 Flora and Fauna 9
4.3.4 Subsurface Conditions 9
4.3.5 Water Quality 10
4.3.6 Bathymetric Data 10
4.3.7 Tides and Currents that Prevail at the Facility 10
4.3.8 Meteorological Conditions Prevailing at the Facility 10
4.3.9 Surrounding Area Environmental Sensitivities 10
SECTION 5. Site Activities 13

5.1 Nature of the Oil Product ... 13
5.2 Bulk Transfer ... 15
5.3 Measures to Minimize a Diesel and Jet-A Pollution Incident ... 15
5.4 Portable Containment Pools ... 16
SECTION 6. Meadowbank Response to Emergencies ... 17
6.1 Response Management Structure ... 17
6.2 Logistics and Planning ... 19
SECTION 7. Equipment and PPE ... 20
7.1 OHF Response Equipment for spills up to ~5m^3 ... 20
7.2 Additional Response Equipment or for Spills >5m^3 ... 20
7.2.1 General Equipment ... 21
7.2.2 Spill Response Kits and Containers ... 22
7.3 PPE ... 23
7.3.1 PPE at OHF for Spills <5m^3 ... 23
7.3.2 PPE for Spills >5m^3 ... 24
SECTION 8. Communication ... 25
8.1.1 Communication with the Public ... 25
8.1.2 Hand Held Radio Communication ... 25
8.1.3 Contacts ... 26
SECTION 9. Roles and Responsibilities ... 29
9.1.1 First Responder (Third Party Contractor (Intertek Personnel) and Spud Barge Supervisor) 29
9.1.2 Supervisor (Spud Barge Supervisor) ... 29
9.2 Roles & Responsibilities of the Emergency Control Group ... 29
9.2.1 Official In-Charge ... 29
9.2.2 General Superintendents ... 30
9.2.3 Incident Commander: A Trained Staff Member (ERT Coordinators or Supt.) ... 31
9.2.4 Emergency Response Team (ERT Team) Duties: ... 31
9.2.5 Environmental Superintendent/Designate Duties: ... 32
9.2.6 Health and Safety Superintendent/Designate Duties: ... 32
9.2.7 Energy and Infrastructures Superintendent/Designate Duties: ... 32
9.2.8 Human Resources Superintendent/Designate Duties: ... 32
9.2.9 Health Care Professional (Nurse/Medic): ... 33
9.2.10 Security Department: ... 33

9.3 Debriefing 33
SECTION 10. General Spill Procedures 34
10.1 Coordination with Government Agencies 34
10.1.1 Coordination with Transport Canada Technical Service Environmental Response 34
10.1.2 Coordination with Canadian Coast Guard 35
10.1.3 Other Government Agencies 35
10.2 Reporting Requirements 35
10.2.1 Government of Nunavut Reporting Requirements 35
10.3 Treatment and Disposal 36
10.4 Resuming Unloading 36
SECTION 11. Spill Scenarios and Response Strategies 37
11.1 Product Properties and Response Strategy 37
11.2 Pipeline safeguards 38
11.3 Wildlife 38
11.4 Scenarios 38
Scenario 1: 39
Scenario 2: 40
Scenario 3: 41
SECTION 12. Preventive Measures 42
12.1 Training 42
12.1.1 Meadowbank site Personnel 42
12.1.2 OHF Personnel Training 43
12.1.3 Boat Operators 44
SECTION 13. Coastal Shipping 46
13.1.1 Coastal Shipping 46
SECTION 14. References 47

FIGURES

Figure 1 - Location of the Community of Baker Lake 6
Figure 2 - Agnico's Baker Lake Oil Handling Facility – Ship to Shore Transfer Area........ 8
Figure 3 - Location of Community Freshwater Intake at Baker Lake........ 12
Figure 4 - Location of Helicopter Island........ 14
Figure 5 - Response Management System........ 18

TABLES

Table 1 - Category of OHF 4
Table 2 - Material available in the Spill Response Sea Can at Agnico's OHF 20
Table 3 - PPE available at OHF........ 23
Table 4 - Agnico Radio Channels 25
Table 5 - Agnico Contact........ 26
Table 6 - Contractors / Local Contacts 27
Table 7 - External Contacts 28
Table 8 - Spill Response Training........ 45

APPENDICES

APPENDIX A - COASTAL SHIPPING LTD. 48
APPENDIX B - Transfer Conduit Annual Pressure Test........ 49
APPENDIX C - MSDS Jet-A and Diesel........ 50
APPENDIX D – MBK-ENV-0013 51
APPENDIX E – COASTAL SHIPPING LTD........ 52
APPENDIX F – Agnico Internal Spill Report Form........ 53
APPENDIX G – The Central and Arctic Regional Response Plan (2008) 54

SECTION 1. OIL HANDLING FACILITY DECLARATION

Pursuant to paragraph 168(1) (b) (i) of the Canada Shipping Act 2001, Agnico Eagle Mines Ltd. (Agnico) has signed an Oil Handling Facility Declaration. This Declaration can be found posted at the Oil Handling Facility (OHF).

OIL HANDLING FACILITY DECLARATION

Pursuant to paragraph 168(1) of the Canada Shipping Act 2001, I, Jamie Quesnel (Name of the operator of the oil handling facility), declare that to comply with the Oil Handling Facility Regulation, Respecting the circumstances in which operators of oil handling facilities shall report discharges or anticipated discharges of pollutants, the manner of making the reports and the persons to whom the reports shall be made; all the information contained in the submission is true and complete to the best of my ability and accurately reflect our interpretation of the regulations.

The persons listed below are authorized to implement the oil pollution emergency plan:

NAME	COMPANY	ADDRESS	PHONE	EMAIL
Jamie Quesnel	Agnico Eagle Mines Ltd.	P.O. Box 540; Baker Lake, Nunavut X0C 0A0	(819) 759-3555 ext 6838	jamie.quesnel@agnicoeagle.com
Erika Voyer			(819) 759-3555 ext 6980	erika.voyer@agnicoeagle.com
Norm Ladouceur			(819) 759-3555 ext 6720	norman.ladouceur@agnicoeagle.com
Yves Leveque			(819) 759-3555 ext 6720	yves.levesque@agnicoeagle.com
Stephane Larose			(819) 759-3555 ext 6902	stephane.larose@agnicoeagle.com
Alexandre Arcand			(819) 759-3555 ext 6902	alexandre.arcand@agnicoeagle.com
Stephane Boucher			(819) 759-3555 ext 6822	stephane.boucher@agnico-eagle.com
Andre Rouleau			(819) 759-3555 ext 6809	andre.rouleau@agnicoeagle.com
Philippe Beaudoin			(819) 759-3555 ext 6809	philippe.beaudoin@agnicoeagle.com

(Signed by the operator of the oil handling facility or its representative)

May 9, 2016
(Date)

AGNICO EAGLE

SECTION 2. GENERAL INTRODUCTION

The Oil Pollution Emergency Plan (OPEP) is to set in motion the necessary actions to stop or minimize the loss of fuel resulting from a mishap at Agnico Eagle Mines Limited's Baker Lake Fuel Farm Oil Handling Facility located in Baker Lake, Nunavut during the ship to shore fuel transfer. Additionally, it provides direction to Agnico personnel and/or contractors at the laydown and tank farm areas, and to Agnico's Emergency Response Team (ERT) for emergency spill response situations; describes oil pollution scenarios, defines the roles and responsibilities of management and responders; and outlines the measures taken to prevent spills. The purpose of the OPEP is to minimize potential health and safety hazards, environmental damage and cleanup costs.

2.1 Fundamental Principles

The following OPEP is submitted for compliance to the Canada Shipping Act 2001 and all the subtending regulations and to outline the appropriate spill response protocol during fuel transfer operations at the Baker Lake OHF. A hard copy of the OPEP will be located on site for reference and review during transfer operations. This OPEP will be reviewed annually and updates will be provides to TCMSS for compliance prior to every shipping season. The following priorities shall be taken into account when responding to an oil pollution incident and in the following order:

1. Safety of the workers;
2. Safety of the OHF;
3. Safety of the community of Baker Lake;
4. Prevention of fire and explosion;
5. Minimize of the oil pollution incident;
6. Notify and reporting of the oil pollution incident to associated Governing bodies;
7. Environmental impact of the spill;
8. Complete clean-up from the oil pollution incident.

2.2 Legislative Requirements

This plan was prepared in accordance with federal legislation listed below, which lists legislative instruments applicable to Agnico's Baker Lake Fuel Oil Handling Facility. All requirements found in the Canada *Shipping Act*, *2001*, ss. 168 are laid out in the Meadowbank Mine site OHF Concordance Table which will be submitted to Transport Canada as a stand-alone document.

The OPEP complies with the requirements for procedures, equipment and resources as set out in the *Canada Shipping Act* (s.s. 660.2(4)) specific to a fuel handling facility - the bulk incoming transfer of fuel from ship-to-shore and spill scenarios directly relating to this operation.

The following standards and regulatory requirements have been reviewed in preparation of this document:

- Canada Shipping Act;
- Response Organizations and Oil Handling Facilities Regulations;
- Vessel Pollution and Dangerous Chemical Regulation;
- Environmental Response Arrangements Regulations;
- Oil Handling Facilities Standards (TP 12402E);
- Response Organization Standards (TP 12401);

- Arctic Waters Oil Transfer Guidelines (TP 10783);
- Environmental Prevention and Response National Preparedness Plan (TP 13585);
- Release and Environmental Emergency Notification Regulations; and
- Guidelines for reporting Incidents Involving Dangerous Goods, Harmful Substances and/or Marine Pollutants.
- **Requirements of the Central & Arctic Regional Response Plan**

2.3 Related Documents

Management and monitoring plans for Meadowbank mine that provided input to the Oil Pollution Emergency Plan include the following:

1. Spill Contingency Plan;
2. Emergency Response Plan; and
3. Shipboard Oil Pollution Emergency Plan[1].

The cornerstones of contingency planning for Agnico are the Spill Contingency Plan and the Oil Pollution Emergency Plan. These, coupled with the Emergency Response Plan, describe the processes to be followed in responding to a spill. The OPEP on its own provides the necessary information in the event of a mishap where fuel is lost during the transfer of fuel from a tanker vessel to the Fuel Tank Facility.

The OPEP complements the Spill Contingency Plan and it should not be construed as superseding it. The Spill Contingency Plan addresses a wider scope of operations stretching 110 kilometers from the Meadowbank mine site in the north to their infrastructure in the south. The OPEP strictly covers the transfers of fuel from ship to OHF.

2.4 Meadowbank Mine Oil Pollution Emergency Plan

This Plan is a working document that will be reviewed annually and updates provided to TCMSS for compliance prior to every shipping season.

This plan specifically centres on the activities in ship-to-shore transfer of fuel from a small tanker delivering fuel to Agnico's Baker Lake Fuel Tank Facility constructed in Baker Lake. On site personnel at the Facility are expected to respond to spill incidents (generally smaller than $1m^3$) that can be contained and cleaned up without assistance, while the Emergency Response Team will respond to larger spills.

Fuel is being delivered to Agnico's Baker Lake Fuel Farm by Coastal Shipping Limited, a Division of the Woodward Group of Companies. Fuel is stored within the existing tank farm owned and operated by Agnico. The Shipboard Oil Pollution Emergency Plan (SOPEP) is the responsibility of the shipping company. The outline of the SOPEP prepared by Coastal Shipping Limited can be found in Appendix A – 1.1.

[1] The Shipboard Oil Pollution Emergency Plan (SOPEP) contains all information and operational instructions as required by the "Guidelines for the development of the Shipboard Marine Pollution Emergency Plan" as developed by the International Marine Organization. Woodward's, the shipping company, is responsible for this Plan.

SECTION 3. PLANNING STANDARDS

3.1 Facility Category

Oil handling facilities are categorized according to their maximum oil transfer rate in cubic meters per hour, in respect of the oil product loaded or unloaded to or from a ship, as follows (Table 1):

Table 1 - Category of OHF

Category of Oil Handling Facility	Maximum Oil Transfer Rate (cubic meters/hour)
Level 1	150
Level 2	750
Level 3	2 000
Level 4	More than 2 000

The product transfer rate (Diesel and Jet-A) for the Agnico's Baker Lake Fuel Farm OHF at Baker Lake is $400m^3$/hr. As indicated in the OHF Standards TP 12402, this flow rate requires the onsite spill response capacity to meet a Level 2. To do this, the OHF will have the equipment and resources to respond to a $5m^3$ spill within the required timelines specified in the Response Organization and Oil Handling Facility Regulations:

1. Contain and control in one hour of spill detection; and
2. Commence cleanup within six hours after spill detection.

3.2 General Planning Guidelines

3.2.1 Response Time Standards

Agnico and contractor personnel at Baker Lake Fuel Farm have appropriate training to respond to spills, if it is safe to do so (see Table 8). The material onsite can be deployed within one hour to contain a spill of $5m^3$ or less, unless deployment within one hour will be unsafe. Generally, for spill greater than $1m^3$, the OPEP and the Emergency Response Plan (ERP) will be activated and the Emergency Response Team (ERT) located at Meadowbank mine site will come in Baker Lake to help. Realistically, the ERT can be on site within 125 minutes (or less) ready to help for the clean-up activity. If the spill is greater than $5m^3$, material from the Meadowbank Mine site will be required and will be bring at the Baker Lake OHF within 125 minutes to finalize the containment (if not complete) and recovered of the oil pollution incident.

3.2.2 On-Water Recovery

Agnico has a boat in a sea can at the Baker Lake barge area that is ready to be deployed in the case of an emergency situation. This boat is presently in process to be registered in the Transport Canada Small Vessel Register Commercial and will have all required components for an industrial use vessel. All personal involved in a response situation will need to have or complete the pleasure craft operator's certification.

If additional water crafts are required to help with the containment of a spill from the OHF local resources such as Peters Expediting Ltd. and Baker Lake Contracting & Supplies (BLCS). Contact info for these companies can be found in Table 6.

3.2.3 Dedicated Facility Spill Response Equipment

Agnico has 3 sea cans with spill response equipment at the Baker Lake shore within Agnico's Marshalling area and includes booms that can rapidly be deployed to limit the spread of any spill on water. The list of equipment can be found in Table 2. The spill supplies and resources are in place to respond to a $5m^3$ spill within the required timelines as specified in the Response Organizations and Oil Handling Facility Regulations. These sea cans will be inspected before each transfer season to ensure that all the spill response material and PPE are there and stored in a manner that is organized and accessible in order to comply with regulatory requirements and allow an efficient spill response. See Appendix D – 1.1 for the checklist inspection sheet that can be found in the sea can.

3.2.4 Transfer Conduit

The transfer conduit or hose that is used to transfer fuel from Coastal Shipping Vessels to the Agnico Baker Lake Fuel Farm OHF will be pressure tested annually by Coastal Shipping according to the regulation prior it being placed into service. A copy of the annual pressure test (Appendix B) will be made available to TCMSS[2] once Coastal Shipping sends the 2016 certifications to Agnico. The transfer conduit will always have a bursting pressure of not less than 4 times its maximum design pressure and the design pressure will be clearly marked on the conduit.

3.2.5 MBK-ENV-0013: OHF / Ship to Shore Fuel Discharge Procedure

Agnico has created an internal procedure to ensure all planning and precautions are in place prior to the transfer of any fuel from the vessels to the OHF. This procedure can be found in Appendix D – 1.2.

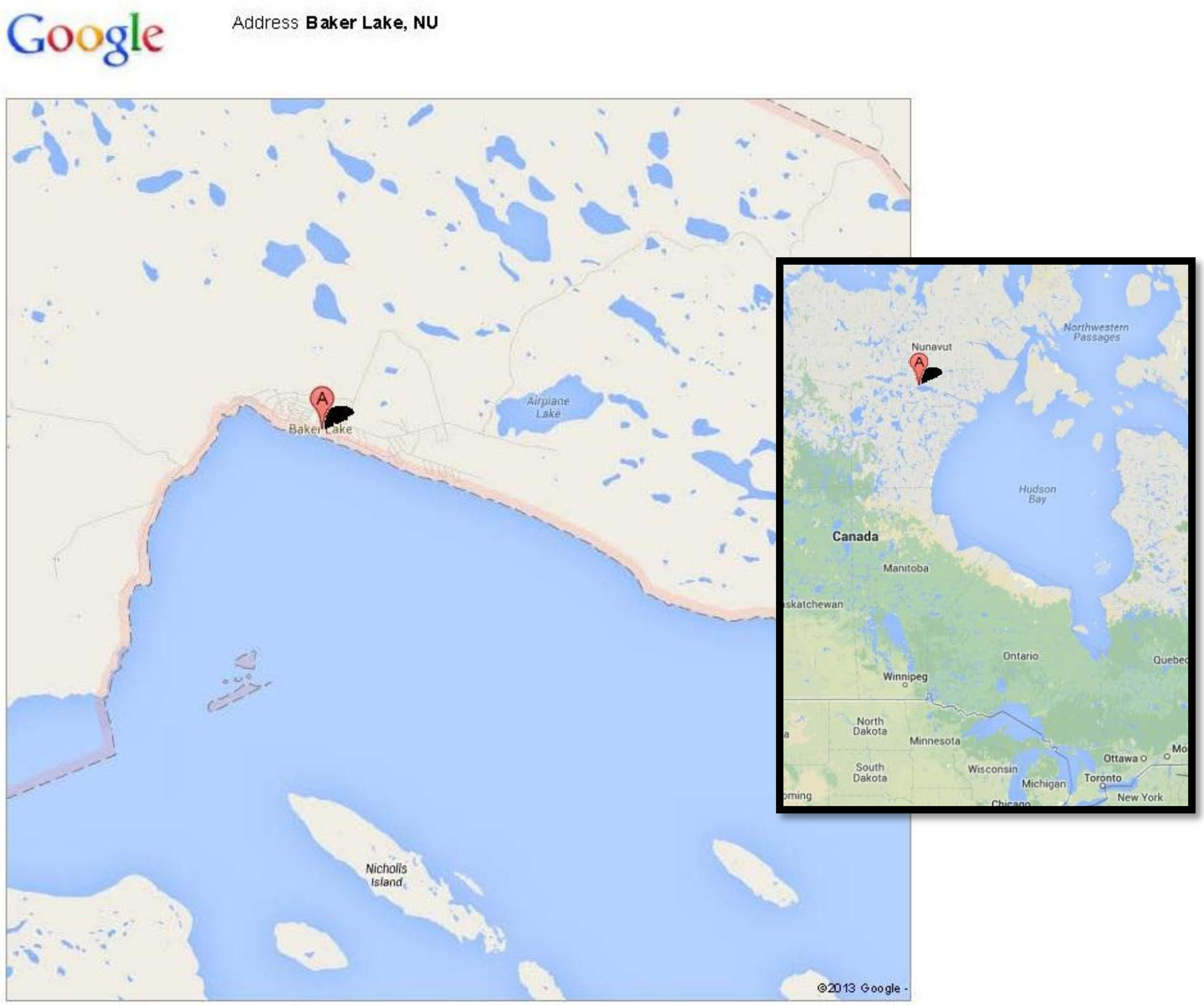
[2]

SECTION 4. BAKER LAKE MARSHALLING AREA AND FUEL STORAGE FACILITY

4.1 General Overview and Site Description

Agnico's Oil Handling Facility (OHF) is located in the area of Baker Lake at latitude 64°18 22.778" N and longitude 95°57'33.990" W. The location shown on Figure 1 provides more detail. The Fuel Tank Facility consists of six - 10 million litres diesel fuel[3] (10,000 m^3) storage tanks all holding P50 grade diesel), and 20 tanks holding 1,800,000 litres of Jet-A fuel (Figure 2). The Facility is located adjacent to Agnico's Marshalling area, approximately 250 meters from the shore of Baker Lake at high tide. Power is provided by a generator for the fuel pump module located next to the tank farm.

Figure 1 - Location of the Community of Baker Lake



[3] 1000 litres = 1 m^3 of fuel. Cubic meters are used throughout this document.

4.2 Fuel Storage Facilities Infrastructure

4.2.1 P-50 Fuel Tanks

The diesel fuel tanks are contained within an impermeable lined and bermed area. The steel fuel tanks have been field-erected and built to API-650 standards with each bermed area holding two tanks. This area is capable of containing 110% of the volume of one 10,000 m^3 storage tank. Each impermeable lined and bermed cell has the following:

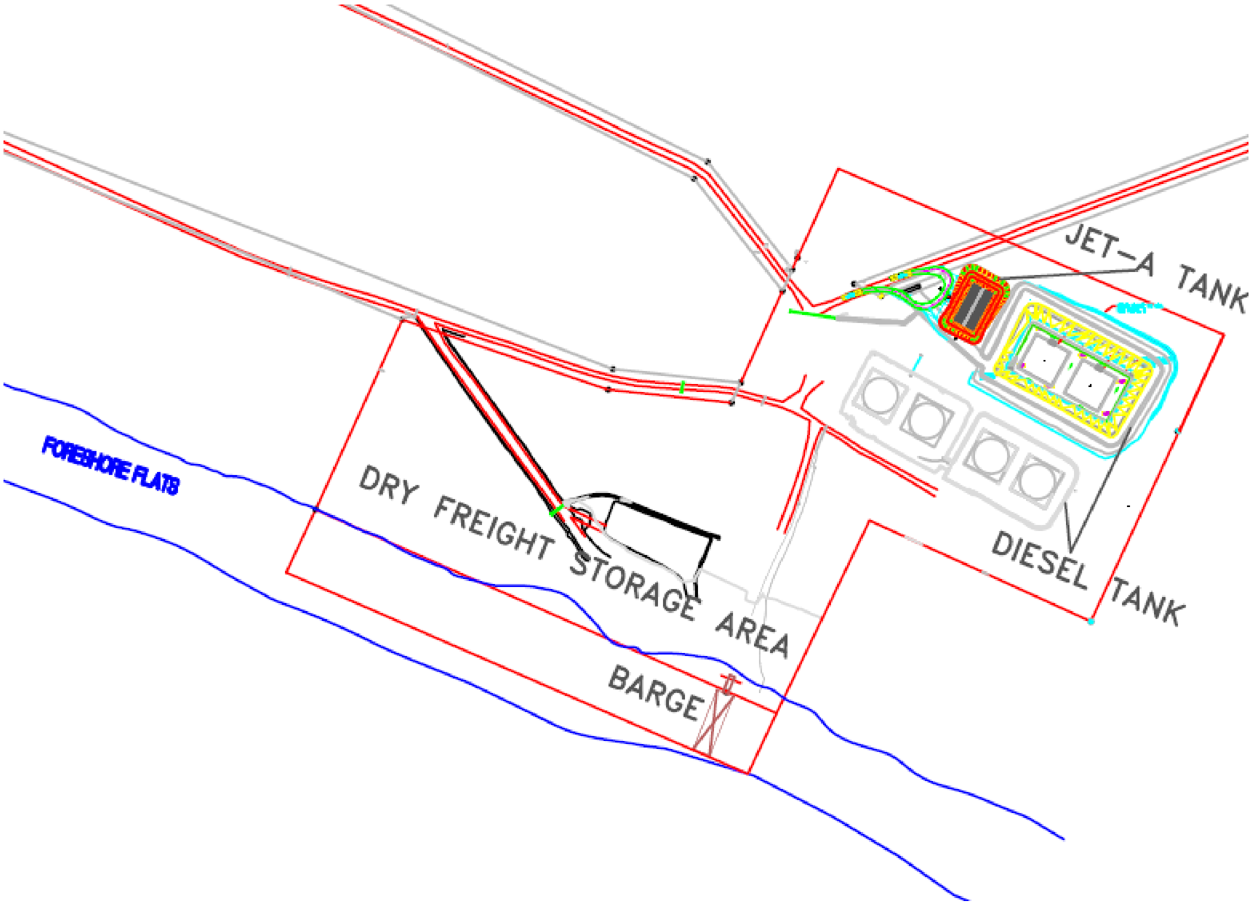
- A granular base for the tank completed with an impermeable LLDPE liner system and granular dikes;
- Two – 10,000 m^3 tanks complete with the required appurtenances such as stairs, base manholes, water draw offs, re-supply nozzle, suction nozzle, tank lighting, tank level monitoring, roof manhole, manual gauge hatch, tank temperature and P/V vent;
- Piping for unloading and loading; and
- Site lighting via fixtures mounted from the dispensing building.

The Tank Farm Facility is designed to meet the following standards:

- National Fire Code 2010;
- *Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations* – 2008; and
- Canadian Council of Ministers of the Environment, "*Environmental Code of Practice of Aboveground and Underground Storage Tank Systems Containing Petroleum Products and Allied Petroleum Products – 2003* (Updated in 2013) (PN1326)".

The Oil Handling Facility (OHF) is constructed and operated in accordance with Transport Canada Arctic Waters Oil Transfer Guidelines (TP 10783E) and Oil Handling Facility Guidelines (TP 12402E). A fuel dispensing pad area completed with a dispensing unit is located in a lined facility with a provision to capture any and all spills at the fueling area and direct them to a containment area provided at the tank farm.

Figure 2 - Agnico's Baker Lake Oil Handling Facility – Ship to Shore Transfer Area



4.2.2 Jet-A Fuel

The Jet-A fuel tanks are contained within an impermeable lined and bermed area. The steel fuel tanks have been field-erected and built to API-650 standards with the bermed area holding eighteen tanks. This area is capable of containing >110% of the volume of one 100,000L storage tank. The impermeable lined and bermed cell has the following:

- A granular base for the tank completed with an impermeable bituminous liner system and granular dikes;
- Eighteen (18) – 100,000L tanks completed with the required appurtenances such as stairs, base manholes, water draw offs, re-supply nozzle, suction nozzle, tank lighting, tank level monitoring, roof manhole, manual gauge hatch, tank temperature and P/V vent; and
- Piping for unloading and loading.

The Jet-A Fuel Facility is designed to meet the following standards:

- National Fire Code 2010;
- *Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations* –

2008; and

- Canadian Council of Ministers of the Environment, "*Environmental Code of Practice of Aboveground and Underground Storage Tank Systems Containing Petroleum Products and Allied Petroleum Products – 2003* (Updated in 2013) (PN1326)".

4.3 Baker Lake Shoreline and Marine Characteristics

The following Baker Lake Shoreline and Marine Characteristics were gathered during the Environmental Impact Assessment that was performed prior to construction of the Baker Lake Marshalling facility and Tank Farm.

4.3.1 Topography

The bulk fuel storage area is located east of the Hamlet of Baker Lake, approximately 350 m north of Baker Lake. The OHF sits on a low terrace parallel with the shoreline of the lake. There is a gradual slope (5 to 10% grade) toward Baker Lake with an approximate elevation change of 35 m from the OHF to the Baker Lake shoreline. The Baker Lake shoreline is gently sloping, well-drained and is lined with marine gravels, sands and boulders.

4.3.2 Geology

The regional surficial geology is characterized by sandy till, bedrock outcrops, felsenmeer (ice-shattered bedrock) and shallow lakes (Golder, 2007). The most common soil type in this region is glacial till. Marine beach deposits are found along the north shore of Baker Lake.

The soil near the bulk fuel storage facility is comprised of silts, sands, gravels, cobble and boulders and frost-susceptible glacial till overlying weathered bedrock (Golder, 2007). The soil thickness is typically less than 1.4 m with permafrost or bedrock encountered at less than 2 m. Approximately 60% of the surface area surrounding the bulk fuel storage facility is comprised of bedrock outcrop.

4.3.3 Flora and Fauna

There are no trees and few shrubs in the area surrounding the bulk fuel storage facility. The site is covered by low-lying vegetation; predominated by grassy hummocks, dwarf willow, sedge, green moss and lichen.

Arctic ground squirrels, ptarmigan and songbirds are inhabitants in the area surrounding the bulk fuel storage facility. Lake cisco, lake trout, arctic char, lake whitefish, round whitefish, slimy sculpin and stickleback are predominant species found in Baker Lake.

4.3.4 Subsurface Conditions

Test pits excavated in 2005 near the Bulk Fuel Storage Facility and between the tanks and the shoreline indicate a saturated top layer (0.2 m) of organic material (primarily green moss) (Golder, 2005; 2007). A layer of grey to black medium sand is present up to 0.7 m thickness throughout the area, below which a saturated, grey brown, sand and silt layer is found.

Bedrock is exposed at shallow depths throughout the site in locations where topsoil or till soils are present (Golder, 2005). Bedrock is encountered at a maximum depth of 1.4 m. As predicted by the soil conditions, seepage flows in test pits indicate high site drainage (*Baker Lake Bulk Fuel Storage Facility Environmental Performance Monitoring Plan Version 3; June 2014*).

4.3.5 Water Quality

Baker Lake water quality closely resembles distilled water as many conventional water chemistry parameters are at or below detection limits (BAER, 2005). The water column is generally well mixed and the water chemistry homogenous. During the open water season there is limited vertical stratification in temperature and dissolved oxygen, with observed higher salinity in the bottom strata.

4.3.6 Bathymetric Data

As required by Water License 2AM-MEA1525 Schedule B, Item 4: *A bathymetric survey(s) conducted prior to each year of shipping at the Baker Lake Marshaling Facility*. The result of this annual bathymetry can be provided if needed.

4.3.7 Tides and Currents that Prevail at the Facility

There is a general southward current in Hudson Bay at Chesterfield Inlet of about 19 km/day (CCG 2008). Tides are 4.6 meters with strong cross-currents at Chesterfield Inlet; usually flowing south-west at about 1.85 km/hr.

4.3.8 Meteorological Conditions Prevailing at the Facility

Monthly meteorological data has been collected from 1971 to 2000 from the Baker Lake “A” climate station, which is a Meteorological Service of Canada climate station. Snow and rain are combined to give monthly average precipitation. The prevailing winds for the area are generally from the north to north-west and average 20.4 km/hr.

4.3.9 Surrounding Area Environmental Sensitivities

The community of Baker Lake is a hamlet in the Kivalliq Region, in Nunavut on mainland Canada. Located 320 km inland from the west coast of the Hudson Bay, it is near the nation's geographical centre, and is notable for being the Canadian Arctic's sole inland community. The hamlet is located at the mouth of the Thelon River on the shore of Baker Lake.

The freshwater provided to the community is taken in Baker Lake. The freshwater intake is located approximately 3.4 km from the Meadowbank OHF. See Figure 3 below for the exact location. In case of a spill during fuel transfer, preventive action will be taken to avoid any contamination in close proximity of the water intake and cause health and safety problems to the community:

1) As part of the spill procedure, Agnico will make the community of Baker Lake aware of any spill to ensure measures can be taken to ensure safety of the community by contacting Mayor / Hamlet counsel and Fire department;
2) As part of the spill procedure, boom and absorbents pads will be deployed to confined and limit the progression of the spill into the water;
3) Booms will be deployed to capture the spill.
4) If spill cannot be captured prior to spreading towards the freshwater intake, booms will be deployed around the freshwater pump and regular inspection will be done to see if there are

visible sheen;

5) As a precaution and depending of the spill size, Agnico will work with the Baker Lake Hamlet Counsel to provide a notice to the community of Bake Lake to stop the consumption of the freshwater during the time spill is recovered and until a test on water is conducted. During this time Agnico will provide potable water to the community. [A] As soon as the spill will be recovered and it's determined that the freshwater intake and distribution system is not contaminated the consumption of freshwater will resume;

[A] The meadowbank project keeps a supply of 120 twenty litre bottles of drinking water in supply at all times in case of emergency. As well the water treatment plant is capable of producing >200m^3 of water a day and the current usage for the mine site is ~100m^3. Thus if required the Meadowbank mine can produce drinking water for the community for an emergency cease in the consumption of potable water due to a spill at the Baker Lake Marshalling Facility.

Figure 3 - Location of Community Freshwater Intake at Baker Lake

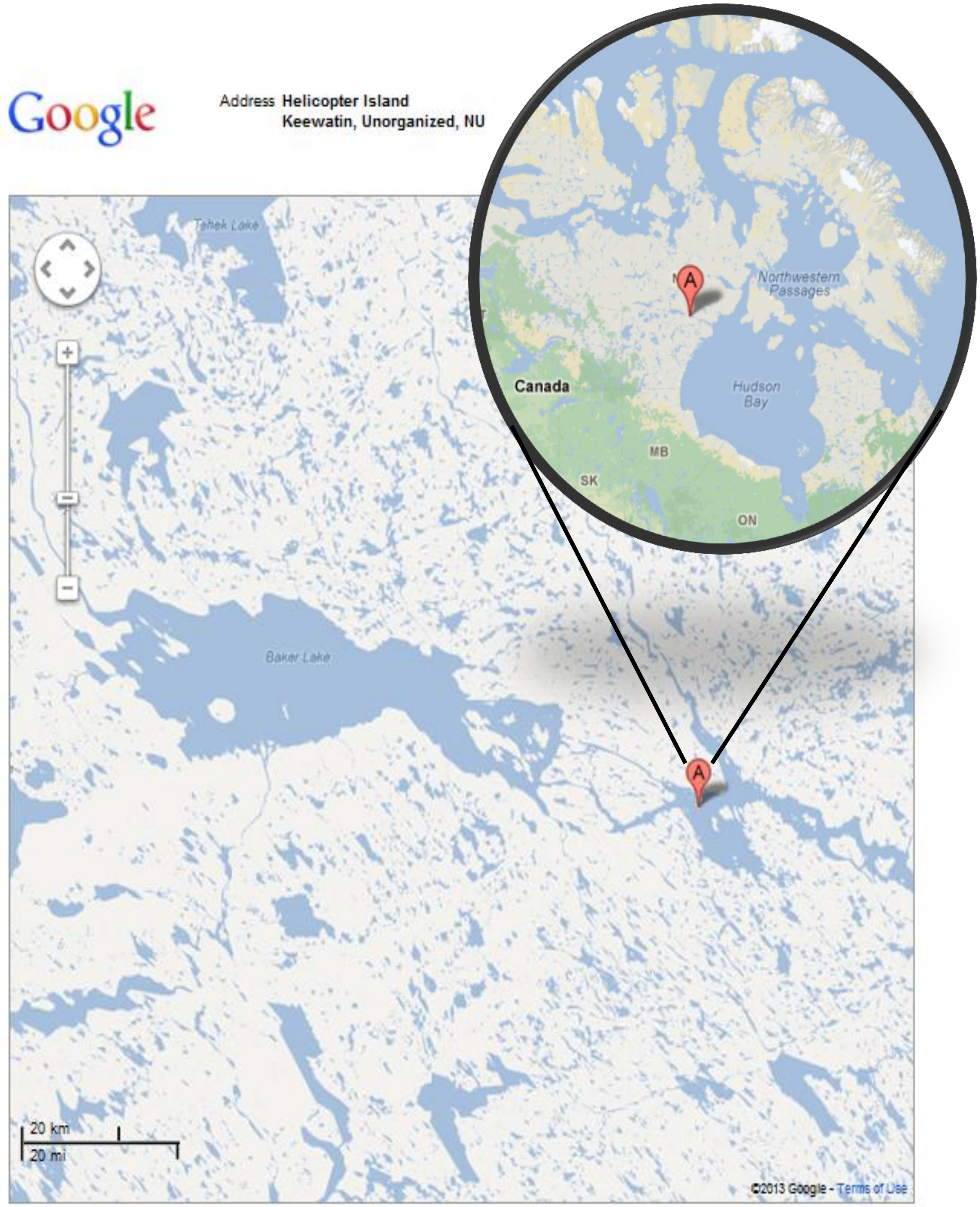
SECTION 5. SITE ACTIVITIES

5.1 Nature of the Oil Product

The main fuel stored at the Agnico's Baker Lake Fuel Farm will be P50 diesel and Jet-A. You can find, in Appendix C, the MSDS for Diesel and Jet-A. All other fuels such as gasoline and possibly other grades of diesel will be purchased in drums or 1m^3 totes and brought to the mine site for storage into the Meadowbank Fuel Storage Facility, or purchased and brought to site from a contractor in Baker Lake.

Coastal Shipping Limited, a division of the Woodward's Group of Companies, is contracted by Agnico to supply and deliver diesel fuel and Jet-A to Agnico's OHF facilities in Baker Lake. The tanker picking up the fuel will be double hulled, Motor Tank type ship, will have segregated ballast compartments and would be able to carry up to 20,000 m^3 of diesel and Jet-A fuel collectively. Ballast will not be required during the inward voyage to Baker Lake by the smaller ships. However, ballast will be picked up while on anchor outside the access passage after offloading the diesel and Jet-A fuel for its outward journey. A total of three (3) tanker loads of fuel will be required to fill the six diesel tanks in the tank farm, cumulatively holding 60,000 m^3 and one (1) tanker load to fill the 18 Jet-A tank, cumulative holding 1,800m^3.

Figure 4 - Location of Helicopter Island



5.2 Bulk Transfer

It is expected that the large tankers delivering diesel fuel and Jet-A will anchor in the same general location as the dry cargo vessels, shown on Figure 4. Ship-to-ship transfer of fuel will occur at this location from the larger tanker to a smaller tanker that can navigate the access passage. The carrying capacity of the small tanker will be either 7,300 m^3 or 10,500 m^3. The Ship to be used at any one time will be subject to its availability at the time when the large fuel tanker is set to deliver fuel to Agnico Eagle Mines Limited's Baker Lake Fuel Farm Oil Handling Facility. The small tanker will anchor directly to Agnico's spud barge. From there, transfer hoses (Conduit) are connected to a shore based pipeline for transfer of P-50 diesel fuel to the diesel tank farm. For Jet-A fuel separate hoses will be laid out from the vessel to the Jet-A storage containment. These hoses or conduit will carry the Jet-A fuel from the vessel to the Jet-A tanks.

Ballast will not be required for the inward voyage of the small tanker as it arrives at Baker Lake loaded with diesel fuel and Jet-A. After transferring the diesel fuel or Jet-A fuel to the tank farm, the small tanker will take on ballast in its segregated ballast compartments before sailing out to Helicopter Island to pick up another load of fuel from the large tanker anchored outside the access passage. Ballast will be dispelled as ship-to-ship transfer of diesel or Jet-A occurs and the small tanker is loaded. This sequence of events will be repeated until the large tanker is empty or the tank farm is full.

Due consideration will be given to prevailing and expected wind, weather and tide conditions when undertaking ship-to-ship and ship-to-shore fuel transfers. The large tanker anchored near Helicopter Island and the small tanker anchored near Baker Lake will be clear of land and traffic routes, and in open water of a depth exceeding the draught of the vessel(s). For ship-to-ship transfers, the ships will be secured alongside or anchored.

The small tanker will discharge at a rate of 400 m^3/hr for diesel fuel and 200 m^3/hr for Jet-A taking approximately one (1) day to fill. Communications between the shore and the small tanker will be maintained throughout to ensure the safe transfer of the fuels and to avoid the overfilling of the tanks. The ship-to-shore transfer to be used will be similar to that used at communities throughout Nunavut.

5.3 Measures to Minimize a Diesel and Jet-A Pollution Incident

The small tanker will be anchored offshore in water of sufficient depth to allow for draught and tidal changes during transfer.

The transfer of the fuels will use sound, well-rehearsed practices, include an adequate number of trained and alert personnel, have sufficient materials, and use well maintained, thoroughly tested equipment. A team of trained personnel on the tanker will be in charge of the tanker fuel transfer equipment, while an onshore team will be in charge of the land based transfer equipment. Agnico will have at least 2 trained personnel on the land to observe for any leak detection: a third part contractor (Intertek) and the Baker Lake Supervisor. The role of the third part contractor will be to apply procedure and oversee operation during the fuel transfer. To do this, the third part contractor will need to come on site at least one (1) day before the first day of transfer to receive the appropriate training given by the Environmental Department. Fire-fighting, spill response equipment and supplies will be located on the tanker and onshore near to the transfer point as required by Transport Canada. This will include readily available absorbent material at the flexible hose connections on deck and onshore to quickly address minor spills at predictable minor spill locations. Additionally, Agnico has placed a sea can with spill response supplies (including boat) and equipment at Agnico's Baker Lake Fuel Farm area where it can quickly be accessed in the event of a spill.

Four-inch (10 cm) steel piping able to accommodate a flow rate of approximately 400 m^3/hr will lead down to the shore from the diesel tank farm. Conduit from ship-to-shore will be connected to the fuel-receiving manifold located onshore using a dry-break coupling(s). For Jet-A fuel separate hoses will be laid out from the vessel to the Jet-A storage containment. Other measures to be taken to minimize and prevent spills include and must be followed by the on land responsible:

- Complete checklist before / during transfer for the on-land responsible (See Appendix E);
- Complete checklist, provide by Woodward, with vessel captain before transfer begin (Appendix E);
- Complete inspection / inventory of spill response sea can before transfer;
- During the transfer, regular monitoring will be undertaken for detection of incipient spills and leaks between the tanker and the tank farm;
- Radio test before transfer and after that each hour between the personnel on land and the captain of the vessel
- Transfer operations will be suspended should any leak be detected or filling alarm are activated;
- The onshore area and ship deck will be well light as fuel transfers could continue around the clock;
- Minimization of land drainage containing spilled diesel or Jet-A to limit the amount reaching the marine environment;
- Have a good knowledge of the OPEP requirement and protocol to follow is case of a spill by receiving a training / review each year before the transfer season; and
- The regular update of the OPEP.

During the ship-to-shore transfer, Agnico will have competent personnel on location at all times to monitor the fuel transfer and maintain contact with the tanker's crew. Should problems arise, the ship can be called to shut down the transfer and onshore piping will be closed down. In the event of a spill that escapes the containment boom, diversion booming will be deployed to minimize migration of a spill throughout Baker Lake. Adequate lighting will be put in place during all transfers, to allow for proper inspections of transfer locations around the clock. The lighting system intensity will be not less than 54 lx at each transfer connection point of the vessel and OHF and a lighting intensity not less than 11 lx at each transfer operation work area around each transfer connection point of the vessel and OHF.

See *APPENDIX D: MBK-ENV-0013: OHF / Ship to Shore Fuel Discharge Procedure.*

5.4 <u>Portable Containment Pools</u>

At the connection of the ship's conduit to the OHF manifold a portable containment pool will be erected and in place during the transfer of product. This pool is capable of holding ~250L of liquid in the case that there is a leak at the flange or residual drips out of the conduit or hard wall pipe.

Spill "pop-up" pools will be in place under each joint for the conduit used to fill the Fuel tanks. These pop-up pools are only capable of holding 20-50 L of fuel and are in place to catch residual and be a first line of defense in the case of a leak.

SECTION 6. MEADOWBANK RESPONSE TO EMERGENCIES

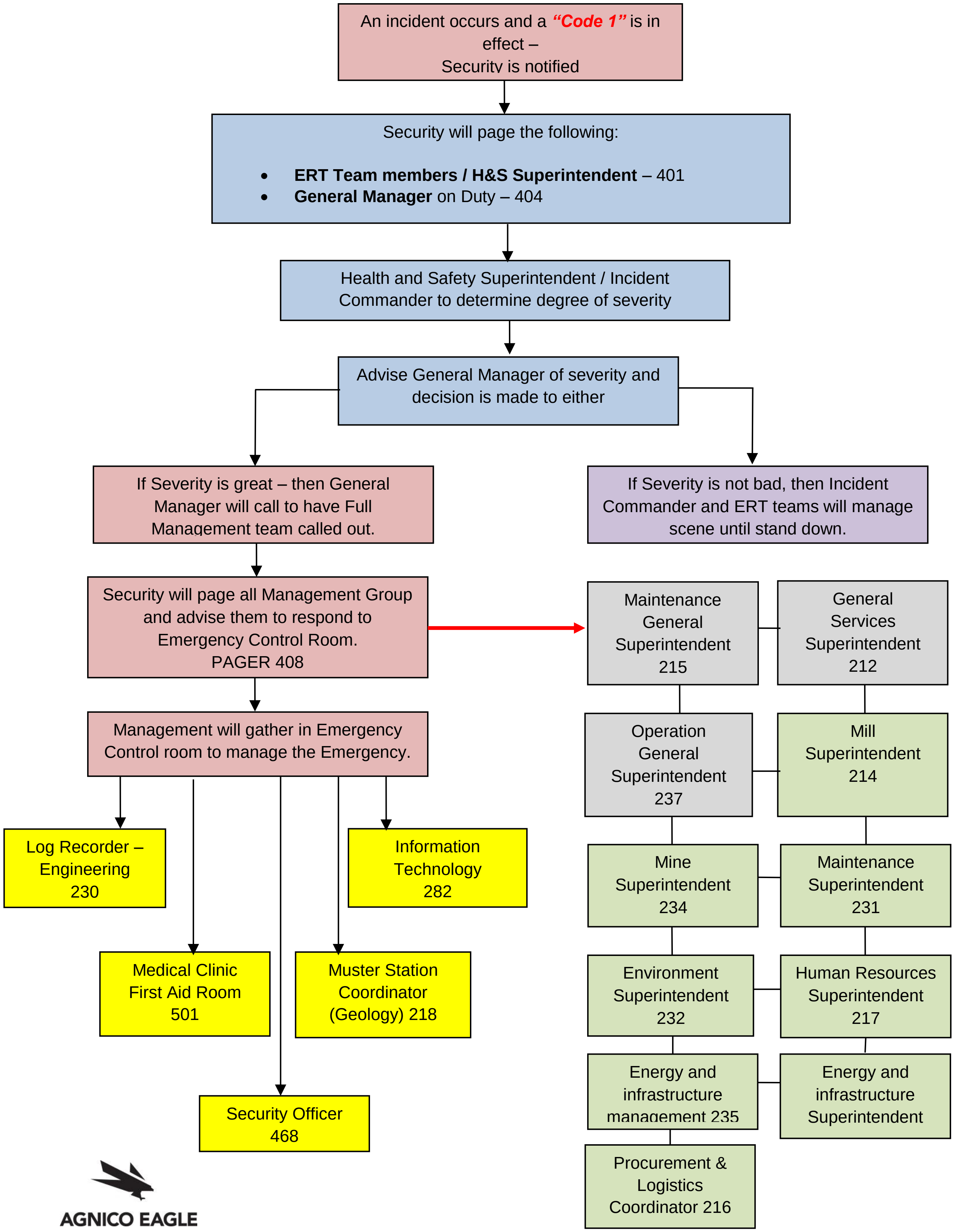
The Agnico Baker Lake Tank Farm OHF is considered Level 2 Handling facility as indicated in the OHF Standards TP 12402. With a transfer rate of ~400 m^3/hr Agnico'S OHF must have the spill response capacity to respond to a minimum of a 5m^3 spill.

6.1 Response Management Structure

Agnico has an Emergency Response Team (ERT) at the Meadowbank Mine trained and responsible for controlling the level 2 or greater spills at the Agnico's Baker Lake laydown and tank farm, and for assisting with medical and other emergencies that may occur at the mine site or the OHF.

Figure 5 depicts the Response Management System.

Figure 5 - Response Management System



6.2 Logistics and Planning

The Emergency Measures Counsellor (EMC) will ensure that site drawings and equipment lists are posted conspicuously in key locations throughout the site so that important information is always readily available. This will include the following:

- Location and isolation points of energy sources;
- Location of emergency equipment (e.g., fire water pumps, fire extinguishers, monitors, self-contained breathing apparatus);
- Emergency procedures outlines, such as specialist firefighting, chemical neutralization;
- Location of equipment for combating pollution (e.g., booms, pumps, absorbents, dispersants);
- Availability of internal and external emergency medical support (e.g., hospitals, clinics, ambulances, medical supplies, personnel with medical or first aid training);
- Location of toxicity testing facilities (e.g., gas and water);
- Location of wind direction / speed indicators;
- Directions on how to contact the local or regional weather forecasting service;
- Location of personal protective equipment and directions on its proper use; and
- Location of first aid stations and muster areas.

The Incident Commander, EMC, and Health and Safety Superintendent will know where, throughout the project site, all of this information is posted and where emergency equipment is stored. These individuals will also be trained in the proper use of emergency equipment.

SECTION 7. EQUIPMENT AND PPE

The following sections describe the items that are available in the case of a spill at the Agnico Eagle Mines Limited's Baker Lake Fuel Farm Oil Handling Facility. Equipment has been classified into items available for spill sizes either up to or greater than $5m^3$. However, any and all means will always be used to respond to a spill in a timely manner and ensure a prompt clean-up of any spill.

7.1 OHF Response Equipment for spills up to ~$5m^3$

The following equipment (Table 2) is available right at the OHF at any given time in a sea can designated for ***Environmental Emergency*** and can be deployed on scene within one hour, if it's safe to do, to contain and control the spill. Agnico can deploy this material within one hour.

Table 2 - Material available in the Spill Response Sea Can at Agnico's OHF

Quantity	Equipment/tool name
3	Empty drums (sealed)
2	Mini Berm 36"x 36"
2	4 Drums Berm 4'x 8'
4	Tarp 20'x 30'
4	Tarp 30'x 50'
10	Oil Spill Absorbent Pads
5	Universal Absorbent Boom 5"x 10' (For Hydro-soluble Chemical)
5	Universal Absorbent Boom 8"x 10' (For Hydro-soluble Chemical)
5	Petroleum base Absorbent Boom 5"x 10' (for Petroleum product)
4	Maritime Barrier (Baffle)
5	ABS pipe: 10' long x 4" diameter
2	Cell-U-Sorb (Absorbent)
2	Amerisorb Peat moss (Absorbent)
2	Oil Gator Absorbent
1	Plug Patties
4	Quatrex bags
2	Fork Lift Crate
4	Hand Shovel
1	Cro Bar Chisel
1	Ice Breaker Chisel
1	Sledge hammer
15	Rod bar 4'
1	½ drum containment
1	16ft Boat with motor and gasoline jerry can (sea can #321225)

7.2 Additional Response Equipment or for Spills >$5m^3$

All equipment previously mention is available for use during any emergency situation for a spill greater than $5m^3$. The following equipment would take time to get to the spill site, time would vary depending on distance from the spill. All these equipment and resources can be deployed on scene in <6 hours for the recover and clean-up of the spill.

7.2.1 General Equipment

This section addresses the emergency response machinery, equipment, tools and other resources that will be made available on-site for spill counter measures.

7.2.1.1 Mobile Equipment

Mobile Equipment available to Agnico, that will be used for spill contingency include:

- Graders-4
- Cranes-6
- Snowmobiles-3
- Vacuum Truck-1
- Loaders-14
- Backhoe-10
- Bulldozer-8
- Forklift & Hysters-16
- Water Trucks-2
- Winch Trucks-2
- Pickup Trucks-70
- Generator Sets-20
- Fire Truck-1
- Boats-4
- Fuel Trucks-2
- Bobcat-2
- Haul Trucks-25
- Snow Cat-1

All the previous listed equipment can be found on the Meadowbank mine site. Wheeled equipment can be at the OHF in Baker Lake in 3-6 hours. Tracked equipment would have to be loaded and transported which would take 5-6 hours.

7.2.1.2 Containment System

Temporary containment systems are also available on site and include:

- Absorbent Booms - 130 kits; 4 booms per Kit; each boom 8”x10’
  - 122 Universal booms; each boom 5”x10’
- Open top Drums x 80@200L
- Tanks – 2 x 100,000L tanks
- Tailings Pond – capable of holding contaminated fluids >1,000 m^3 capacity
- Spill absorbent material packages/pads - Quantity changes depending on demand on the Meadowbank site

7.2.1.3 Emergency Transportation

Emergency transportation that will be used under an emergency situation are:

- Aircraft (fixed wing or helicopter)
- 4-wheel drive vehicles >70
- Snowmobiles x 3
- Boats and motor x 4

7.2.2 Spill Response Kits and Containers

7.2.2.1 Kits

Spill response kits are strategically located where required. Each department and work area is responsible for providing sufficient spill response kits in their respective work areas. The kits are kept in marked and accessible locations. The locations include all fuel storage areas, chemical storage areas and so on.

All of the mobile equipment on site (including heavy equipment) contains an emergency spill kit.

7.2.2.2 Emergency Trailer

Agnico also have an Environmental Emergency Trailer which is easily accessible and mobile. The trailer is located on site east of the Environmental Office at the Meadowbank Mine Site. This trailer contains the following items:

- Pump Elastec
- Pump accessories
- Vaccum ends
- 45 gallons top
- Tubing 2 inches diameter
- Tubing 3 or 4 inches diameter
- Diesel Fuel jerry can (place on a miniberm)
- Spill kit accessory (red box)
- Drums opener
- Wescot (to open empty drum screw)
- Empty drums
- 2 drums berm
- 4 drums berm 4x8
- Tarp 20x30
- Tarp 30x50
- Oil white spill pads
- Universal boom 5x10
- Universal boom 8x10
- ABS pipe: 10' (4")
- ABS pipe: 10' (6")
- Cell U-Sorb
- Sphagsorb
- 3 Size of Wedge wood
- Plug pattie
- Quattrex bags
- Hand shovel
- Ice braker chisel
- Sledge hammer
- Rod bar (4')

7.2.2.3 AWAR Sea cans

Along the AWAR there are 9 environmental emergency sea cans. These sea cans are strategically placed along the road at water crossings. Each environmental emergency sea can contains the following material:

- Empty drums (Sealed)
- Mini berm 36"x36" x4'
- 4 drum spill berm 4x8
- Tarp 20'x30'
- Tarp 30'x50'
- Oil white spill pads
- Universal boom 5"x10' (Chemical)
- Universal boom 8"x10' (Chemical)
- Oil only booms 5"x10' (Hydro-carbons)
- Maritime barrier (Baffle)
- ABS pipe: 10' (4")
- Cell U-Sorb
- Amerisorb peat moss
- Oil gator absorbant
- Plug pattie
- Quattrex bags
- Fork lift crate (pallets)
- Long handle round point shovel
- Chisel point crow bar 16 lbs 57"
- Ice braker chisel
- Sledge hammer 12 lbs 36"
- Rod bar (4')

7.3 PPE

7.3.1 PPE at OHF for Spills <5m^3

The following PPE (Table 3) will be found in the Emergency Trailer and also on sea can at the OHF:

Table 3 - PPE available at OHF

Quantity	Equipment/tool name
3	Rain gear -- Pants and Top (L & 2-XL)
3	Rubber boots (size 8,10,12)
6	Rubber gloves
3	Goggles
3	Tyvex suits (L & 2 XL)
3	Safety glasses
3	Leather gloves

This is adequate PPE intended for 3 persons. Additional PPE will be available from the Meadowbank mine site.

7.3.2 PPE for Spills >5m^3

Personal Protective Equipment is stored in bulk quantities at the Meadowbank Warehouse. Quantities of each can be found on site using the JD Edwards system. In addition, the community of Baker Lake has certain PPE that can be purchased through Agnico Eagle after consulting the Agnico Eagle Procurement and Logistics department; however quantities of this PPE cannot be relied on within Baker Lake.

SECTION 8. COMMUNICATION

The primary basis for communication will be the phone system; back-up communication will be available via satellite phone. For on-site communication, hand-held radios will be mandatory for all employees working or travelling in remote areas from the OHF. Cell phones can be used as an additional means of communication however only CDMA service is available at the OHF. Back-up power sources and replacement batteries for communications equipment will be available to provide continuous, uninterrupted operation either at fixed facilities or at emergency sites.

Key site personnel will be accessible at all times by either portable radios, radios in vehicles, or office radios. The Health Care Professional will carry a hand-held radio and will be available at all times. Security personnel will monitor the emergency channel twenty-four hours per day. Senior management personnel will rotate as “On-Call Managers” for after-hour emergencies. An accommodations list that highlights key personnel will be posted and updated as required.

In the event of a major emergency all external communications for the mine site and associated areas will be cut and all external contact will take place solely through the Emergency Control Center at the Meadowbank Site.

During fuel transfer operation, the vessel master and the operator of the OHF will always have a two-way communication on a continuing basis. This two-way communication will be the direct communication by radio and the use of the cell phone.

8.1.1 Communication with the Public

Communication with public bodies during the state of emergency will be the responsibility of the General Mine Manager or by the Communications & Public Affairs Corporate Director.

In the case that the communities of Baker Lake should need to be evacuated on short notice, the Emergency Response Team will immediately assist in the evacuation of the community. The General Mine Manager will immediately contact the Mayor of the Hamlet to inform regarding the situation. In addition, if safe to do so, a radio notification should be immediately broadcast on the Baker Lake Radio station.

8.1.2 Hand Held Radio Communication

The channels used for hand held radio communication on the Meadowbank mine site, the All Weather Private Road, OHF, and associated facilities are as follows in Table 4:

Table 4 - Agnico Radio Channels

Surface
1. Spare RPTR
2. Mill Simplex
3. Mill Repeater
4. Exploration
5. Simplex 5
6. Baker Lake
7. Project
8. Auto-Patch

9. Agnico Surface
10. MB Dykes
11. Goose Operation
12. Portage Operation
13. Vault Operation
14. RD MB
15. RD KM37
16. RD Baker

The colors in each zone represents that they are 'linked' together. For instance, the RD MB, RD KM37 and RD Baker are plugged in a way that 3 persons talking on those 3 channels separately will hear each other as if they were on the same channel.

8.1.3 Contacts

Internal contact information is contained in Table 5 for all Agnico personnel involved in spill recovery. Table 6 contains contact information for contractor contacts which can be called for assistance with spill recovery. Table 7 is a list of government officials and external contacts to notify and provide subsequent reporting.

Table 5 - Agnico Contact

Title	Name	Telephone No.
Sr. Vice President, Environment and Sustainable Development	Louise Grondin	416.847.8656 Cell: 819.724.2020
Vice President of Environment, Environment and Sustainable Development	Michel Julien	416-947-1212 ext. 3738 Cell: 514.244.5876
Director of Environment, Environment and Sustainable Development	Gonzalo Rios	604.608.2557 ext. 6537
Corporate Director, Communications & Public Affairs	Dale Coffin	416.847.8669 Cell: 647.274.4154
Manager of Regulatory Affairs Nunavut	Stephane Robert	819.759.3700 ext. 5188 Cell: 819.763.0229
Manager of Nunavut Services Group	Jason Allaire	819.759.3555 ext. 6968 M: 819.355.2608
Meadowbank General Mine Manager	Bertin Paradis	819.759.3555 ext. 6725 Cell: 819.355.9348
Meadowbank Assistant General Manager	Luc Chouinard	819.759.3555 ext. 6896 Cell: 819-856-8160
H&S Superintendent or H&S Ass. Superintendent	Normand Ladouceur or Yves Levesque	819.759.3555 ext.6720 Cell: 819.860.6258 or 819.759.3555 ext.6720 Cell: 819.856.9051
Incident Commander	André Rouleau Or	819.759.3555 ext.6809 Cell: 819.355.2191

	Philip Beaudoin	or 819.759.3555 ext.6809 Cell: 450.847.4214
Environmental Nunavut Superintendent	Jamie Quesnel	819.759.3555 ext.6838 Cell: 819-856-0821
Environmental Senior Coordinator	Erika Voyer	819.759.3555 ext.6980 Cell: 819-856-0821
Environmental Coordinator	Martin Theriault or Robin Allard	819.759.3555 ext. 6744
Environmental Department	Environmental Technicians	819.759.3555 ext.6747/6759
On-site Medics	On-site Nurses	819.759.3555 ext.6734 or 6751
Site Security	On-site Security	(867) 793-4610 ext. 6748

Table 6 - Contractors / Local Contacts

Title	**Telephone No.**	**Contact in Emergency for:**
Nolinor Aviation Services	Protocol Agent (867).759.3700 ext. 8008 Emergency (450) 476-0018 (888) 505-7025	Flight services for additional crew, or additional supplies
First Air	(867) 669-6605 Emergency (867) 669-6694 (867) 444-2002	Flight services for additional crew, or additional supplies
Calm Air	(867) 793-2873 Emergency (204) 677-5013 (204) 677-5019	Flight services for additional crew, or additional supplies
Dyno Nobel Explosives Ltd.	(867) 793-4610 ext. 6804	Heavy Equipment, Man power, Emergency Blasting
Woodward Group of Companies (Shipping)	(709) 896-2421	Fuel Hauler
Baker Lake Contracting & Supplies	(867) 793-2831 Press #1 (867) 793-1679	Man power, equipment, trades personnel i.e. pipefitter, plumber, electrical
Peter's Expediting	(867) 793-2703 Cell (867) 793-1701	Equipment, man power, Ground transportation services
Arctic Fuel Services	(867) 793-2311 Office (867) 793-2301 Supervisor	Fuel hauling, trucking, man power.

Table 7 - External Contacts

Organization/Authority	Telephone Number	Fax Number
NT-NU 24-Hour Spill Report Line	(867) 920-8130 spills@gov.nt.ca	(867) 873-6924
Workers Safety and Compensation Commission	(867) 979-8500 or (800) 661-0792	(867) 979-8501
Kivalliq Inuit Association	(867) 645-5725 (867)645-2810 (reporting line)	(867) 645-2348
Nunavut Water Board	(867) 360-6338	(867) 360-6369
AANDC Inspector	(867) 645-2830	(867) 645-2592
Department of Fisheries and Ocean (DFO) – Nunavut Regional Office	1 (855) 852-8320	
Manager, Environmental Protection, Government of Nunavut (Kristi Lowe)	(867) 975-7748	
Kivalliq Health Services – Baker Lake	(867) 793-2816 *Dial 0*	(867) 793-2812
Baker Lake Hamlet Office	(867) 793-2874	(867) 793-2509
Baker Lake Fire Emergency	(867) 793-2900	
RCMP Regular Hour RCMP 24 Hour Emergency Number	(867) 793-0123 (867) 793-1111	
Canadian Coast Guard (in the event of a spill to the marine environment) Superintendent Environmental Response	(800) 265-0237 (519) 383-1954 (519) 381-6186 (cell)	(519) 337-2498
Transport Canada – Tech services Shane Sadoway Ian Salisbury	587-338-7141 (780) 495-8360 cell 780-495-8360	(780) 495-8607

All above phone numbers are current as of <u>April 2016.</u>

SECTION 9. ROLES AND RESPONSIBILITIES

9.1.1 First Responder (Third Party Contractor (Intertek Personnel) and Spud Barge Supervisor)

The person who has caused a spill or is the first to observe the spill is the first responder.

The responsibilities of the First Responder are as follows:

- Oversee the fuel transfer operation;
- Follow procedure set-up in the OPEP to prevent and minimize spill (See Section 5.3)
- In case of spill to land, ice or water, contact the Baker Lake Gatehouse to report the incident;
- Identify and contain the spill, IF SAFE TO DO SO; commence preparing spill response equipment, and
- Participate in spill response as a member of the clean-up crew.

9.1.2 Supervisor (Spud Barge Supervisor)

The responsibilities of the Supervisor are as follows:

- Contact the Baker Lake Gatehouse; contact Environment Department;
- Gather facts about the spill; and
- Participate in spill response.

9.2 Roles & Responsibilities of the Emergency Control Group

Below are the roles and responsibilities of the Emergency control group.

9.2.1 Official In-Charge

The Official In-Charge (General Manager or designate) will take charge for overseeing and approving the overall emergency strategy.

Immediate duties of the Official In-Charge include:

- Consult with the Incident Commander the status of emergency;
- Appoint an Emergency Log Recorder to maintain a written record of the time and events, including all discussions, instructions and decisions made by the Emergency Control Team;
- Issues specific tasks to the members of the Management as they arrive at the Control Room, as per this guideline;
- Brief the Emergency Control Team;
- Ensure that the safety of personnel is maintained, throughout the operation;
- Ensure procedures are in place for prompt dispatch of requested personnel, materials and

equipment to the emergency area;

- Arrange for all reports to be presented at specific intervals to the Emergency Control Team;

- Finalize the recommendations of the Incident Commander for rescue and recovery operations;

- The Official In-Charge is the only person authorized to release information to Government Agencies, Corporate Office or the Local Communities. He may delegate this activity to other members of the Emergency Control Team;

    - Verify all information you release;
    - Keep a record of all inquiries (media and non-media);
    - Do not speculate on causes;
    - Do not speculate on resumption of normal operations or when the problem will be solved; and
    - Advise that further updates will be forth coming.

- Notify the corporate management, if the following appear probable:

    - Fatalities;
    - Injuries that could probably become items of local, regional or national media interest;
    - There is a public health or environmental risk;
    - An incident involving chemicals where there is a large volume or the potential for over reaction (e.g., cyanide);
    - A spill of effluent or contaminated water or chemical substance to an area that lies outside the area of drainage control of the mine site (i.e., an external spill);
    - Mine operations may be stopped for more than two (2) days; and
    - Government authorities will become involved.

- Ensure all response teams, regulatory agencies and any other agency on emergency alert notice are advised when the emergency has ended;

- Ensure all documentation (i.e., notes, log sheets, written instructions, etc.) is gathered for the creation of the final report; and

- Participate in debriefing.

9.2.2 General Superintendents

- General Services, Operations and Maintenance will report to the Emergency Control Room and support the General manager/Designate in whatever capacity required;

- They will also ensure that the Superintendent/Designate in each of their respective Department's is aware of the emergency; and

- They will assist with the investigation and write up of the final report.

9.2.3 Incident Commander: A Trained Staff Member (ERT Coordinators or Supt.)

The responsibilities of the Incident Commander include:

- Ensure Security has been notified of emergency;
- Ensure the evacuation procedures have been activated, if required;
- Ensure that there are sufficient ERT members available to respond to the emergency;
- Ensure that the ERT has back-up support, a standby Team;
- Ensure that ERT Team has refreshments and nourishment (if the emergency requires several hours to resolve);
- Assess the size and severity of the emergency and the likely consequences. Establish response priorities; as well coordinate prevention of fire or explosion;
- Maintain communication with the ERT Captain;
- Advise the Official In-Charge of the ERT Team's activities, regarding the rescue and recovery operations;
- Appoint sufficient personnel, equipment and outside services are available. Utilize the members of the Emergency Control Team to organize these resources;
- Advise Official In-Charge when the emergency situation is under control and give the "All Clear";
- Participate in emergency investigation;
- Coordinate an orderly return to normal operating conditions;
- Arrange for a debriefing session, and utilize the services of all involved in resolving the emergency; and
- Assist to write the final report.

9.2.4 Emergency Response Team (ERT Team) Duties:

- The ERT Team Members must report to the Fire Hall, when paged for a "Code One" emergency;
- ERT Team Members will be given instructions on the emergency by the Incident Commander;
- ERT Team Members will follow instructions from the Incident Commander and will not put the Team at risk; and
- The ERT Team Captain will maintain radio contact with the Incident Commander throughout the emergency.

9.2.5 Environmental Superintendent/Designate Duties:

The following are the responsibilities of the Environmental Superintendent/Designate;

- Provide technical advice on probable environmental effects resulting from a spill and how to minimize them;
- Provide advice to the Official-in-Charge for appropriate spill response procedures;
- Ensure that Environmental Staff are available to direct the spill response action plan; and
- Assist with restoring of the Operations back to normal operating standards.

9.2.6 Health and Safety Superintendent/Designate Duties:

The Health and Safety Superintendent/Designate will be responsible for:

- Ensure that an Incident Commander is in place to oversee the ERT Teams;
- Ensure that all Management respond to the emergency and meet in the emergency control room;
- Oversee all activities that require Security or Nursing and arrange for Medevac transport, if required;
- Assist with getting a “head count” for the Official in-charge; and
- Assist with obtaining outside help if required.

9.2.7 Energy and Infrastructures Superintendent/Designate Duties:

The following are the responsibilities of the Site Services Superintendent/Designate;

- Ensure that all his employees are accounted for;
- Ensure that all ERT Member on his Crew, respond to the “ Code One” emergency;
- If the “ Emergency” is involves the site facilities, assist the Official-in-Charge with the action plan to deal with the emergency;
- Assist as required by supplying equipment and/or manpower; and
- Assist with restoring of the Operations back to normal operating standards.

9.2.8 Human Resources Superintendent/Designate Duties:

The following are the responsibilities of the Human Resources (HR) Superintendent/Designate:

- Ensure that all HR employees are accounted for; and

- Provide assistance to the Official-in-Charge if there are employees issues, such as injuries, transportation requirements, etc.

9.2.9 Health Care Professional (Nurse/Medic):

The on-site health professionals are responsible for the following:

- Providing on-site first aid and other medical support;
- Establish a triage location if there are multiple casualties;
- Arrange for medevac transportation, if required; and
- Ensuring that the first aid room is maintained at all times, by using First Responders as support.

9.2.10 Security Department:

The on-site Security Supervisor is responsible for the following:

- Ensuring that the Security officer has activated the appropriate level of emergency notification;
- Ensure that access points to the emergency are properly guarded;
- Notify the Baker Lake Gatehouse if the emergency involves the all-weather private road (AWPR); and
- Assist with other duties as requested by the Emergency Control Group.

9.3 Debriefing

After an incident has taken place and the location is brought back to normal operating standards a debriefing session will occur between ECG, Field Supervisors for the incident, ERT Captain(s), and the supervisor of the department involved with the spill.

The point of this debriefing session to determine the *who, what, where, when, why, and how* the incident occurred. It will also be the time to reflect on the steps that were taken to carry out the response and to determine what was done right and what corrective measures need to be put in place to better the response if needed in the future.

SECTION 10. GENERAL SPILL PROCEDURES

SPILL RESPONSE PRIORITIES

1. **Safety of the personnel working at or around the OHF**
   a. Contact all personnel working around the spud barge area and make them aware
   b. Make contact with the vessels Captain to make aware the ship and stop the transfer of the product
   c. Dawn appropriate PPE
   d. STOP the spill
2. **Make safe the facility**
   a. Create a no entry perimeter to ensure unaware persons do not enter the area in which the incident took place.
   b. Barricade entrances to the facility with red danger tape
   c. Have a person designated to watch entrances to ensure no community persons come on to site.
3. **Make the community of Baker Lake aware of the Spill to ensure measures can be taken to ensure safety of the community**
   a. Contact Mayor / Hamlet counsel
   b. Fire department
   c. RCMP
4. **Prevent fires or explosions / Stop all ignition sources**
   a. Disconnect power supplies
   b. Do not contain diesel or Jet-A fuel if vapors might ignite
   c. Allow fuel vapors to evaporate before intervention
5. **Minimize the Spill**
   a. When safe to proceed stop the spread of the product
   b. Use spill response equipment in emergency sea cans and ask for additional material if the spill is greater than $5m^3$
6. **Notice and Report the Spill**
   a. Spill need to be reported to Transport Canada, Coast Guard and Government of Nunavut immediately
   b. Other governing bodies will also be notified (see section 10.2)
7. **Environmental Impact**
   a. Deter wildlife from entering spill area. Keep track of any wildlife mortalities
   b. Determine what impacts the spill will have on the Environment
8. **Clean-up**
   Commence clean-up of the spill

10.1 Coordination with Government Agencies

10.1.1 Coordination with Transport Canada Technical Service Environmental Response

In the event of a marine spill Transport Canada Technical Service Environmental Response (TC) will be contacted immediately regarding the incident. Agnico will adhere to further recommendations from TC in response to the spill.

TC will also be contacted annually prior to the deposition of fuel at the OHF. As well, annual approval of this OPEP will be required by TC Pollution prevention Officer.

10.1.2 Coordination with Canadian Coast Guard

In the event of a marine spill, the coordination with Canadian Coast Guard (CCG)[4] is required and they will be contacted to report the incident. A description of the event will be provided to the CCG Environmental Response. Agnico will adhere to further recommendations from CCG in response to the spill.

On an Annual basis prior to the shipment of fuels to the OHF commencing, Agnico will contact the CCG and make them aware that the shipping season will be starting so they are aware that fuels will be travelling to Agnico's Baker Lake Fuel Tank Facility constructed in Baker Lake.[5] Also Agnico will inquire if there is any updates to "*The Central and Arctic Regional Response Plan (2008).*"

Agnico's Environmental Group will annually, prior to fuel transfer, review "*The Central and Arctic Regional Response Plan (2008).*" A copy of this plan can be found in Appendix G for reference. The plan will be reviewed to ensure that the OPEP and the actions of Agnico's OHF meet all requirements listed for an OHF.

10.1.3 Other Government Agencies

Agnico will contact all government agencies associated with the Meadowbank Gold Project as is the norm for any reportable spill. These groups include: Government of Nunavut (GN) via 24 hour spill reporting line, Aboriginal Affairs and Northern Development Canada (AANDC), Nunavut Water Board (NWB), and Kivaliq Inuit Association (KIA).

10.2 Reporting Requirements

10.2.1 Government of Nunavut Reporting Requirements

As per the Canada Shipping Act spills to the marine environment will be reported to the Transport Canada Technical Service Environmental Response and Canadian Coast Guard (contact numbers in Table 7). Marine spills will be reported in accordance with Transport Canada Guideline TP- 9834E, *Guidelines for Reporting Incidents Involving Dangerous Goods, Harmful Substances and /or Marine Pollutants*. Others to receive the spill report include the Kivalliq Inuit Association, Hamlet of Rankin Inlet, Fisheries and Oceans Canada, Canadian Coast Guard and Indigenous and Northern Affairs Canada Canada. Incidents that require media communications will be the responsibility of Agnico General Mine Manager or Public Affairs Corporate Director.

To ensure compliance with Section 36(3) of the *Fisheries Act*, all spills of fuel or hazardous materials, regardless of quantity, into a water body or onto ice will be reported immediately to the NT-NU 24-HOUR SPILL REPORT LINE (phone: (867) 920-8130, fax: (867) 873-6924, spills@gov.nt.ca).

[4] CCG: 1-800-265-0237, Superintendant Environmental Response Phone: 519-383-1954 Cellphone :519-381-6186
[5] *JJ Brickett with CCG was contacted on July 7, 2015*

Agnico possess a thorough internal spill reporting system that documents all spills for internal tracking. A copy of this Agnico internal spill report can be found in Appendix F, this is this spill report that the first responder will have to complete. Regardless of the volume, these spills are all reported to the Environment Department and if the NT-NU spill limits are exceeded or if the spill occurs in a water body, the Environmental Department reviews the incident, produces the NT-NU spill report and submits the NT-NU spill report to the regulator listed above. Investigation of all reportable spills is completed by the Meadowbank Environment Department.

10.3 Treatment and Disposal

All diesel or Jet-A fuel recovered through the spill response and any contaminated material will be taken to the Meadowbank mine site for recovery and, if applicable, incineration. It could also be packaged for disposal/recycling by a certified hazardous waste management company in southern Canada.

10.4 Resuming Unloading

The unloading of fuel from the tanker to the OHF will not resume if it hinders the response to the spill in any way. Unloading will resume once all problems are corrected, thus ensuring that the spill will not continue.

SECTION 11. SPILL SCENARIOS AND RESPONSE STRATEGIES

Agnico will strive to prevent any accidental spills and take all reasonable steps to minimize the risk of spill incidents and their impact on the environment. In 2015, an exercise program scenario was developed as a prevention protocol for the OHF operation. Safety, including use of personal protective equipment around water, and spill response training were part of this training. This exercise program evaluated the effectiveness of all the aspects of the procedure, equipment and resources that are identified in the OPEP. A summary of the 2015 exercise is provided in Appendix D - 1.3. An exercise will be conducted this year and the summary will be provided in next year's revision of the OPEP.

11.1 Product Properties and Response Strategy

Jet fuel, Jet-A, Jet-A1, or kerosene is a type of aviation fuel designed for use in aircraft powered by gas-turbine engines. It is colourless to straw-coloured in appearance.

P50 Diesel is a bright oily substance that has a low viscosity. It spreads rapidly on the water, has a low solubility in salt water (60 mg/L), and a high evaporation rate as described in the text box below.

At Baker Lake, the wind is largely from the NW to N.

Predicted Evaporation Rate of Spilled Diesel

Weight percent Evaporation = (5.8 + 0.045T) in(t)
Where T = water temperature
t = time in minutes

After a time span of 60 minutes at a surface temperature of 5°C, up to 25 % weight of the spilled diesel would have evaporated.

After 240 minutes, or 4 hours, the weight percent of the diesel that would have evaporated would be 33%.

Source: *Environment Canada, Emergencies Science and Technology Division*

In relation to Jet-A Fuel we will use the same evaporation rate as diesel as per Journal of Petroleum Science Research states; "*Diesel fuel and similar oils, such as jet fuel, kerosene and the like, evaporate as a square root of time. The reasons for this are simply that diesel fuel and such like have a narrower range of compounds which evaporating at similar rates, yield rates which together sum as a square root.*"[6]

As a result of the properties of diesel and Jet-A and the environmental conditions that predominate at Baker Lake, the spill response will need to aim to stop the spilled product from spreading across Baker Lake. This could include activating the Shipboard Oil Pollution Emergency Plan. The tanker would have response equipment on board and a fully trained crew in spill response. This, coupled with a shore based response under the OPEP, would ensure sufficient resources are available to control and recover as much diesel and Jet-A fuel as feasible.

[6] Journal of Petroleum Science Research (JPSR) Volume 2 Issue 3, July 2013 - *Modeling Oil and Petroleum Evaporation* by Merv F. Fingas

11.2 Pipeline safeguards

There are a number of safeguards in operating the ship-to-shore pipeline; these include:

- Save-all trays to capture any minor spills at the ends of the floating pipeline;
- Dry-break couplings at both ends of the floating pipeline;
- A pressure test will be performed before the diesel transfer to confirm the system is free of leaks; and
- Both the crew on the tanker and Agnico's shore based personnel will be fully trained in spill response and spill recovery.

11.3 Wildlife

During a spill event, Agnico will take care to deter any animal that will be near the spill area to minimize the risk to wildlife. In a case of mortalities, Agnico will track any mortality and report these numbers to the GN.

11.4 Scenarios

Three scenarios are considered, these being:

1. A spill between the ship and the flange of the OHF, the floating pipeline, resulting in a spill smaller than 1000 L of diesel or Jet-A fuel;
2. A major failure between the ship and the flange of the OHF, the floating pipeline, resulting in a spill greater than 1000 L but smaller than 5000L of diesel or Jet-A fuel; and
3. Spill greater than 5000 litres.

In most instances Agnico personnel and/or contractors will be able to respond to the spill but if necessary, backup can be requested by calling for the assistance of the Agnico Emergency Response Team that is stationed at the Meadowbank site located 110 kilometers away. The ERT can be at Baker Lake within 125 minutes to take charge of the spill response. Agnico will make every effort to have its equipment and resources deployed within 6 hours of an incident.

Diesel and Jet-A spills will be responded to in the same way. Review of the CANUTEC Emergency Response Guidebook designates the spill response to both products as the same.[7]

[7] 2012 Emergency Response Guidebook

<u>Scenario 1:</u> **Loss between the ship and the flange of the OHF, the floating pipeline, resulting in spill smaller than 1000L of diesel or Jet-A fuel.**

Appropriate Actions	Resources
1. Communicate with vessel and immediately stop the ship-to-shore transfer of fuel, if it's safe to do. The transfer should not restart in a manner that would interfere with the immediate, effective and sustained response to the oil pollution. 2. Make sure that the environment is safe for the facility and vessel personnel, the facility and Baker Lake community. 3. Make sure that risk of fire or explosion are minimize. 4. Contact person found on OHF Declaration to initiate the OPEP. 5. Minimize the oil pollution incident by containing the spilled fuel to spreading within the marine environment, if it's safe to do. 6. Notify CCG, local and regulatory authorities. 7. Containment boom is manned to prevent the escape of fuel outside the boom. 8. If necessary, place a diversion boom outside the containment boom to stop the diesel from getting onto the beach. 9. Spread absorbent material on the spill to capture it. 10. Monitor any fuel that could not be recovered and collect water samples near the spill site and in the access passage for analysis. Repeat as necessary. 11. If diesel reaches the beach, excavate the contaminated beach material and take it to the Landfarm area at the Meadowbank site.	a. Crew on the tanker trained in spill response. b. Agnico's shore based personnel trained in spill response and recovery. c. Emergency Response Team to take control of the spill response and recovery. d. Spill response equipment and supplies maintained on board the tanker and also in the sea can located on shore of Agnico's Fuel Farm and Marshalling area. e. Save-alls (Pop-up pools) placed under the pipeline manifolds to collect minor spills. f. Shore-based boat to position booms. g. Absorbent booms to recover spilled diesel on sea water. h. Heavy equipment such as excavators, back hoes, vacuum trucks, and dump trucks available if beach is contaminated.

Scenario 2: **Loss between the ship and the flange of the OHF, the floating pipeline, resulting in spill greater than 1000L but smaller than 5000L of diesel or Jet-A fuel.**

Appropriate Actions	Resources
1. Communicate with vessel and immediately stop the ship-to-shore transfer of fuel, if it's safe to do. The transfer should not restart in a manner that would interfere with the immediate, effective and sustained response to the oil pollution. 2. Make sure that the environment is safe for the facility personnel, the facility and Baker Lake community. 3. Make sure that risk of fire or explosion are minimize. 4. Contact person found on OHF Declaration to initiate the OPEP. 5. Minimize the oil pollution incident by containing the spilled fuel to spreading within the marine environment, if it's safe to do. 6. Notify CCG, local and regulatory authorities. 7. Containment boom is manned to prevent the escape of fuel outside the boom. 8. If necessary, place a diversion boom outside the containment boom to stop the diesel from getting onto the beach 9. Spread absorbent material on the spill to capture it 10. For larger amounts of spilled materials on water, use absorbent booms to collect the spilled diesel 11. Monitor any fuel that could not be recovered and collect water samples near the spill site and in the access passage for analysis. Repeat as necessary. 12. If diesel reaches the beach, excavate the contaminated beach material and take it to the Landfarm area at the Meadowbank site.	a. Crew on the small tanker trained in marine spill response. b. Crew from the large tanker anchored outside the access passage. c. Agnico's shore based personnel trained in near shore spill response and recovery. d. Emergency Response Team trained for near shore spill response. e. Shore-based boat to position booms and spread absorbent material. f. Spill response equipment and supplies maintained on board the tanker, in Agnico sea can locate at Agnico's Marshalling area. g. Additional booms to place outside the containment boom. h. Additional boats can be transported from the Meadowbank site as well local boats can be rented from local contracting companies i Heavy equipment such as excavators, back hoes, vacuum trucks, and dump trucks for waste materials. j. in the case of larger spills an Incident Command System will be set up at the Meadowbank site as laid out in the Meadowbank Emergency Response Plan.

Scenario 3: **A spill >5,000 litres**

In the case of an ***Extreme*** spill, Agnico follow the actions listed in Scenario 2 to complete the best clean up possible. Between the spill response equipment that the tanker delivering fuel has on board and the spill response supplies at the OHF, a spill up to the size of 5, 000 - 10, 000L will be able to be controlled and cleaned up. However if the spill is greater than 10, 000L, at this point Agnico will require external assistance with the clean-up.

The Canadian Coast Guard (CCG) will be made aware each year prior the fuel transfer, there is a possibility that under direction of CCG that there spill depot supplies located in Baker Lake may be used.

SECTION 12. PREVENTIVE MEASURES

Agnico recognises that spill prevention is more desirable than any modern efficient cleanup measures after the fact. Preventive measures have been adopted in relation to any transport, transfer, use and storage of diesel and Jet-A fuel. The tankers carry a Ship Oil Pollution Emergency Plan (SOPEP) as per the MARPOL 73/78 requirement under Annex I. All ships with 400 GT and above must carry an oil prevention plan as per the norms and guidelines laid down by the International Maritime Organization (IMO).

A SOPEP contains the following things:

- The action plan contains duty of each crew member at the time of spill, including emergency muster and actions;
- General information about the ship and the owner of the ship etc.;
- Steps and procedure to contain the discharge of oil into the sea using SOPEP equipment;
- On-board Reporting procedure and requirement in case of oil spill;
- List of authorities to contact and reporting requirements in case of oil spill. Authorities like port state control, oil clean up team etc. are to be notified;
- Drawing of various fuel lines, along with other oil lines on board vessel with positioning of vents, save-all trays, etc.;
- General arrangement of ship, which includes location of all the oil tanks with capacity, content, etc.; and
- The location of the SOPEP locker and contents of the locker with a list of inventory. (Marine Insight 2012)

The Spill Contingency Plan, Emergency Response Plan and the Oil Pollution Emergency Plan identify potential causes of emergencies and provides for the development and implementation of strategies to minimize the likelihood of the same.

As described in the Spill Contingency Plan, exercises are part of training for the Emergency Response Team. This will include comprehensive spill response exercise to practice the use of spill response equipment, including the use of booms and oil water separator.

The OPEP will be updated annually based on the results of spill exercises, changes to the infrastructure at Agnico's Fuel Handling Facilities, changes to procedures and other variables. The updated OPEP will be distributed to the Agnico Emergency Response Team, Transport Canada, the Kivalliq Inuit Association, the Municipality of Baker Lake and other agencies as appropriate.

12.1 Training

The environmental department and ERT team received training from a response organization and as a result will be able to respond to or assist with incidents that may occur at the OHF.

12.1.1 Meadowbank site Personnel

A designated Emergency Response Team (ERT) consisting of on-site personnel is established at Agnico's Meadowbank Mine Site. Agnico will ensure that the ERT is trained and staffed in sufficient number so that the ERT is present at all times. All members of the team will be trained and familiar with emergency and spill response resources, including their location and access, the Spill Contingency Plan, the Oil Pollution Emergency Plan and appropriate emergency spill response methodologies. The ERT will have up to 60 members, each of whom will train approximately 8 hours per month.

The training will include the following:

- Worker health and safety during emergency interventions;
- A review of the spill response plan and responsibilities of the ERT members;
- The nature, status, and location of fuel and chemical storage facilities;
- The on-site and off-site spill response equipment and how to use it;
- Emergency contact lists;
- Communication methods and signals;
- Desktop exercises of “worst case” scenarios;
- Emergency evacuation;
- Fires or explosions;
- Emergency equipment and use;
- Personal protective equipment and clothing;
- Marine shoreline recovery operations; and
- The likely causes and possible effects of spills.

Every employee at the Meadowbank project will receive spill and waste management induction during their initial site orientation, so they are able to respond to small spills and raise the alarm if a larger response is required. ERT members will receive more extensive spill response training and learn how to respond while wearing personal protective clothing, use of specific spill response gear, proper deployment of absorbents and maritime boom.

The Environmental Department will regularly provide tool-box sessions to give information on spill response and reporting procedures.

You can find records of different trainings that Agnico personnel have attended in Table 8. Basic spill response training will be completed in 2016 by all Agnico employees and contractors working on the Meadowbank project as part of the induction which is mandatory for all personnel coming to the Meadowbank site.

12.1.2 OHF Personnel Training

Prior to the first discharge of fuel form the vessel to the OHF a mandatory training will take place. This will be a review with all the personnel responsible for the shore based portion of the fuel transfer, including the third party contractor and the Baker Lake supervisor, the current OPEP and make them aware of the procedures to follow in case of a spill before the first fuel barge arrived. A copy of the 2016 log sheet will be provided to TCMSS once the training is completed.

In April 2016, a meeting with all Departments of Agnico involved with fuel transfer was held. The OPEP, prior to and during transfer checklists were reviewed. Meeting minutes can be found in Appendix D – 1.4.

12.1.3 Boat Operators

All people involved in the supervision during operation and / or on the spill response will complete the training course for the pleasure craft operator. Records of pleasure craft operator certification will be retained by the Meadowbank Training department.

All concerned persons working for Agnico Eagle Mines Ltd. must possess a pleasure craft operator card and provide proof of this certification prior to operating any boat relating to the Meadowbank project which includes the Baker Lake Marshalling facility. This includes emergency responders.

Table 8 - Spill Response Training

Agnico Eagle Mines Meadowbank Division									
	Spill Response Training								
		Company	Spill Response Operations Course / CCG	Emergency Planning and Spill Response Awareness / SWAT Consulting	OHF & AWPR Spill Response / Jamie Kataluk	OHF & AWPR Spill Response / Tom Thompson	OHF & AWPR Spill Response / Robin Allard	OHF & AWPR Spill Response / Martin Therialut	OHF Spill Response and Ship to Shore Checklist / Jeffrey Pratt
	Name								
AEM EE	Jeffrey Pratt	AEM		15-Jan-13		14-Jul-15			30-Sep-14
AEM EE	Robin Allard	AEM	Jan-2012	16-Jan-13		14-Jul-15			30-Sep-14
AEM EE	Martin Theriault	AEM	Jan-2011	15-Jan-13					
AEM EE	Fanny Laporte	AEM		15-Jan-13					
AEM EE	Richard Jackson	AEM		15-Jan-13					
AEM EE	Tom Thomson	AEM	24-Apr-15	15-Jan-13					
GONE	Jamie Kataluk	AEM	24-Apr-15	16-Jan-13					30-Sep-14
AEM EE	Dave Holmstrom	AEM		16-Jan-13					
AEM EE	Potogu Noah	AEM			10-Jul-13				
AEM EE	Stephane Larose	AEM		16-Jan-13					
AEM EE	Jean-Claude Poitras	AEM					18-Jun-13		
AEM EE	Bernard Paradis	AEM					18-Jun-13		
AEM EE	Serge Pare	AEM					18-Jun-13		
AEM EE	Ray Carlson	AEM					18-Jun-13		
AEM EE	Mark Nulait	AEM						20-Sep-12	
AEM EE	Tim Chappelle	AEM						20-Sep-12	
AEM EE	Alexandre Arcand	AEM						25-Sep-12	
AEM EE	Alexande Ouellette	AEM				14-Jul-15			30-Sep-14
AEM EE	Steve Paquin	AEM							30-Sep-14
NOT AEM	Francois Moses	Intertek				14-Jul-15			30-Sep-14
NOT AEM	Alberto Rodriguez	Intertek				14-Jul-15			30-Sep-14
NOT AEM	Sanik Faraq	Intertek				14-Jul-15			30-Sep-14

SECTION 13. COASTAL SHIPPING

13.1.1 Coastal Shipping

In Appendix A - 1.2 you will find the 2013 contact information for Coastal Shipping during the barge season. This contact information will be used again in the 2016 season; no changes are required for this year. This will be reviewed with Coastal Shipping on an annual basis.

SECTION 14. REFERENCES

Transport Canada *Oil Handling Facilities Standards*, TP12402E.

Canadian Coast Guard, Central & Arctic Region, 2008. *Regional Response Plan.*

Marine Insight, 2012. What is Ship Oil Pollution Emergency Plan (SOPEP)? http://www.marineinsight.com/misc/maritime-law/what-is-ship-oil-pollution-emergency-plan-sopep/#ixzz21B2YvDTW http://www.marineinsight.com/misc/maritime-law/what-is-ship-oil-pollution-emergency-plan-sopep/#ixzz21B1dDGL5

Moller, T.H. & Santner, R.S. 1997. *Oil Spill Preparedness and Response: the Role of Industry,* 1997 International Oil Spill Conference, Technical Report IOSC-005.

National Oceanic and Atmospheric Administration http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/in-situ-burning.html

Transport Canada, TP- 12401, 1995. *Response Organizations Standards.*

Transport Canada, TP-12402, 1995. *Oil Handling Facilities Standards.*

Transport Canada, TP-10783, 1997*. Arctic Waters Oil Transfer Guidelines.*

Transport Canada Guideline, TP-10783E, 1997. *Arctic Waters Oil Transfer Guidelines,* Prairie and Northern Region, Marine (AMNS - OTT).

Transport Canada, TP-13585, 2008. *Environmental Prevention and Response National Preparedness Plan.*

Transport Canada Guideline TP- 9834E, 2009. *Guidelines for Reporting Incidents Involving Dangerous Goods, Harmful Substances and /or Marine Pollutants*.

Journal of Petroleum Science Research (JPSR) Volume 2 Issue 3, July 2013 - Modeling Oil and Petroleum Evaporation by Merv F. Fingas

APPENDIX A - COASTAL SHIPPING LTD.

1.1 – SOPEP

1.2 – CONTACT INFO

The **W**OODWARD **G**ROUP OF **C**OMPANIES

Coastal Shipping Limited
A Division of Woodward Group of Companies

Coastal Shipping Ltd.
The Woodward Group of Companies
114 Main Street, P.O. Box 910
Lewisporte, NL A0G 3A0 CANADA

SHIPBOARD MARINE POLLUTION EMERGENCY PLAN (SMPEP)

In accordance with MARPOL 73/78, Annex I
IMO Res. MEPC. 78(43)

MT "ALSTERSTERN"
IMO 9053220

CONFIRMATION OF ACKNOWLEDGE

Shipboard Marine Pollution Emergency Plan

Date Entered:	Rank:	Name:	Signature:
			.

INDEX OF CORRECTIONS

Date of Correction	SMPEP pages exchange (date)		APPENDIX 2 Date of Current List of Contact Points
	IN	OUT	

SHIPBOARD MARINE POLLUTION EMERGENCY PLAN

In accordance with Regulation 37 of Annex I and Regulation 17 of MARPOL 73/78

SHIP'S IDENTIFICATION

GL- REGISTER - NUMBER	34583
NAME OF SHIP	ALSTERSTERN
CALL SIGN	XJAZ
IMO NUMBER	9053220
TYPE OF SHIP	CHEMICAL / OIL TANKER
PORT OF REGISTRY	ST. JOHN'S
GROSS TONNAGE	11426
FLAG	CANADA
OFFICIAL NUMBER	835794

TABLE OF CONTENTS

INTRODUCTION		6
SECTION 1	PREAMBLE	7
SECTION 2	Reporting Requirements	9
2.1	**General**	9
2.2	**Reporting Procedures**	9
2.2.1	When to Report	9
2.2.1.1	Actual Discharge	9
2.2.1.2	Probable Discharge	9
2.2.2	Information Required	10
2.2.3	Whom to contact	15
2.2.3.1	Coastal State contacts	15
2.2.3.2	Port Contacts	15
2.2.3.3	Ship Interest Contacts	15
SECTION 3	**STEPS TO CONTROL DISCHARGE**	16
3.1	**Operational Spills**	16
3.1.1	Operational Spill Prevention	16
3.1.2	Pipeline Leakage	18
3.1.3	Tank Overflow	18
3.1.4	Hull Leakage	18
3.1.5	Spills caused by Equipment in Machinery Spaces	19
3.2	**Spills resulting from Casualties**	19
3.2.1	Ship grounded / stranded	19
3.2.1.1	Prevention of Fire and Explosion	20
3.2.1.2	Hull Damage / Hull Failure / Containment Failure	20
3.2.1.3	Procedures to reduce ot Stop Outflow of Oil or NLS	21
3.2.1.4	Refloating by own means	21
3.2.1.5	Securing the Ship	22
3.2.2	Fire / Explosion	22
3.2.3	Collision	22
3.2.4	Excessive List	23
3.2.5	Dangerous reactions of Cargo	23
3.2.6	Other Dangerous Cargo and /or Vapour Release	24
3.2.7	Loss of Tank environmental control	24
3.2.8	Ship submerged / foundered / wrecked	24
3.3	**Priority Actions**	24
3.4	**Mitigating Activities**	26
3.5	**Transfer of Bunkers / Cargo - Lightering**	27
3.6	**Damage Stability and Hull Stress Calculation**	28

3.7	**General Responsibilities of the Master and designated Officers / crew members**	30
SECTION 4	**NATIONAL AND LOCAL CO-ORDINATION**	32
APPENDICES		36
Appendix 1	Spill Equipment Inventory	37
Appendix 2	Ships Drawings and Diagrams	39
	Layout of General Arrangement Stowage Plan	
	Diagram of Fuel Bunkering	
	Tank Plan	
	Diagram of Fuel Service Lines	
	Lubricating Oil System	
	Stripping System	

INTRODUCTION

1. This Shipboard Marine Pollution Emergency Plan (hereafter referred to as the "Plan") is written in accordance with the requirements of regulation 37 of Annex I and regulation 17 of Annex II of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 there to and amended by Res. MEPC. 78 (43).
As recommended by IMO this plan is a **combination of a SOPEP and a Shipboard Marine Pollution Emergency Plan for noxious liquid substances.**

2. The purpose of the Plan is to provide guidance to the Master, officers and operating personnel onboard the Ship, with respect to the steps to be taken when an oil or marine pollution incident has or is likely to occur. The appendices contain communication data of all contacts referenced in the Plan, as well as other reference material.

3. The Plan contains all information and operational instructions required by the "Guidelines for the development of the Shipboard Marine Pollution Emergency Plan" as developed by the Organization (IMO) and published under MEPC. 85(44) and MPEC.54 (32) amended by MPEC.86(44). .

4. This Plan has been examined byGermanischer Lloyd or GL on behalf of Transport Canada and, except as provided below, no alteration or revision shall be made to any part of it without prior approval by or on behalf of GL.

5. Changes to Sections 4 and the appendices will not be required to be approved by the Board. The appendices should be maintained up to date by the Owners, Operators, and Managers.

6. For the purposes of this Plan, the Master is taken to be that person who is a member of the vessel's operational personnel and to which is given senior responsibility for the vessel and any circumstances pertaining thereto.

7. Before entering a port of call, the Master should be aware of local emergency response procedures and organizations and have up to date contact information readily available.

SECTION 1 • Preamble

1.1 This Plan is intended to assist the ship's personnel in dealing with an unexpected discharge of oil or noxious liquid substances (NLS). Its primary purpose is to set in motion the necessary actions to stop or minimize the discharge of those substances and to mitigate its effects.

1.2 Effective planning ensures that the necessary actions are taken in a structured, logical and timely manner.

1.3 The primary objectives of this Plan are to:

- prevent pollution
- stop or minimize outflow when a damage to the ship or its requirement occurs
- stop or minimize outflow when an operational spill occurs in excess of the quantity or instantaneous rate permitted under the present Convention.

1.4 Further, the purpose of the Plan is to provide the Master, officers and certain crew members with a practical guide to the prevention of marine spills and in carrying out the responsibilities associated with regulation 37 of Annex I and Reg. 17 of Annex II of MARPOL 73 / 78.

- procedures to report an oil / marine incident.
- Coastal States (Focal Points) and Port Contact Lists to be contacted in the event of any pollution incident.
- co-ordination with national and local Authorities in combating a pollution.

1.5 In summary, the Plan will serve to promote a practiced response when the ship's personnel is faced with a spill.

1.6 Although the Plan is designed as a ship-specific tool it must be also be considered as an additional instrument and is a link to shore-based plans. With this the Plans allows an efficient co-ordination between the ship and shore-based Authorities /Organizations in mitigating the effects of any pollution incident.

1.7 The Plan includes a summary flowchart (See page 8) to guide the Master through reporting and acting procedures required during an oil pollution incident response.

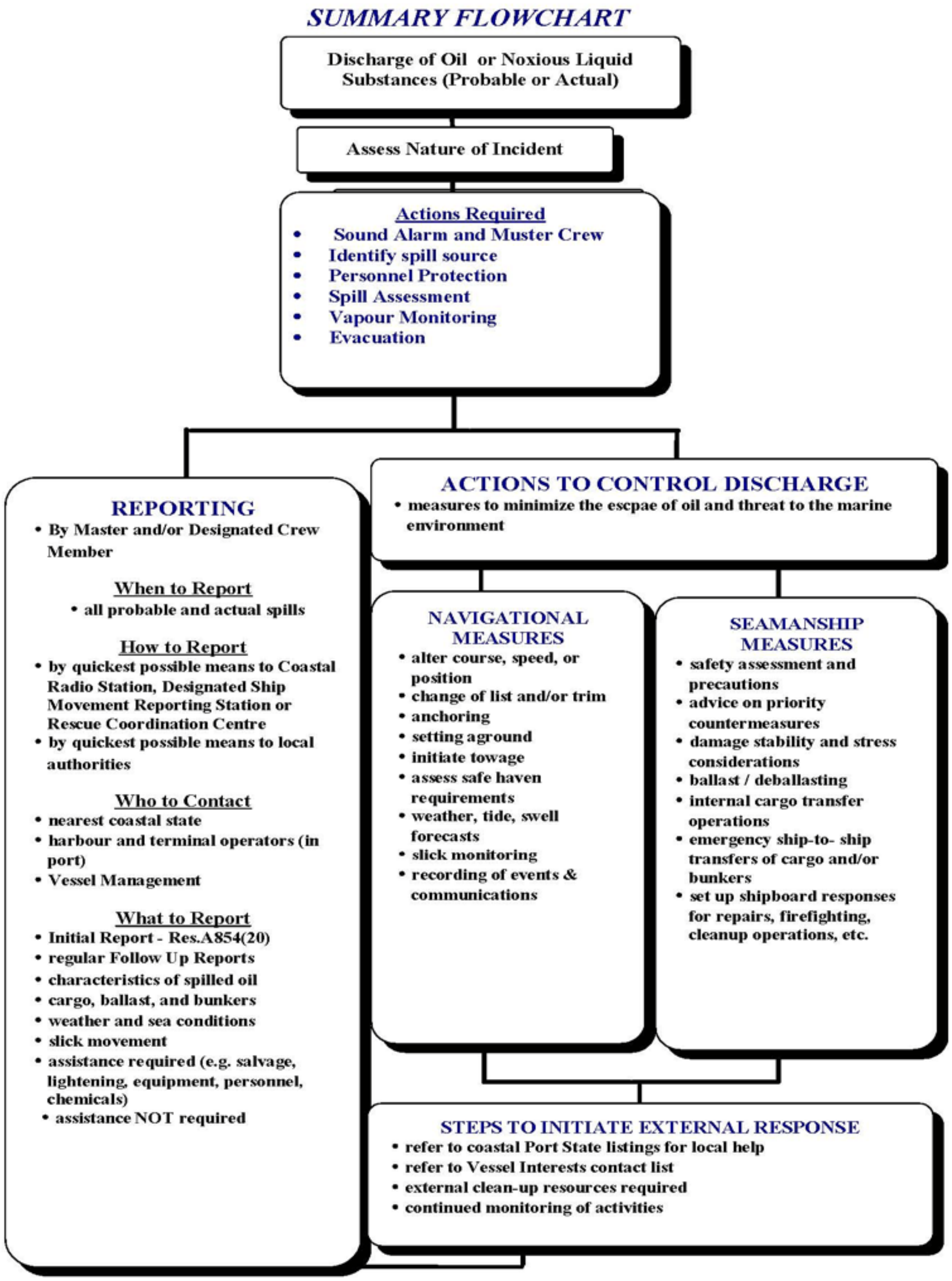
1.8 The Plan is likely to be a document used on board by the Master and the officers of the ship and must therefore be available in the working language used by them.

1.9 The Plan is not applicable if the vessel operates in U.S waters within the EEZ (exclusive economic zone). The Vessel Response Plan (VRP) has to be activated.

1.10 All Procedures in this Plan are in line with Coastal emergency procedures which can be found in the file Emergency Preparedness as part of the Safety Management System (SMS). They should be referred to in any case for obtaining additional information.

SHIPBOARD MARINE POLLUTION EMERGENCY PLAN - SUMMARY FLOWCART

This flow diagram is an outline of the course of action that shipboard personnel should follow in responding to a pollution emergency based on the guidelines published by the Organization. This diagram is not exhaustive and should not be used as a sole reference in response. Consideration should be given inclusion of specific reference to the Plan. The steps are designed to assist ship personnel in action to stop or minimize the discharge of oil or NLS and mitigate its effects. These steps fall into two main categories - reporting and actions.



SECTION 2: Reporting Requirements

2.1 GENERAL

The reporting requirements of this section comply with those of regulation 37 Annex I and 17 Annex II of MARPOL 73 / 78.
When the ship is involved in an incident which results in the discharge of oil or NLS, the Master is obliged under the terms of MARPOL 73 / 78 to report details of the incident, without delay, to the nearest Coastal state by means of the fastest telecommunication channels available.

The intent of these requirements are to ensure that Coastal States are informed, without delay, of any incident giving rise to pollution, or threat of pollution of the marine environment, as well as of the assistance and salvage measures, so that appropriate action may be taken.

Without interfering with ship owner's liability, some coastal states consider that it is their responsibility to define techniques and means to be taken against a marine pollution incident and approve such operations which might cause further pollution i.e. lightening. States are in general entitled to do so under the International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969 and the Protocol relating to Intervention on the High Seas in Cases of Pollution by Substances other than Oil, 1973

2.2 Reporting Procedures

For easy reference the reporting requirements in the context of this plan are divided in to the following information blocks:

2.2.1 When to Report

Taking the summary flowchart as shown on page 5 as a basic guide into consideration reports are necessary in the following cases:

2.2.1.1 Actual discharge

The Master is obliged to report to the nearest Coastal state whenever there is a discharge of oil resulting

- from damage to the ship
- from damage to the ship's equipment
- for the purpose of securing the safety of a ship or saving life at sea
- during the operation of the Ship in excess of the quantity or instantaneous rate permitted under the present Convention.

2.2.1.2 Probable discharge

The Master is obliged to report even when no actual discharge of oil or NLS has occurred but there is a probability that one could.

However, as it is not practicable to lay down precise definitions of all types of situations involving probable discharge of oil / NLS which would warrant an obligation to report the Master is obliged to judge by himself whether there is such a probability and whether a report should be made.

Therefore, it is recommended that, at least, the following events

- damage, failure or breakdown which affects the safety of the ship (e.g. collision, fire, grounding, explosion, structural failure, flooding, cargo, cargo shifting, list, etc.)

or

- failure or breakdown of machinery or equipment which results in impairment of the safety of navigation (e.g. failure or breakdown of steering gear, propulsion, electrical generating system, essential shipborne navigation aids etc.)

are carefully considered by the Master - taking into account the nature of the damage failure or breakdown of the ship, machinery or equipment as well as the ship's location , proximity to land, weather, state of the sea and traffic density - as cases in which a probable discharge is more likely.

If in doubt, the Master should always make a report in cases aforementioned.

In all cases the Authorities should be kept informed by the Master as how the situation progress and be advised when all threats of pollution has passed.

2.2.2 Information Required

As required in article 8 and Protocol I of MARPOL 73 / 78 Convention the Master or other persons having charge of the ship should report the particulars of any pollution incident. In this context the International Marine Organization (IMO), in 1997, adopted Resolution A. 851 (20) "General Principles for Ship Reporting Systems and Ship Reporting Requirements, including Guidelines for Reporting Incidents involving Dangerous Goods, Harmful Substances and / or Marine Pollutants"

The intent of the Resolutions aforementioned is to enable Coastal States and other interested parties to be informed, without delay, of any incident giving rise to pollution, or threat of pollution of the marine environment, as well as of assistance and salvageable measures, so that appropriate action may be taken.

Nothing in this chapter relieves the Master in using sound judgment to make sure that any incident or probable discharge is reported as quick as possible in the prevailing situation.

When Transmitting initial reports to the authorities of the nearest Coastal State, the Master or other persons dealing with such a transmission should take note of IMO Resolution A 851(20).

Especially, the format of the initial report as well as supplementary of the follow up reports should conform with the guidance contained in Resolution A 851(20). All reporting whether initial or follow up, should follow IMO's reporting format as outlined below and should contain the following information:

FORMAT AND INFORMATION REQUIRED FOR OFFICIAL REPORT

AA VESSEL NAME, CALL SIGN, FLAG

BB DATE AND TIME (GMT) OF INCIDENT: 11/1935 meaning 11th of month at 7:35 pm.

CC SHIPS POSITION: 2230N 0600E meaning 22 deg. 30 min. N, 6 deg. E

or

DD SHIPS POSITION BY TRUE BEARING (3 DIGITS) AND DISTANCE FROM CLEARLY IDENTIFIED LANDMARK.

EE TRUE COURSE (3 DIGITS)

FF SPEED IN KNOTS AND TENTHS OF A KNOT (3 DIGITS)

LL ROUTE INFORMATION - INTENDED TRACK

MM RADIO STATIONS AND FREQUENCIES GUARDED

NN TIME OF NEXT REPORT (same as in BB)

OO DRAFT (4 DIGITS - meters and centimeters)

PP TYPES AND QUANTITIES OF CARGO AND BUNKERS ON BOARD

QQ BRIEF DETAILS OF DAMAGE, LIMITATIONS ETC. (must include condition of vessel and ability to transfer cargo, ballast, or fuel)

RR BRIEF DETAILS OF ACTUAL POLLUTION (oil type, estimate of quantity discharged, whether discharge continues, cause, estimate of slick movement)

SS WEATHER AND SEA CONDITIONS (wind force/direction, relevant tidal and/or current information)

TT NAME, ADDRESS, FAX, TELEPHONE NUMBERS OF VESSEL OWNER OR REPRESENTATIVE

UU DETAILS OF LENGTH, BREADTH, TONNAGE, AND TYPE OF VESSEL

WW TOTAL NUMBER OF PERSONS ON BOARD

XX MISC. DETAILS (This includes brief details of incident, actions taken, injuries sustained and assistance required. If no outside assistance is required, then this should be clearly stated.)

SHIPBOARD MARINE POLLUTION EMERGENCY PLAN

INITIAL NOTIFICATION

AA(SHIPS NAME; CALL SIGN; FLAG)

BB(DATE AND TIME OF EVENT; UTC)

D D H H M M

CC (POSITION; LAT; LONG) OR DD (BEARING; DISTANCE FROM LANDMARK)

N S

d d m m d d d N miles

E W

d d d m m

EE (COURSE) FF(SPEED)

d d d kn kn 1/ 10

LL (INTENDED TRACK)

MM (RADIO STATION(S) GUARDED)

NN (DATE AND TIME OF NEXT REPORT; UTC)

D D H H M M

OO (DRAFT; METERS, centimeters)

M M cm cm

PP(TYPE AND QUANTITY OF CARGO/ BUNKERS ON BOARD)

QQ (BRIEF DETAILS OF DEFECTS/ DEFICIENCIES/ DAMAGE)
RR (BRIEF DETAILS OF POLLUTION; INCLUDING ESTIMATE OF QUANTITY LOST)
SS (CONTACT DETAILS OF WEATHER AND SEA CONDITIONS) Wind: Direction, Speed (Beaufort) SWELL: Direction, Height (m)
TT (CONTACT DETAILS OF SHIP´S OWNER/ OPERATOR/ AGENT)
UU (SHIP SIZE AND TYPE)
XX (ADDITIONAL INFORMATION)

All follow up reports by the Master should include information relevant to the Coastal State Authorities to keep them informed as the incident develops.

Follow up reports should include information on any significant changes in the ship's condition, the rate of release and spread of the substances, weather and sea conditions and clean-up activities underway.

In this context details of bunker and cargo disposition, condition of any empty tanks and nature of any ballast carried are information needed by those involved in order to assess the threat posed by an actual or probable discharge from the damaged ship.

2.2.3 Whom to Contact

The Master is responsible for reporting any incident involving an actual or probable discharge of oil or NLS.
Contact information for coastal State and other concerned parties (port contacts, vessel interest contacts) is located in Section 4.

2.2.3.1 Coastal State Contacts

The vessel, in accordance with the regulations, has onboard a **declaration** that the vessel's management has, in accordance with 167 of the Canada Shipping Act 2001, entered into an arrangement with response organization, **ECRC** to which a certificate of designation has been issued pursuant to section 169 in respect of the quantity of oil that is carried both as fuel and cargo on board the vessel.

The **Director of Operations**, identified in the **declaration** , shall be responsible for contacting and mobilizing the response organization, **ECRC at 613-930-9690**.

2.2.3.2 Port Contacts

As Ports of Call vary, MASTER to ensure that pprior t entering port any local contacts are obtained and displayed in MASTERS designated location. After departure contacts are to be added to manual and updated as necessary.

2.2.3.3 Vessel Interest Contacts

Vessel interest contacts are outlined on **page 31**

SECTION 3: Steps to Control Discharge

Ship personnel will most probably be in the best position to take quick action to mitigate or control the discharge of oil or noxious liquid substances from their ship

Therefore, this Plan provides the Master with clear guidance on how to accomplish this mitigation for a variety of situations.

It is the Master's responsibility to initiate a response in the event of a discharge of oil/NLS or substantial threat of discharge - actual or probable - into waters.

In no case action should be taken that in any way could jeopardize the safety of personnel either onboard or ashore.

In cases of a discharge of a noxious liquids substances the Master has to refer to the "Material Safety Data Sheet" (MSDS) provide onboard for any NLS cargo. Consideration to be made to any danger resulting from discharge of such substances, i.e. mixing with water, air, other materials / substances.

Special consideration is to be taken in case of the necessity to transfer cargo into another compartment onboard the compatibility of the material to be transferred and the material of pipes and tanks to be used for such actions.

In cases of small spills on deck, the vessel's crew should take whatever actions are necessary to prevent oil from escaping over the side. Once the spill is contained on deck, the crew will need to take action to clean up the oil. SPILLED OIL SHALL NOT BE WASHED OVER THE SIDE. Once oil is in the water, the crew's ability to respond in a practical manner is greatly reduced.

The following list specifies different kinds of possible operational spills with regard to reactions to be taken.

3.1 OPERATIONAL SPILLS

3.1.1 Operational Spill Prevention

All crew members shall maintain a close watch for the escape of oil or NLS during bunker or cargo operations.

Prior to bunker or cargo transfer the competent crew members should mobilize the spill equipment, as far as available on board, and place it close to the planned operation, e.g. along the railing on the side at which bunker operation takes place. All deck scuppers and open drains must be effectively plugged. Accumulations of water should be drained periodically and scupper plugs replaced immediately after the water has run off. Any free floating substances should be removed prior to draining.

Bunker or Cargo tanks which have been topped up should be checked frequently during the remaining operations to avoid an overflow.

Unless there are permanent means for retention of any slight leakage at ship / shore connections for bunker or cargo transfer, it is essential that a drip tray is in place to catch any leaking substance.

All crew members of the ship's crew should be familiar with the fundamentals of the ship's vital systems including the ventilation and electrical systems. Crew members should be able to isolate the accommodation and/or machinery spaces using the louvers and fan shutoffs and, from the distribution panels, isolate electrical circuits in areas of risk.

In the event of an operational spill which occurs during bunkering or cargo operations, it is important that the bunkering party terminate any and all bunkering operations and close all manifold valves.

Before closing any manifold valves, the bunkering / cargo party must immediately inform the terminal / loading master so that they may take action to eliminate the possibility of over-pressurization of the shore side transfer components.

After dealing with the cause of the spill, it may be necessary to obtain permission from local authorities and/or the terminal before resuming bunkering or cargo operations.

If the possibility of fire or explosion exists, nonessential air intakes to accommodations and machinery spaces should be closed and all sources of ignition should be eliminated. See Section 1.3.3 of this Plan.

Care must be taken to consider stability and stress when taking action to mitigate the spillage of oil. Internal transfers should be undertaken only with a full appreciation of the likely impact on the vessel's overall stress and stability. Please refer to the "Approved Stability Book" carried on board.

Operational Spill Checklist

Action Considered	Designated Person	Completed
Sound emergency alarm	Person Discovering Incident	Y / N
Mobilize Oil Pollution Prevention Team	Chief Engineer / Master	Y / N
Cease all bunkering operations	Chief / 2nd Engineer	Y / N
Locate source of leakage	Chief / 2nd Engineer	Y / N
Operate manifold valves	Chief / 2nd Engineer	Y / N
Close all nonessential vent intakes and tank vents as required	Chief / 2nd Engineer	Y / N
Stop or reduce outflow	Chief Engineer / Deckhand	Y / N
Assess fire risk	Chief Officer	Y / N
Commence clean up	Chief Officer	Y / N
Assess Stress / Stability	Master / Chief Officer	Y / N
Transfer fuel from damaged area to slack tanks or other containment space	Chief / 2nd Engineer	Y / N

Request outside assistance if required	Master	Y / N
Counter excessive list if required / possible	Chief Officer	Y / N

3.1.2 Pipeline Leakage

In the event of leakage from an oil / NLS pipeline, valve, hose or metal arm, the Chief Engineer must ensure that the following actions are taken:

- Stop oil flow, close manifold and other valves.
- Sound emergency alarm and mobilize Oil Pollution Prevention Team
- Locate source and drain affected section into an available empty or slack tank. Repair if possible
- If there is any possibility of vapours entering the engine room or accommodation intakes, appropriate preventative steps must be taken quickly.
- Absorb spill with any absorbent materials on hand and dispose of oil soaked materials in an appropriate container.
- If oil is overboard, report to proper authorities immediately (as per section 4 of this plan).

3.1.3 Tank Overflow

In the event of an oil tank overflow, the Chief Engineer must ensure that the following actions are taken:

- Stop oil flow, close manifold and other valves.
- Sound emergency alarm and mobilize Oil Pollution Prevention Team
- Place drain buckets under overflow pipes to contain possible spills.
- If there is any possibility of vapours entering the engine room or accommodation intakes, appropriate preventative steps must be taken quickly.
- Drain or transfer oil to slack or empty tanks if possible with due consideration paid to vessel stability. If no slack or empty tanks are available, oil may be pumped back ashore through delivery lines, having first gained permission to do so.
- Absorb spill with any absorbent materials on hand and dispose of oil soaked materials in an appropriate container.
- If oil is overboard, report to proper authorities immediately (as per section 4 of this plan).

3.1.4 Hull Leakage

If oil is noticed on the water near the vessel during normal operations and cannot be accounted for, the possibility of hull leakage should be suspected.

In the event of a hull leakage, the Master must ensure that the following actions are taken:

- Sound emergency alarm and mobilize Oil Pollution Prevention Team.
- Stop any transfer or bunkering operations.
- Identify damage and report to proper authorities immediately (as per section 4 of this plan). Consider a diver if necessary and possible.

- If possible, contain spill using materials on hand and dispose of oil soaked materials in an appropriate container.
- If there is any possibility of vapours entering the engine room or accommodation intakes, appropriate preventative steps must be taken quickly.
- Transfer fuel away from suspected leaks to empty or slack tanks if possible, or to a ballast tank if necessary. If in port, arrangements can be made to pump oil ashore to tanks or trucks. Due consideration is to be paid to vessel stress and stability.
- If it is not possible to identify the leaking tank, reduce level in all tanks in the vicinity, giving due consideration to vessel stress and stability.

3.1.5 Spills caused by Equipment in Machinery Spaces

- If operational spills are caused by failure of equipment in machinery spaces, any further operation of this equipment should be stopped immediately and measures are to be taken to avoid a spill. Such equipment may be
  - Oily - water separating equipment or oil filtering equipment or oil filtering equipment to de-oil bilge water from the engine room bilges.
  - Valves in pipes connecting ballast / cargo systems
  - Cooling pipes in cooler systems
  - Gearing of bow thruster
  - Stern tubes

- Sound emergency alarm and mobilize Oil Pollution Prevention Team.
- Absorb spill with any absorbent material in hand and dispose of oil soaked materials in an appropriate container.
- Do not restart equipment until problem has been rectified.

3.2 <u>Spills Resulting from Casualties</u>

In the event of a casualty the Master's first priority will be to ensure the safety of personnel and the vessel and initiate action to prevent escalation of the incident and marine pollution.

3.2.1 Ship grounded / stranded

If the vessel grounds, the Master must ensure that the following actions are taken:

- Sound emergency alarm, muster crew, and Mobilize Oil Pollution Prevention Team once safe to do so.
- Eliminate all avoidable sources of ignition and ban smoking onboard. Action bust be taken to prevent hazardous vapours from entering accommodation and machinery spaces. See section 1.1.3.
- Identify damage by means of a visual inspection.
- Take soundings around vessel to determine the nature and gradient of seabed.
- Check differences in tidal range at grounding site.
- Evaluate tidal current in grounding area.
- Take soundings of all tanks on shell and compare with departure soundings.

- Determine probability and/or quantity of oil released
- If oil release is determined or is probably, this is to be included in the casualty report.
- Determine other possible hazards to the vessel such as sliding off the grounding site or further damage from seas / swell, and torsion forces.

At this point, determine risk of additional damage to vessel by attempting to refloat. If remaining aground is determined to be less of a risk then:

- Use anchors to prevent vessel movement.
- Take on ballast in empty tanks with due consideration paid to stress and stability. Please refer to the approved stability book.
- Consider transfer of fuel from damaged tanks with due consideration paid to stress and stability. Please refer to the approved stability book.
- Reduce longitudinal stress on the hull by transfer of fluids internally. Please refer to the approved stability book.
- If the change in stability and stress cannot be calculated onboard, contact the vessel's management to arrange for the necessary calculations. Refer to appendix 3 for information which should be provided.

3.2.1.1 Prevention of Fire and Explosion

If a fire or explosion occurs on board, the vessel's fire control party must ensure that the following actions are taken:

- Sound emergency alarm, muster crew, and mobilize Oil Pollution Prevention Team once safe to do so.
- Determine extent of damage and what damage control measures can be taken.
- Determine whether there are casualties.
- Request assistance as deemed necessary.
- Take necessary actions to prevent smoke and other hazardous vapours from entering the accommodation and machinery spaces.
- Assess possibility of oil leakage.
- Determine possible actions to control the discharge of oil. This will depend largely on the damage to the ship and cargo.
- If there is a discharge or possible discharge of oil, this to be included in the casualty report.
- Should abandonment be necessary, the Master must ensure that every effort is made to maneuver survival craft upwind of any oil spill.

3.2.1.2 Hull Damage / Hull Failure / Containment Failure

If the vessel suffers structural hull failure, the Master must ensure that the following actions are taken:

- Sound emergency alarm, muster crew, and mobilize Oil Pollution Prevention Team once safe to do so.

- Reduce speed or stop to minimize stress on hull.
- Assess immediate danger of sinking or capsizing.
- Initiate damage control measures if possible.
- If lightening is required, all efforts should be made to wait for a barge or other ship to receive the cargo.
- If oil has spilled, or if it is necessary to jettison oil to maintain stability, make a report as per section 2.
- If the change in stability and stress cannot be calculated onboard, contact the vessel's management to arrange for the necessary calculations.
- Consider forecasted weather conditions and their effect on the situation.
- Should abandonment be necessary, the Master must ensure that every effort is made to maneuver survival craft upwind of any oil spill.

3.2.1.3 Procedures to reduce or Stop Outflow of Oil or NLS

The Master should assess the possibility of damage to the environment and whatever action can be taken to reduce further damage from any release, such as;

- Transfer /cargo internally, provided shipboard piping system is in an operational condition and in careful view of the compatibility of the substance and the tanks/pipes used for transfer, and taking into account the impact on the ship's overall stress and stability.
- Isolate damaged/penetrated tanks hermetically to ensure that hydrostatic pressure in tanks remains intact during tidal changes.
- Evaluate the necessity of transferring bunkers / cargo to barges or other ships and request such assistance accordingly.
- Evaluate the possibility of additional release of oil or NLS in close co-operation with coastal states.

In case of large differences between the tide levels, the Master should try to isolate the damaged tanks to reduce additional to reduce additional loss of substances.

3.2.1.4 Refloating by own means

The Master should also evaluate the question of refloating the vessel by own means. Before such an attempt is made, it must be determined:

- whether the ship is damaged in such a way that it may sink, break up or capsize after getting off
- whether the ship , after getting off, may have maneuvering problems upon leaving the dangerous area on its own.
- whether machinery, rudder or propeller are damaged due to grounding or may be damaged by trying to get off ground by own means.
- whether the ship may be trimmed or lightened sufficiently to avoid damage to other tanks in order to reduce additional pollution.
- weather evaluation; whether there is time/reason to await improvements in weather or tide.

- whether ship's structure permits refloating/consultation of GL Emergency Response Service
- whether all steps of Coastal Shipping Ltd. procedure "Grounding" have been complied with.

3.2.1.5 Securing the Ship

If the risk of further damage the ship is greater in an attempt to refloat the ship by own means, than in remaining aground until professional assistance has been obtained, the ship's Master should try to secure the ship as much as possible:

- Trying to prevent the ship from moving from its present position
- By dropping anchors (adequate water depth and anchor ground provided)
- By taking ballast into empty tanks, if possible
- Trying to reduce longitudinal strain on hull by transferring ballast or bunkers internally
- Reducing fire risk by removing all sources of ignition.

Inform in line with Section 2 all parties interested about Grounding and the actions taken so far.

3.2.2 Fire /Explosion

Should an explosion and a fire occur onboard, sound the GENERAL ALARM immediately. Further actions should be initiated in accordance with the ship's Muster List.
In case of fire and explosion the following priorities exist:

- Rescuing lives
- Limiting damage /danger to the ship and cargo
- Preventing environmental pollution

The Coastal Shipping Emergency Procedure **" Fire and Explosion"** in the file Emergency Preparedness should be complied with.

Steps to control the discharge of oil will depend largely on the damage to the ship and cargo. Special information thereto is contained in subparagraphs 3.2.4, 3.2.5 and 3.2.6.
Inform in line with Section 2 all parties interested about the Fire /Explosion and the actions taken so far.

3.2.3 Collision

The Master shall follow the emergency plan as given in Coastal Shipping Ltd Emergency procedure "Collision" in file: Emergency Preparedness as follows:

- Sound emergency alarm, muster crew, and mobilize Oil Pollution Prevention Team once safe to do so.
- Determine whether there are casualties.
- If there is a possibility of fire or explosion, eliminate all avoidable sources of ignition and ban smoking onboard. Action should be taken to prevent flammable vapours from entering the accommodation and machinery spaces. .

- Decide whether separation of vessels may cause or increase spillage of oil, or increase the risk of sinking.
- If any oil tanks are penetrated, isolate these tanks or transfer oil to slack or empty tanks with due attention paid to stress and stability of the vessel. Please refer to the approved stability book.
- If there is an oil spill, make a report as per section 4.
- If possible to maneuver, the Master, in conjunction with the appropriate shore authorities should consider moving his ship to a more suitable location in order to facilitate emergency repair work or lightening operations, or to reduce the threat posed to any sensitive shoreline areas.

3.2.4 Excessive List

Should the ship for some reasons suddenly start to list excessively during discharging/loading operations, or bunkering, all ongoing operations should be stopped immediately until the cause has been determined.

The Officer on duty should inform the Master and/or Chief Officer without delay.

The Master should try to determine the reason for excessive list, and take steps to rectify the situation and to stabilize the ship's condition:

- Check reasons for list
- Soundings / Ullage to be taken in all tanks
- Bunker / Ballast / Cargo pumps to be made ready
- Consider measures to minimize list in transferring liquid from one compartment to another
- Ensure water tightness of empty spaces
- Close all opening
- Secure vent pipes to avoid ingress of water
- If bunkering: Change to corrective tanks for rectifying the situation
- If ballasting/deballasting: Change to corrective tanks to rectify the situation
- If there is reason to believe that the list may cause any spill, notify as per Section 4
- If the ship's crew is in jeopardy, prepare lifeboats for launching, and notify as per Section 4

If the situation is brought under control, inform all parties interested.

3.2.5 Dangerous reaction of cargo

In case of spillage of NLS cargo on deck, to the sea or incidents mixture with other cargo through internal tanks leakage consider dangerous reactions of such mixture. Promptly consult the Material Sheet Data Sheet (MSDS) available for the cargo shipped to the information provided. Take necessary actions for the safety of the crew for the case of (possible) contamination with spilled material or its vapours

3.2.6 Other dangerous cargo and/or vapour release

In case release of dangerous liquid noxious substances take necessary actions for the protection of the crew against health hazards, especially by contamination with materials or its toxic vapours. Avoid material or vapours spreading over the ship. If any dangerous material or vapour is released from any part of the containment system, take arrangements to free the deck area as far as possible by turning the ship to have the accommodation upwind of the point of release.

Evacuate crew members from the endangered area. If persons have to carry out any unavoidable duties within the endangered area, care for the personal protection for those persons to avoid direct contact.
All possible sources of ignition should be eliminated and non-essential air intakes shut down to prevent intake of vapour into accommodation and engine spaces.

Take measures to reduce tanks level or pressure to stop any emission of material or vapour.

Report about such spillage to nearest coastal state in order to arrange precautionary measures for the environment.

3.2.7 Loss of tank environmental control

Consider any hazards arising out of loss of environmental control in view of possible explosion dangers by contacting the Material Safety Data Sheets (MSDS) of the cargo concerned.
Avoid any intake of air into the uncontrolled spaces to avoid a dangerous mixture to be built within the respective.

3.2.8 Ship submerged/foundered/wrecked

If the ship is wrecked to the extent that it or parts of it are submerged, take all measures to evacuate all persons onboard. Avoid contact with any spilled cargo or oil . Alert other shops and/or the nearest coastal state for assistance in rescuing lives and the as far as possible.

3.3 Priority Actions

Top priority shall in all cases of emergency be put on the safety of the persons onboard and to take actions to prevent escalation of the incident.
Immediate consideration should be given to the protective measures against fire, fire explosions and personal exposure to toxic vapour.
Detailed information about damage sustained to the ship and its containment system has to be obtained.
On the basis of the information the Master can decide next actions for the protection of lives, the ship, the cargo and the environment.
The Master should take into account the following when he is determining whether salvage assistance will be needed or not:

- Nearest land or hazard to navigation
- Vessel's set and drift

- Estimated time of casualty repair
- Determination of nearest capable assistance and its response time.

Detailed information about the cargo, especially NLS Cargo has to be available and to be referred to further actions regarding the cargo.

In case of necessary movement of cargo within the ship careful consideration is to be given to hull strength and stability as well as to the compatibility of all material. (cargo, tanks, coating, piping) in view of any transfer actions planned.

Plans/tables about location and specification of the current cargo as well as bunkers and ballast have to be readily available.
Information about Current cargo/bunker/ballast distribution and the Material Safety Data Sheets (MSDS) for the carried cargo substances are available at:

- Cargo, bunkers, ballast distribution: Cargo Office
- Material Safety Data Sheets (MSDS); Alleyway opposite of the cargo office

3.4 Mitigating Activities

If safety of both the ship and the personnel has been addressed the Master shall care for the following issues:

- Assessment of the situation and monitoring of all activities as documented evidence
- Care for further protection of the personnel, use of protection gear, assessment of further risk for health and safety
- Containment of the spilled material by absorption and proper and safe disposal of all material onboard until proper delivery ashore under close guidance of the safety information given by the Product Data Sheet
- Decontamination of Personnel after finishing the cleanup process.

3.5 Transfer of Bunker/Cargo - Lightering

If the ship has sustained extensive structural damage, it may be necessary to transfer all or part of the cargo/bunker to another ship. In Ship to Ship transfer operations involving a specialized service ship, the Master of that ship will normally be in overall charge.
In the case of non-specialized ships the Master or other person in overall charge of the operation should be mutually agreed and clearly established by the Masters concerned prior to the start of operations.
The actual bunker/cargo transfer should be carried out in accordance with the requirements of the receiving ship.
In all cases each Master remains responsible for the safety to be jeopardized by the action of the other Master, his owner, regulatory officials or others.

The ship to ship transfer operations should be coordinated with the appropriate responsible local Authority. When selecting the area of operation the Masters should consider the following points:

- The need to notify and obtain the agreements of any responsible authority
- The destinations of the ships concerned
- The shelter provided, particularly from sea and swell
- The sea area and depth of water, which should be sufficient for maneuvering during mooring, unmooring, and transfer operations and allow a safe anchorage if operations have to be undertaken at anchor
- The traffic density
- The weather conditions and weather forecasts.

Further, before commencing Ship to Ship Transfer operations each ship should carry out, as far as possible, appropriate preparations like

- Pre-mooring preparations of the ship
- Positioning of fenders if such equipment is available on board
- Mooring equipment arrangements
- Checking the communication channels between the two ships.

In addition to the general principles of Ship to Ship operations as aforementioned the Master should take note of supplemented instructions issued in the Coastal Shipping Ltd bunkering procedures.

3.6 Damage Stability and Hull Stress Calculation

Whenever the tank status changes in the course of the incident the stability and stress of the vessel has to be checked using the class approved cargo computer.

In case of hull damage stability shall instantly be checked using the appropriate application of the cargo computer. The damage control plan should be referred to. In addition to that the **GL Emergency Response Service** is to be consulted for proper stress and stability calculations.

Whenever possible the contact to the **GL Emergency Response Service** will be via Coastal Shipping Ltd. office in order to reduce the workload onboard.
Otherwise the vessel can contact the **GL Emergency Response Service** directly using the following numbers:

Phone: **011-49-40-3614-9134**
Mobile: **011-49-172-405-9713**
Fax: **011-49-40-361-493-620**
email: **matthias.galle@gl-group.com**

Vessel Stress and Stability Information

VOYAGE PARTICULARS

Departure Port

Departure Date

Time (GMT)

VESSEL CONDITION IMMEDIATELY BEFORE CASUALTY

Mean Draft Forward

Mean Draft Aft

KG(solid)

KG(fluid)

LCG of Vessel

Condition of Tanks and Compartments

#	COMPARTMENT	S.G.	TONNES

3.7 General Responsibilities of the Master and designated Officers / crew members

The responsibilities of the Master Officers and the crew onboard in the event of a spill actual or probable to bring the accident under control on board, limit overflows or cleanup procedures, and to secure the ship immediately if an incident occurs.

The following is an example which can be used by the Master to aid in designating officers. Should changes to the team be made, please make a record in this section :

Master
Chief Mate
Chief Engineer

In the event of an emergency, the team should be called out as soon as it is safe to do so.

The team should be given necessary training in the use of such equipment as oil absorbents that the vessel may carry. All members crew should be aware of their duties should an oil spill occur.

Master

- In overall charge.
- Informs terminal authorities or coastal authorities of incident.
- Informs the local agent and requests agent to inform the local underwriter’s representative.
- Advises the company’s head office of the situation. Keeps everyone updated at regular intervals. and advises of any changes in status of the emergency.
- Keeps log of all events and progress of actions.

Chief Mate

- In charge of deck / cargo operations.
- In charge of lifeboats if required.
- Keeps the Master informed and updated on the situation and of the results of steps taken to contain any spills and limit outflow.
- Insures all openings in the deck and superstructure are closed to limit vapour entry.
- Position sorbent / clean up material to prevent any fluid escape.

Chief Engineer

- In charge of bunkering operations.
- Organizes distribution of oil spill detergents if required.
- Stops bunkering operations if applicable.
- Stops pumps and any unnecessary pieces of machinery.

Other Personnel

Deck Officer on duty

- Alerts and informs Chief Officer / Chief Engineer on the situation.

- Mobilize off duty crew as necessary.

Engineer on duty

- Assist the Chief Engineer.
- Prepare for fire fighting.
- Ensure sufficient power and water to deck.
- Organizes onboard clean up equipment.

Deck Officer off duty

- Under the direction of the Master, responsible for the reporting and record keeping of all events.

On duty Ratings

- Alerts the Officer on duty of any leakage.
- Position sorbent / clean up material to prevent any fluid escape.

Off duty personnel

- Assist as required

SECTION 4: National and Local Co-Ordination Steps to Control Discharge

In accordance with the Canadian Pollutant Discharge Reporting Regulations, the Master or Owner of a ship must report, without delay, any discharge or anticipated discharge of a pollutant in Canadian waters or fishing zones, to a Pollution Prevention Officer (PPO). Reports must be made in the manner described in Guidelines for Reporting Incidents Involving Dangerous Goods, Harmful Substances and/or Marine Pollutants, TP 9834, or "General Principles for Ship Reporting Systems and Ship Reporting Requirements, including Guidelines for Reporting Incidents Involving Dangerous Goods, Harmful Substances and/or Marine Pollutants" adopted by the IMO by Resolution A.851(20). These initial reports can be made to Marine Communication and Traffic Service (MCTS) or any other Canadian Coast Guard Radio Station (CGRS), on the frequencies listed in the publication, Radio Aids to Marine Navigation (RAMN).

Alternatively, spills may be reported to the appropriate regional center or nearest Vessel Traffic Service Center on VHF channel 16:

CANADA

Atlantic Region

St. John's, NL	Tel:	1-800-563-9089
Halifax, NS	Tel:	1-800-565-1633

Central & Arctic Region

Quebec City, QC	Tel:	1-800-363-4735
Sarnia, ON	Tel:	1-800-265-0237

Western Region

Vancouver, BC	Tel:	1-800-889-8852

GREENLAND

Spill Notification Point

Joint Arctic Command	Tel:	+299 36 40 00
MRCC Greenland	Fax:	+299 36 40 29
Aalisartut Aqquttaat 47	Email:	ako@mil.dk
Po Box 1072, 3900 Nuuk, Greenland		ako-commcen@mil.dk

Competent National Authority

Greenland Bureau of Minerals and Petroleum (BMP)	Tel:	(+299) 34 68 00
Imaneq 1A 201,	Fax:	(+299) 32 43 02
PO Box 930, 3900 Nuuk, Greenland	Email:	bmp@nanoq.gl
	Web:	www.bmp.gl

Note:

The following contacts have been included as they are within the expected range of operation of the Vessel. Due to the nature of the Vessel's voyages and varied ports of call this list should not be considered exhaustive. For this reason space has been included at the end of this section for addenda.

Within Canada, administrative inquiries related to pollution prevention, compliance and enforcement, vessel regulations, design and construction should be directed to:

Transport Canada
Marine Safety and Security
330 Sparks Street
Ottawa, Ontario
K1A 0N5
Tel: (613) 998-0610 Fax: (613) 954-1032

Inquiries relating to pollution response should be directed to:

Commissioner
Canadian Coast Guard
Department of Fisheries and Oceans
6th Floor, Centinnial Towers
200 Kent Street
Ottawa, Ontario
K1A 0E6
Tel: (613) 990-0999/7728 Fax: (613) 990-1866 Email: info@dfo-mpo.gc.ca

ECRC East Coast Response Corporation
1201-275 Slater Street
Ottawa, Ontario
K1P 5H9
Tel:(613) 230-7369

Additional Contact Information

Region	
Spill Notification Point	Contact Numbers

Region	
Spill Notification Point	Contact Numbers

Region	
Spill Notification Point	Contact Numbers

Region	
Spill Notification Point	Contact Numbers

VESSEL INTEREST CONTACTS

VESSEL MANAGEMENT

Coastal Shipping Limited (Owners)
P. O. Box 300, Station C
Happy Valley-Goose Bay, NL
A0P 1C0
Canada
Ph: (709) 896-2421
Fax: (709) 896-5028

24 HOUR EMERGENCY CONTACTS

General Manager	Dennis White	(709) 896-2421 work (709) 896-1404 cell (709) 896-2870 home
Engineering Superintendent	Jim Babij	(709) 579-6127 work (709) 727-5065 cell (709) 576-0160 home
	Kevin Brewer	(709) 579-6127 work (709) 682-0826 cell (709) 227 2600 home
Fleet Manager	Phillip John	(709) 535-6944 work (709) 541-1807 cell pjohn@woodwards.nf.ca
Designated Person Ashore	Craig Whiteway	(709) 834-1320 work (709) 727-4848 cell cwhiteway@woodwards.nf.ca

APPENDICES:

Appendix I:

- **Spill Equipment Inventory**

Appendix II:

- **General Arrangement**
- **Layout of General Arrangement Stowage Plan**
- **Diagram of Fuel Bunkering**
- **Tank Plan**
- **Capacity Plan**
- **Diagram of Fuel Service Lines**
- **Lubricating Oil System**
- **Stripping System**

APPENDIX I

SPILL EQUIPMENT "MT ALSTERSTERN"

LOCATION PLAN

Date Checked (dd/mm/yy):

Quantity	Unit	Description
		BOX 2 (CATWALK)
100	Pcs	Oil sorbent pads / sheets
1	Bag	Sorbent boom
2	Bags	Saw Dust
2	Bags	Granules
		BOX 3 (CATWALK)
3	Pcs	Compressed air breathing apparatus
1	Pc	Chemical suit (gas tight)
2	Pairs	Rubber boots
2	Pcs	Safety lamp
2	Pcs	Face mask
3	Pcs	Safety goggles
2	Pcs	Rubber gloves
3	Pcs	CHEMTEX chemical clothing
		BOX 4 (CATWALK)
2	Pcs	Sorbent blanket
2	Bags	Sorbent boom
25	Ltr.	Oil spill dispersant (SEACARE)
1	Pc	Pressure sprayer
1	Pc	Non sparking shovel
2	Pcs	Safety goggles
2	Pairs	Rubber gloves
2	Pairs	Rubber boots
2	Pcs	Plastic scoop
2	Pcs	Galvanized scoop
2	Pcs	Rain suit
		BOX 5 (BLOWER EXHAUST)
2	Bags	Saw dust
2	Bags	Granules
		BOX 6 (ACCOMMODATION)
2	Pcs	Compressed air breathing apparatus
2	Pcs	Chemical suit (gas tight)
2	Pcs	Safety helmet
2	Pcs	Safety lamp
1	Pc	Air drill
2	Pcs	Safety goggles
2	Pairs	Gloves
2	Pairs	Rubber boots
		SAFETY LOCKER #415
7	Pcs	Foam spray (Montage Schaum)
		FORECASTLE
4	Bags	Saw dust
		AFT WET LOCKER
14	Bags	Saw dust
5	Bags	Granules

****TO BE CHECKED MONTHLY AND DATE OF INSPECTION RECORDED****

APPENDIX II

STEAMSHIP MUTUAL

CERTIFICATE OF ENTRY AND ACCEPTANCE

This is to certify that the ship below has been entered for insurance in
The Steamship Mutual Underwriting Association (Bermuda) Limited
for

Class 1 - Protection and Indemnity

With effect from

Noon G.M.T 20/02/2013 to Noon G.M.T 20/02/2014

until sold, lost, withdrawn or the entry is terminated in accordance with the Rules, to the extent specified and in accordance with the Act, Bye-Laws and the Rules from time to time in force and the special terms specified overleaf.

For the account of:

Coastal Shipping Ltd (Owner)

and Joint Members, if any, under Rule 9 (i) as listed overleaf

whose names have been entered in the Register of Members of the Club as a Member.

Vessel Name:	**"DORSCH"**		
Gross Tonnage:	**6,729**	Built:	**1980**
Class:	**GL**	IMO no:	**8007195**
Port of Registry:	**ST. JOHN`S, NFL.**		

THIS CERTIFICATE OF ENTRY IS EVIDENCE ONLY OF THE CONTRACT OF INDEMNITY INSURANCE BETWEEN THE ABOVE NAMED MEMBER(S) AND THE ASSOCIATION AND SHALL NOT BE CONSTRUED AS EVIDENCE OF ANY UNDERTAKING, FINANCIAL OR OTHERWISE, ON THE PART OF THE ASSOCIATION TO ANY OTHER PARTY.
IN THE EVENT THAT A MEMBER TENDERS THIS CERTIFICATE AS EVIDENCE OF INSURANCE UNDER ANY APPLICABLE LAW RELATING TO FINANCIAL RESPONSIBILITY, OR OTHERWISE SHOWS OR OFFERS IT TO ANY OTHER PARTY AS EVIDENCE OF INSURANCE, SUCH USE OF THIS CERTIFICATE BY THE MEMBER IS NOT TO BE TAKEN AS ANY INDICATION THAT THE ASSOCIATION THEREBY CONSENTS TO ACT AS GUARANTOR OR TO BE SUED DIRECTLY IN ANY JURISDICTION WHATSOEVER. THE ASSOCIATION DOES NOT SO CONSENT.

NOTES

1. REFERENCE IS REQUESTED TO THE RULES AS TO THE CIRCUMSTANCES OF ENTRY BEING CANCELLED AND AS TO THE CIRCUMSTANCES OF AN ALTERATION IN THE RULES OR BYE-LAWS.

2. THE RULES ARE PRINTED ANNUALLY IN BOOK FORM, INCORPORATING ALL PREVIOUS ALTERATIONS AND A COPY IS SENT TO EACH MEMBER. ALTERATIONS CAN BE MADE BY ORDINARY RESOLUTION FOLLOWING A GENERAL MEETING NOTIFIED TO ALL MEMBERS.

3. THIS CERTIFICATE OF ENTRY SUPERSEDES ANY PREVIOUS CERTIFICATE OF ENTRY IN RESPECT OF THESE RISKS AND ENTERED SHIP(S). SAVE AS OTHERWISE EXPRESSLY PROVIDED HEREIN ANY SUCH PREVIOUS CERTIFICATE OF ENTRY SHALL REMAIN IN FULL FORCE AND EFFECT UP TO THE DATE OF THIS CERTIFICATE OF ENTRY.

STEAMSHIP MUTUAL MANAGEMENT (BERMUDA) LTD.
MANAGERS

Hamilton, Bermuda - 07/02/2013

Certificate Number - 43113/ 1

Heather J. Cooper

STEAMSHIP MUTUAL

Limit of Liability

Cover hereunder for all claims in respect of Oil Pollution shall be limited to US$ 1,000,000,000 each vessel any one accident or occurrence.

Inclusions of Cover

Cover as per Rules including but not limited to:

Liabilities in respect of Cargo in accordance with Rule 25 xiii and/save as may be more particularly set out in this Certificate of Entry.

Liability to Persons including Crew for illness, injury or death in accordance with Rule 25 i-iii, and/save as may be more particularly set out in this Certificate of Entry.

Liability for Loss of or Damage to Fixed and Floating Objects (including docks, jetties etc.) in accordance with rule 25 vii and/save as may be more particularly set out in this Certificate of Entry.

Liabilities in respect of Pollution in accordance with Rule 25 vi and/save as may be more particularly set out in this Certificate of Entry.

Liabilities in respect of Wreck Removal in accordance with Rule 25 xi and/save as may be more particularly set out in this Certificate of Entry.

Subject to the Rules and the Member's terms of entry this vessel is covered for trading to Arctic Waters.

Warranties

Vessel carrying non-persistent oil cargoes only, or held covered at terms and conditions to be agreed.

Trading between 15th June and 30th November annually, and to be laid-up at a safe port with less than 1/4 crew onboard for the remainder of the time

Trading Canadian waters only

Deductibles

US$5,235 - from all other cargo claims, each single voyage.

US$4,000 - from all other claims, any one accident or occurrence.

Other Conditions

Sanctions Clause

Heather J. Cooper

It is a condition of this insurance that no coverage will be provided and no entries will be accepted in respect of:

1. Vessels owned, managed, operated or chartered by a party (who need not be a Member or prospective Member of the Club); and/or

2. Vessels;

designated under any legislation, regulation or order of any State or International Organisation which howsoever exposes those vessels and/or the Club and/or the Member entering such vessels and/or any other Member of the Club to the risk of being or becoming subject to any sanction, prohibition or adverse action whatsoever.

If, notwithstanding this condition,

(a) a vessel, in relation to which cover has been provided, or the entry of which has been accepted by the Club (whether or not a certificate of entry has been issued) ; or

(b) such vessel's owner, manager, operator or charterer, (whether or not a Member of the Club)

is or becomes so designated, the entry of that vessel and/or the coverage provided to the Member, shall cease forthwith and no claims, liabilities, costs or expenses shall be paid by or recoverable from the Club in relation thereto.

In the event that any vessel entered (whether or not a certificate of entry has been issued), or a vessel in relation to which cover has been provided, is employed on any voyage, in any trade, or for the carriage of cargo in breach of any legislation, regulation or order of any State or International Organisation which howsoever exposes the Club to the risk of being or becoming subject to any sanction, prohibition or adverse action whatsoever, the insurance of that vessel and/or the coverage provided to the Member shall cease forthwith and no claims, liabilities, costs or expenses in relation thereto, and arising after the date of such cessation, shall be recoverable hereunder. Save that at any time after such cessation, if the Directors in their absolute discretion so determine, that vessel's entry in the Club or the coverage in relation to that vessel, may be reinstated on such terms and conditions and from such date and time as the Directors or the Managers direct.

Crew Clauses

CANADIAN COMPENSATION EXCLUSION CLAUSE

Excluding any and all liability to crew and/or others employed on or about the vessel under any and all Workmens' Compensation Acts or equivalent legislation applicable under Canadian Federal or Provincial Law

Premium

Cancelling Returns only.

Heather J. Cooper

Additional Parties

Joint Members

The cover afforded to:

1. Woodwards Oil Ltd (Other)
2. Labrador Leasing Ltd (Operator)
3. Labrador Motors Ltd (Operator)
4. Woodwards Ltd (Other)
5. Arctic Services Ltd (Other)

as Joint Member shall extend only to risks, liabilities, costs and expenses arising out of operations and/or activities customarily carried on by or at the risk and responsibility of shipowners and which are within the scope of the cover provided under the terms, conditions and exceptions provided by the Rules and by this Certificate of Entry.

The conduct of any one Joint Member which is sufficient to bar that Joint Member's right of recovery under the terms, conditions and exceptions provided by the Rules and by this Certificate of Entry shall bar absolutely the rights of recovery of all Joint Members thereunder.

All Joint Members shall be jointly and severally liable to pay contributions due to the Club in respect of this entry, and the receipt by any one Joint Member of any sums payable by the Club in respect of this entry shall be sufficient discharge of the Club for the same.

There shall be no recovery out of the funds of the Club in respect of any liability, costs and expenses arising out of or as a result of any claim, dispute or difference between any Joint Members, affiliates and/or any others insured to any extent under one entry.

Loss Payable Clause

Payment of any recovery the Owner is entitled to receive out of the funds of the Association in respect of any liability, costs or expenses incurred by him shall be made to the Owner or to his order unless and until the Association receives notice from:

The Royal Bank of Canada

that the Owner is in default under the Mortgage, in which event all recoveries shall thereafter be paid to:

The Royal Bank of Canada

or their order; provided always that no liability whatsoever shall attach to the Association, its Managers or their Agents for failure to comply with the latter obligation until after the expiry of two clear business days from the receipt of such notice. The Association shall, unless it receives from the Mortgagee notice to the contrary, be at liberty at the request of the Owner to provide bail or other security to prevent the arrest or obtain the release of the vessel, without liability to the Mortgagee.

Affiliated Companies Clause
It is noted that cover has been extended as follows, subject to the terms of Rule 9 (ii):

Heather J. Cooper

Should a claim in respect whereof a Member named in this Certificate of Entry is insured by the Association be made or enforced through an Affiliated, Associated or Subsidiary Company of such Member, the Association shall if so requested by the Member indemnify such Company against any loss which as a consequence thereof such Company shall have incurred in that capacity provided always that nothing herein contained shall be construed as extending to any amount which would not have been recoverable from the Association by the Member had such claim been made or enforced against him. Once the Association has made such indemnification it shall not be under any further liability and shall not make any further payment to any person or Company whatsoever, including the Member, in respect of that claim.

Conduct of any one of the parties insured under this entry which is sufficient to bar the insured's rights hereunder shall bar the rights of recovery of all the said insured.

Addenda

War Risk Extension Clause

1) Cover excluded under Rule 21 is hereby reinstated subject to the terms set out in this Certificate of Entry and any Endorsement thereto, and to the following conditions.

2) This special cover shall be subject to an excess of either:

a) the "proper value" of the entered ship as defined in the Note to Rule 25 xv, (which, for the purpose of this War Risk Extension only, shall be deemed not to exceed US$100 million), or
b) the amount recoverable in respect of the claim under any other policy of insurance, whether of war risks or otherwise,

whichever shall be the greater, save that such excess shall not apply where the entry of the ship is solely in the name of or on behalf of a Charterer other than a Charterer by Demise or Bareboat Charterer, provided that the Directors may authorise the payment, in whole or in part, of any claim or part of a claim which falls within such excess, if in their discretion and without having to give any reasons for their decision they decide that the Owner should recover from the Club.

3) Subject to the exception set out below, the limit applying to this special cover shall be US$500 million, any one event each vessel or any limit set out elsewhere in this Certificate, whichever shall be the lesser.

4) All perils included in the special cover shall be subject to the following:

Chemical, Biological, Bio-chemical, Electromagnetic Weapons and Computer Virus Clause:

In no case shall this insurance cover loss damage liability or expense directly or indirectly caused by or contributed to by or arising from
a) any chemical, biological, bio-chemical or electromagnetic weapon;
b) the use or operation, as a means for inflicting harm, of any computer virus.

5) At any time or times before, or at the commencement of, or during the currency of any Policy Year of the Club, the Directors may in their discretion determine that any ports, places, countries, zones or areas (whether of land or sea) be excluded from the insurance provided by this P&I war risks cover. Save as otherwise provided by the Directors, this P&I war risks cover shall cease in

Heather J. Cooper

respect of such ports, places, countries, zones or areas at midnight on the seventh day following the issue to the Members of notice of such determination in accordance with the terms of the cover provided pursuant to Rule 21 of the Club's Rules. Unless and to the extent that the Directors in their discretion otherwise decide there shall be no recovery from the Club under this P&I war risks cover in respect of any claim howsoever arising out of any event, accident or occurrence within the said area after such date.

6) Whether or not notice has been given under Clause (5) above, this P&I war risks cover shall terminate automatically:

i) upon the outbreak of war (whether there be a declaration of war or not) between any of the following countries:

United Kingdom, United States of America, France, the Russian Federation, the People's Republic of China and this insurance excludes loss, damage, liability or expense arising from such outbreak of war;

ii) in respect of any vessel, in connection with which cover is granted hereunder, in the event of such vessel being requisitioned either for title or use and this insurance excludes loss, damage, liability or expense arising from such requisition.

7) Notwithstanding any other term or condition of this insurance, the Directors may in their discretion cancel this special cover giving 7 days' notice to the Members (such cancellation becoming effective on the expiry of 7 days from midnight of the day on which notice of cancellation is issued by the Club and the Directors may at any time after the issue of notice of such cancellation resolve to reinstate special cover pursuant to the proviso to the terms of the cover issued pursuant to Rule 21 on such terms and conditions and subject to such limit as the Directors in their discretion may determine.

8) When either a Demise, Time, Voyage, Space or Slot Charterer and/or the Owner of the Entered Ship are separately insured for losses, liabilities, or the costs and expenses incidental thereto covered under Rule 21 of the Club and/or the equivalent Rule of any other Association which participates in the Pooling Agreement and General Excess Loss Reinsurance Contract, the aggregate of claims in respect of such losses, liabilities, or the costs and expenses incidental thereto covered under Rule 21 of the Club and/or the equivalent Rule of such other Association(s), shall be limited to the amount set out in the Certificate of Entry in respect of any one ship, any one incident or occurrence. If such claims exceed this limit, the liability of the Club in respect of each Certificate of Entry shall be limited to that proportion of the limit that claims recoverable from the Club under that Certificate bear to the aggregate of the said claims recoverable from the Club and from such other Association(s), if any.

9) Cover for acts of terrorism as defined in the U.S. Terrorism Risk Insurance Act of 2002 (TRIA) is included hereunder, subject to the conditions set out above, the estimated cost of this element of coverage being US0.25 cents per entered gross ton.

10) The Club shall not provide insurance hereunder for any losses, liabilities, costs or expenses if the provision of such insurance would create a liability for the (Insured Owner) under the Tanker Oil Pollution Indemnification Agreement 2006 to contribute to the IOPC Supplementary Fund.

11) Sanctions Clause - Excluding coverage for liabilities, costs and expenses to the extent that the payment of any claim or the provision of any benefit in respect of those

Heather J. Cooper

liabilities, costs and expenses would expose the Club and/or their reinsurers hereunder to any sanction, prohibition or restriction under United Nations Resolutions or the trade or economic sanctions, laws or regulations of the European Union, United Kingdom or United States of America.

Bio-Chem Clause

1.1 Subject to the terms and conditions and exclusions set out herein, cover is extended to include the liability of the Member:
(a) To pay damages, compensation or expenses in consequence of the personal injury to or illness or death of any seaman (including diversion expenses, repatriation and substitute expense and shipwreck unemployment indemnity),
(b) For the legal costs and expenses incurred solely for the purpose of avoiding or minimising any liability or risk insured by an Association (other than under the Omnibus Rule)
1.2 Where such liability is not recoverable under either:
(a) cover provided by the Club for such liabilities, costs, losses and expenses as would be covered under the Rules but for the exclusion of war risks in Rule 21, or
(b) Any underlying war risk policies covering the same risks,
1.3 Solely by reason of the operation of an exclusion of liabilities, costs, losses and expenses directly or indirectly caused by or contributed to by or arising from :
(a) Any chemical, biological, bio-chemical or electromagnetic weapon
(b) the use or operation, as a means for inflicting harm, of any computer, computer system, computer software program, malicious code, computer virus or process or any other electronic system,
1.4 Other than liabilities, costs, losses and expenses arising from:
(i) Explosives or the methods of the detonation or attachment thereof
(ii) The use of the entered ship or its cargo as a means for inflicting harm, unless such cargo is a chemical or bio-chemical weapon.
(iii) the use of any computer, computer system or computer software program or any other electronic system in the launch and/or guidance system and/or firing mechanism of any weapon or missile.

2. Excluded Areas
2.1 The Directors may in their discretion decide that there shall be no recovery in respect of any liabilities, costs, losses and expenses directly or indirectly caused by or contributed to by or arising out of any event, accident or occurrence within such ports, places, zones or areas, or during such period as they may specify.
2.2 At any time or times before, or at the commencement of, or during the Policy Year, the Club may by notice to the Member change, vary, extend, add to or otherwise alter the ports, places, countries, zones and periods specified in Clause 2.1 from a date and time specified by the Club not being less than 24 hours from midnight on the day the notice is given to the Member.

3. Cancellation
Cover hereunder may by notice to the Member be cancelled by the Club from a date and time specified by the Club, not being less than 24 hours from midnight on the day notice of cancellation is given to the Member.

4. Limit of Liability
4.1 Subject to Clause 4.2 the limit of liability of the Club under this extension of cover in respect of all claims shall be in the aggregate US$30 million each ship any one accident or occurrence or series thereof arising from any one event.

Heather J. Cooper

4.2 In the event that there is more than one entry by any person for Bio-Chem cover as provided herein in respect of the same ship with the Club and/or any other insurer which participates in the Pooling Agreement or General Excess Loss Reinsurance Contract, the aggregate recovery in respect of all liabilities, costs, losses and expenses arising under such entries shall not exceed the amount stipulated in Clause 4.1 and the liability of the Club under each such entry shall be limited to such proportion of that amount as the claims arising under that entry bear to the aggregate of all such claims recoverable from the Club and any such other insurer.

5. Deductible
The deductible shall be the deductible applicable to the relevant cover set out in the Certificate of Entry.

6. Law and Practice
This clause is subject to English law and practice.

Association:
The Steamship Mutual Underwriting Association (Bermuda) Limited
Washington Mall 1, PO Box HM 447, Hamilton HM BX, Bermuda
Tel: (441) 295-4502 Fax: (441) 292-8787

Managers:
Steamship Mutual Management (Bermuda) Limited
Washington Mall 1, PO Box HM 447, Hamilton HM BX, Bermuda
Tel: (441) 295 4502 Fax: (441) 292 8787

Managers' London Representative:
Steamship Insurance Management Services Limited
Authorised and Regulated by the United Kingdom Financial Services Authority
Aquatical House, 39 Bell Lane, London E1 7LU
Tel: 020 7247 5490 Website: www.simsl.com
Registered No: 3855693 England

Heather J. Cooper

STEAMSHIP MUTUAL

CERTIFICATE OF ENTRY AND ACCEPTANCE

This is to certify that the ship below has been entered for insurance in
The Steamship Mutual Underwriting Association (Bermuda) Limited
for

Class 1 - Protection and Indemnity

With effect from

Noon G.M.T 20/02/2013 to Noon G.M.T 20/02/2014

until sold, lost, withdrawn or the entry is terminated in accordance with the Rules, to the extent specified and in accordance with the Act, Bye-Laws and the Rules from time to time in force and the special terms specified overleaf.

For the account of:

Coastal Shipping Ltd (Owner)

and Joint Members, if any, under Rule 9 (i) as listed overleaf

whose names have been entered in the Register of Members of the Club as a Member.

Vessel Name:	**"NANNY"**		
Gross Tonnage:	**6,544**	Built:	**1993**
Class:	**DNV**	IMO no:	**9051399**
Port of Registry:	**ST. JOHN`S, NFL.**		

THIS CERTIFICATE OF ENTRY IS EVIDENCE ONLY OF THE CONTRACT OF INDEMNITY INSURANCE BETWEEN THE ABOVE NAMED MEMBER(S) AND THE ASSOCIATION AND SHALL NOT BE CONSTRUED AS EVIDENCE OF ANY UNDERTAKING, FINANCIAL OR OTHERWISE, ON THE PART OF THE ASSOCIATION TO ANY OTHER PARTY.
IN THE EVENT THAT A MEMBER TENDERS THIS CERTIFICATE AS EVIDENCE OF INSURANCE UNDER ANY APPLICABLE LAW RELATING TO FINANCIAL RESPONSIBILITY, OR OTHERWISE SHOWS OR OFFERS IT TO ANY OTHER PARTY AS EVIDENCE OF INSURANCE, SUCH USE OF THIS CERTIFICATE BY THE MEMBER IS NOT TO BE TAKEN AS ANY INDICATION THAT THE ASSOCIATION THEREBY CONSENTS TO ACT AS GUARANTOR OR TO BE SUED DIRECTLY IN ANY JURISDICTION WHATSOEVER. THE ASSOCIATION DOES NOT SO CONSENT.

NOTES
1. REFERENCE IS REQUESTED TO THE RULES AS TO THE CIRCUMSTANCES OF ENTRY BEING CANCELLED AND AS TO THE CIRCUMSTANCES OF AN ALTERATION IN THE RULES OR BYE-LAWS.

2. THE RULES ARE PRINTED ANNUALLY IN BOOK FORM, INCORPORATING ALL PREVIOUS ALTERATIONS AND A COPY IS SENT TO EACH MEMBER. ALTERATIONS CAN BE MADE BY ORDINARY RESOLUTION FOLLOWING A GENERAL MEETING NOTIFIED TO ALL MEMBERS.

3. THIS CERTIFICATE OF ENTRY SUPERSEDES ANY PREVIOUS CERTIFICATE OF ENTRY IN RESPECT OF THESE RISKS AND ENTERED SHIP(S). SAVE AS OTHERWISE EXPRESSLY PROVIDED HEREIN ANY SUCH PREVIOUS CERTIFICATE OF ENTRY SHALL REMAIN IN FULL FORCE AND EFFECT UP TO THE DATE OF THIS CERTIFICATE OF ENTRY.

STEAMSHIP MUTUAL MANAGEMENT (BERMUDA) LTD.
MANAGERS

Hamilton, Bermuda - 07/02/2013

Certificate Number - 43117/ 1

Heather J. Cooper

Limit of Liability

Cover hereunder for all claims in respect of Oil Pollution shall be limited to US$ 1,000,000,000 each vessel any one accident or occurrence.

Inclusions of Cover

Cover as per Rules including but not limited to:

Liabilities in respect of Cargo in accordance with Rule 25 xiii and/save as may be more particularly set out in this Certificate of Entry.

Liability to Persons including Crew for illness, injury or death in accordance with Rule 25 i-iii, and/save as may be more particularly set out in this Certificate of Entry.

Liability for Loss of or Damage to Fixed and Floating Objects (including docks, jetties etc.) in accordance with rule 25 vii and/save as may be more particularly set out in this Certificate of Entry.

Liabilities in respect of Pollution in accordance with Rule 25 vi and/save as may be more particularly set out in this Certificate of Entry.

Liabilities in respect of Wreck Removal in accordance with Rule 25 xi and/save as may be more particularly set out in this Certificate of Entry.

Subject to the Rules and the Member's terms of entry this vessel is covered for trading to Arctic Waters.

Warranties

Vessel carrying non-persistent oil cargoes only, or held covered at terms and conditions to be agreed.

Trading between 15th June and 30th November annually, and to be laid-up at a safe port with less than 1/4 crew onboard for the remainder of the time

Trading Canadian waters only

Deductibles

US$5,235 - from all other cargo claims, each single voyage.

US$4,000 - from all other claims, any one accident or occurrence.

Other Conditions

Sanctions Clause

Heather J. Cooper

It is a condition of this insurance that no coverage will be provided and no entries will be accepted in respect of:

1. Vessels owned, managed, operated or chartered by a party (who need not be a Member or prospective Member of the Club); and/or

2. Vessels;

designated under any legislation, regulation or order of any State or International Organisation which howsoever exposes those vessels and/or the Club and/or the Member entering such vessels and/or any other Member of the Club to the risk of being or becoming subject to any sanction, prohibition or adverse action whatsoever.

If, notwithstanding this condition,

(a) a vessel, in relation to which cover has been provided, or the entry of which has been accepted by the Club (whether or not a certificate of entry has been issued) ; or

(b) such vessel's owner, manager, operator or charterer, (whether or not a Member of the Club)

is or becomes so designated, the entry of that vessel and/or the coverage provided to the Member, shall cease forthwith and no claims, liabilities, costs or expenses shall be paid by or recoverable from the Club in relation thereto.

In the event that any vessel entered (whether or not a certificate of entry has been issued), or a vessel in relation to which cover has been provided, is employed on any voyage, in any trade, or for the carriage of cargo in breach of any legislation, regulation or order of any State or International Organisation which howsoever exposes the Club to the risk of being or becoming subject to any sanction, prohibition or adverse action whatsoever, the insurance of that vessel and/or the coverage provided to the Member shall cease forthwith and no claims, liabilities, costs or expenses in relation thereto, and arising after the date of such cessation, shall be recoverable hereunder. Save that at any time after such cessation, if the Directors in their absolute discretion so determine, that vessel's entry in the Club or the coverage in relation to that vessel, may be reinstated on such terms and conditions and from such date and time as the Directors or the Managers direct.

Crew Clauses

CANADIAN COMPENSATION EXCLUSION CLAUSE

Excluding any and all liability to crew and/or others employed on or about the vessel under any and all Workmens’ Compensation Acts or equivalent legislation applicable under Canadian Federal or Provincial Law

Premium

Cancelling Returns only.

Heather J. Cooper

STEAMSHIP MUTUAL

Additional Parties

Joint Members

The cover afforded to:

1. Woodwards Oil Ltd (Other)
2. Labrador Leasing Ltd (Operator)
3. Labrador Motors Ltd (Operator)
4. Woodwards Ltd (Other)
5. Arctic Services Ltd (Other)

as Joint Member shall extend only to risks, liabilities, costs and expenses arising out of operations and/or activities customarily carried on by or at the risk and responsibility of shipowners and which are within the scope of the cover provided under the terms, conditions and exceptions provided by the Rules and by this Certificate of Entry.

The conduct of any one Joint Member which is sufficient to bar that Joint Member's right of recovery under the terms, conditions and exceptions provided by the Rules and by this Certificate of Entry shall bar absolutely the rights of recovery of all Joint Members thereunder.

All Joint Members shall be jointly and severally liable to pay contributions due to the Club in respect of this entry, and the receipt by any one Joint Member of any sums payable by the Club in respect of this entry shall be sufficient discharge of the Club for the same.

There shall be no recovery out of the funds of the Club in respect of any liability, costs and expenses arising out of or as a result of any claim, dispute or difference between any Joint Members, affiliates and/or any others insured to any extent under one entry.

Affiliated Companies Clause
It is noted that cover has been extended as follows, subject to the terms of Rule 9 (ii):

Should a claim in respect whereof a Member named in this Certificate of Entry is insured by the Association be made or enforced through an Affiliated, Associated or Subsidiary Company of such Member, the Association shall if so requested by the Member indemnify such Company against any loss which as a consequence thereof such Company shall have incurred in that capacity provided always that nothing herein contained shall be construed as extending to any amount which would not have been recoverable from the Association by the Member had such claim been made or enforced against him. Once the Association has made such indemnification it shall not be under any further liability and shall not make any further payment to any person or Company whatsoever, including the Member, in respect of that claim.

Conduct of any one of the parties insured under this entry which is sufficient to bar the insured's rights hereunder shall bar the rights of recovery of all the said insured.

Addenda

War Risk Extension Clause

1) Cover excluded under Rule 21 is hereby reinstated subject to the terms set out in this

Heather J. Cooper

Certificate of Entry and any Endorsement thereto, and to the following conditions.

2) This special cover shall be subject to an excess of either:

a) the "proper value" of the entered ship as defined in the Note to Rule 25 xv, (which, for the purpose of this War Risk Extension only, shall be deemed not to exceed US$100 million), or
b) the amount recoverable in respect of the claim under any other policy of insurance, whether of war risks or otherwise,

whichever shall be the greater, save that such excess shall not apply where the entry of the ship is solely in the name of or on behalf of a Charterer other than a Charterer by Demise or Bareboat Charterer, provided that the Directors may authorise the payment, in whole or in part, of any claim or part of a claim which falls within such excess, if in their discretion and without having to give any reasons for their decision they decide that the Owner should recover from the Club.

3) Subject to the exception set out below, the limit applying to this special cover shall be US$500 million, any one event each vessel or any limit set out elsewhere in this Certificate, whichever shall be the lesser.

4) All perils included in the special cover shall be subject to the following:

Chemical, Biological, Bio-chemical, Electromagnetic Weapons and Computer Virus Clause:

In no case shall this insurance cover loss damage liability or expense directly or indirectly caused by or contributed to by or arising from
a) any chemical, biological, bio-chemical or electromagnetic weapon;
b) the use or operation, as a means for inflicting harm, of any computer virus.

5) At any time or times before, or at the commencement of, or during the currency of any Policy Year of the Club, the Directors may in their discretion determine that any ports, places, countries, zones or areas (whether of land or sea) be excluded from the insurance provided by this P&I war risks cover. Save as otherwise provided by the Directors, this P&I war risks cover shall cease in respect of such ports, places, countries, zones or areas at midnight on the seventh day following the issue to the Members of notice of such determination in accordance with the terms of the cover provided pursuant to Rule 21 of the Club's Rules. Unless and to the extent that the Directors in their discretion otherwise decide there shall be no recovery from the Club under this P&I war risks cover in respect of any claim howsoever arising out of any event, accident or occurrence within the said area after such date.

6) Whether or not notice has been given under Clause (5) above, this P&I war risks cover shall terminate automatically:

i) upon the outbreak of war (whether there be a declaration of war or not) between any of the following countries:

United Kingdom, United States of America, France, the Russian Federation, the People's Republic of China and this insurance excludes loss, damage, liability or expense arising from such outbreak of war;

ii) in respect of any vessel, in connection with which cover is granted hereunder, in the event of such vessel being requisitioned either for title or use and this insurance excludes loss, damage,

Heather J. Cooper

liability or expense arising from such requisition.

7) Notwithstanding any other term or condition of this insurance, the Directors may in their discretion cancel this special cover giving 7 days' notice to the Members (such cancellation becoming effective on the expiry of 7 days from midnight of the day on which notice of cancellation is issued by the Club and the Directors may at any time after the issue of notice of such cancellation resolve to reinstate special cover pursuant to the proviso to the terms of the cover issued pursuant to Rule 21 on such terms and conditions and subject to such limit as the Directors in their discretion may determine.

8) When either a Demise, Time, Voyage, Space or Slot Charterer and/or the Owner of the Entered Ship are separately insured for losses, liabilities, or the costs and expenses incidental thereto covered under Rule 21 of the Club and/or the equivalent Rule of any other Association which participates in the Pooling Agreement and General Excess Loss Reinsurance Contract, the aggregate of claims in respect of such losses, liabilities, or the costs and expenses incidental thereto covered under Rule 21 of the Club and/or the equivalent Rule of such other Association(s), shall be limited to the amount set out in the Certificate of Entry in respect of any one ship, any one incident or occurrence. If such claims exceed this limit, the liability of the Club in respect of each Certificate of Entry shall be limited to that proportion of the limit that claims recoverable from the Club under that Certificate bear to the aggregate of the said claims recoverable from the Club and from such other Association(s), if any.

9) Cover for acts of terrorism as defined in the U.S. Terrorism Risk Insurance Act of 2002 (TRIA) is included hereunder, subject to the conditions set out above, the estimated cost of this element of coverage being US0.25 cents per entered gross ton.

10) The Club shall not provide insurance hereunder for any losses, liabilities, costs or expenses if the provision of such insurance would create a liability for the (Insured Owner) under the Tanker Oil Pollution Indemnification Agreement 2006 to contribute to the IOPC Supplementary Fund.

11) Sanctions Clause - Excluding coverage for liabilities, costs and expenses to the extent that the payment of any claim or the provision of any benefit in respect of those liabilities, costs and expenses would expose the Club and/or their reinsurers hereunder to any sanction, prohibition or restriction under United Nations Resolutions or the trade or economic sanctions, laws or regulations of the European Union, United Kingdom or United States of America.

Bio-Chem Clause

1.1 Subject to the terms and conditions and exclusions set out herein, cover is extended to include the liability of the Member:
(a) To pay damages, compensation or expenses in consequence of the personal injury to or illness or death of any seaman (including diversion expenses, repatriation and substitute expense and shipwreck unemployment indemnity),
(b) For the legal costs and expenses incurred solely for the purpose of avoiding or minimising any liability or risk insured by an Association (other than under the Omnibus Rule)
1.2 Where such liability is not recoverable under either:
(a) cover provided by the Club for such liabilities, costs, losses and expenses as would be covered under the Rules but for the exclusion of war risks in Rule 21, or
(b) Any underlying war risk policies covering the same risks,
1.3 Solely by reason of the operation of an exclusion of liabilities, costs, losses and expenses

Heather J. Cooper

directly or indirectly caused by or contributed to by or arising from :
(a) Any chemical, biological, bio-chemical or electromagnetic weapon
(b) the use or operation, as a means for inflicting harm, of any computer, computer system, computer software program, malicious code, computer virus or process or any other electronic system,
1.4 Other than liabilities, costs, losses and expenses arising from:
(i) Explosives or the methods of the detonation or attachment thereof
(ii) The use of the entered ship or its cargo as a means for inflicting harm, unless such cargo is a chemical or bio-chemical weapon.
(iii) the use of any computer, computer system or computer software program or any other electronic system in the launch and/or guidance system and/or firing mechanism of any weapon or missile.

2. Excluded Areas
2.1 The Directors may in their discretion decide that there shall be no recovery in respect of any liabilities, costs, losses and expenses directly or indirectly caused by or contributed to by or arising out of any event, accident or occurrence within such ports, places, zones or areas, or during such period as they may specify.
2.2 At any time or times before, or at the commencement of, or during the Policy Year, the Club may by notice to the Member change, vary, extend, add to or otherwise alter the ports, places, countries, zones and periods specified in Clause 2.1 from a date and time specified by the Club not being less than 24 hours from midnight on the day the notice is given to the Member.

3. Cancellation
Cover hereunder may by notice to the Member be cancelled by the Club from a date and time specified by the Club, not being less than 24 hours from midnight on the day notice of cancellation is given to the Member.

4. Limit of Liability
4.1 Subject to Clause 4.2 the limit of liability of the Club under this extension of cover in respect of all claims shall be in the aggregate US$30 million each ship any one accident or occurrence or series thereof arising from any one event.
4.2 In the event that there is more than one entry by any person for Bio-Chem cover as provided herein in respect of the same ship with the Club and/or any other insurer which participates in the Pooling Agreement or General Excess Loss Reinsurance Contract, the aggregate recovery in respect of all liabilities, costs, losses and expenses arising under such entries shall not exceed the amount stipulated in Clause 4.1 and the liability of the Club under each such entry shall be limited to such proportion of that amount as the claims arising under that entry bear to the aggregate of all such claims recoverable from the Club and any such other insurer.

5. Deductible
The deductible shall be the deductible applicable to the relevant cover set out in the Certificate of Entry.

6. Law and Practice
This clause is subject to English law and practice.

Association:
The Steamship Mutual Underwriting Association (Bermuda) Limited
Washington Mall 1, PO Box HM 447, Hamilton HM BX, Bermuda
Tel: (441) 295-4502 Fax: (441) 292-8787

Heather J. Cooper

STEAMSHIP MUTUAL

Managers:
Steamship Mutual Management (Bermuda) Limited
Washington Mall 1, PO Box HM 447, Hamilton HM BX, Bermuda
Tel: (441) 295 4502   Fax: (441) 292 8787

Managers' London Representative:
Steamship Insurance Management Services Limited
Authorised and Regulated by the United Kingdom Financial Services Authority
Aquatical House, 39 Bell Lane, London E1 7LU
Tel: 020 7247 5490   Website: www.simsl.com
Registered No: 3855693 England

Heather J. Cooper

ATLANTIC TOWING

WOODWARD

BAKER LAKE AREA OPERATIONAL PROCESSES

To further support safe operations in the Baker Lake area between Woodward and Atlantic Towing, the following information and procedures will be followed in the 2016 season.

1.0 COMMUNICATION PROTOCOL

Daily e-mail sent out by each vessel to all vessels by 8:00am. Distribution of e-mail would include all ATL, Woodward and Desgagnes vessels in the area.

E-mail to include:

- Current position
- ETA thru narrows
- Communication equipment status

Long Distance Communication

- Primary – satellite phone
- Secondary – Sat-C

Short Distance Communication

- VHF communication – channel 16

2.0 ATL COMMUNICATION INFORMATION

Atlantic Beech

- E-mail: 43252810@stratosmobile.net
- Cellular: (902) 229-3904
- Satellite: 011-8707-6481-1379

Atlantic Teak

- E-mail: 432521310@stratosmobile.net
- Cellular: (506) 343-4539
- Satellite: 011-8707-6487-5881

ATL VHF working channel is 69

WOODWARD COMMUNICATION INFORMATION

*** 2016 Contacts found at the end of this document.

WOODWARD VHF working channel is 10

DESGAGNES TRANSARCTIK INC.

Sedna Desgaganes

- E-mail: captain.sedna@desgagnes.com
- Cellular: (581) 998-3961
- Satellite: (418) 907-1134

Zelada Desgaganes

- E-mail: captain.zelada@desgagnes.com
- Cellular: (581) 998-6295
- Satellite: (418) 241-6175

Master Claude A. Desgagnes

- E-mail: captain.claudea@desgagnes.com
- Cellular: (418) 802-8596
- Satellite: (418) 907-8409

Master Rosaire A. Desgaganes

- E-mail: captain.rosairea@desgagnes.com
- Cellular: (418) 254-2355
- Satellite: (514) 907-5719

<u>3.0 RULES OF THE WATER WAYS</u>

Note: Outbound refers to Tanker and/ or Tug & Barge leaving Baker Lake for Helicopter Island
Inbound refers to Tanker and/or Tug & Barge leaving Helicopter Island for Baker Lake

<u>Helicopter Island to Baker Lake</u>

Inbound ATL Tug will contact outbound Woodward Tanker by e-mail to get its transit time thru the narrows . Tug and barge will depart Helicopter Island 3 and ½ hours prior to the transit time of the Tanker. It takes 3 hours for the Tug and Barge to reach the narrows from Helicopter Island. This allows plenty of time for all 4 vessels to transit the narrows. A couple of minutes before entering

Inbound ATL Tug and Barge **<u>WILL ALWAYS</u>** depart Helicopter Island prior to inbound Woodward Tanker. Inbound Woodward Tanker **<u>WILL ALWAYS</u>** follow inbound ATL Tug and Barge until to entrance of Baker Lake (no passing). Inbound ATL Tug and Barge and inbound Woodward Tanker will communicate on VHF channel 16 and should give a "security call" on channel 16 before entering the channel (satellite used as back up). All vessels (inbound and outbound) will use VHF channel 16 for communication (satellite used as back up).

Inbound ATL Tug and Barge will pass thru the narrows first, followed by the inbound Woodward Tanker. Outbound Woodward Tanker will pass thru the narrows next, followed by the outbound ATL Tug and Barge.

<u>Baker Lake to Helicopter</u>

Outbound Woodward Tanker will depart for the narrows. When reaching the narrows, outbound Woodward Tanker **<u>WILL NEVER</u>** proceed until inbound traffic has cleared the narrows. Outbound Woodward Tanker will hold position above the narrows just south of Bannerman Island.

Outbound ATL Tug and Barge will depart for the narrows. When reaching the narrows, outbound ATL Tug and Barge **<u>WILL NEVER</u>** proceed until inbound traffic has cleared the narrows. Outbound ATL Tug and Barge will hold position above the narrows just south of Bannerman Island.

Once inbound vessel traffic has cleared the narrows, the outbound Woodward Tanker will proceed thru the narrows first. The outbound ATL Tug and Barge **<u>WILL ALWAYS</u>** proceed thru the narrows after the outbound Woodward Tanker. All vessels (inbound and outbound) will use VHF channel 16 for communication (satellite used as back up).

FUEL HOSE POSITIONING

The fuel hose from the Woodward Tanker will be connected to the far side of the vessel away from the spud barge. The fuel hose will lay directly to shore, where a support structure will guide the fuel hose along the shore line until it mates with the shore manifold. This eliminates the risk of the ATL Tug and Barge coming into contact with the fuel hose while departing/ arriving at the spud barge. Also, a tender will be near the cargo hose with a line in order to move the hose away from the tug and barge.

In case of foul weather, where the tug and barge must cast off in a hurry, pumping operations will be suspended for a very short period of time, while the tug and barge depart.

APPENDIX B - Transfer Conduit Annual Pressure Test

APPENDIX C - MSDS Jet-A and Diesel

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name : DIESEL FUEL

Synonyms : Seasonal Diesel, #1 Diesel, #2 Heating Oil, #1 Heating Oil, D50, Arctic Diesel, Farm Diesel, Marine Diesel, Low Sulphur Diesel, LSD, Ultra Low Sulphur Diesel, ULSD, Mining Diesel, Naval Distillate, Dyed Diesel, Marked Diesel, Coloured Diesel, Furnace special, Biodiesel blend, B1, B2, B5, Diesel Low Cloud (LC). Marine Gas Oil

Product code : 101802, 100107, 100668, 100658, 100911, 100663, 100652, 100460, 100065, 101796, 101793, 101795, 101792, 101794, 101791, 100768, 100643, 100642, 100103, 101798, 101800, 101797, 101788, 101789, 101787, 102531, 100734, 100733, 100640, 100997, 100995, 100732, 100731, 100994

Manufacturer or supplier's details

Petro-Canada
P.O. Box 2844, 150 - 6th Avenue South-West
Calgary Alberta T2P 3E3
Canada

Emergency telephone number

Suncor Energy: +1 403-296-3000;
Poison Control Centre: Consult local telephone directory for emergency number(s).

Recommended use of the chemical and restrictions on use

Recommended use : Diesel fuels are distillate fuels suitable for use in high and medium speed internal combustion engines of the compression ignition type. Mining diesels, marine diesels, MDO and naval distillates may have a higher flash point requirement.

Prepared by : Product Safety: +1 905-804-4752

SECTION 2. HAZARDS IDENTIFICATION

Emergency Overview

Appearance	Bright oily liquid.
Colour	Clear to yellow (This product may be dyed red for taxation purposes).
Odour	Mild petroleum oil like.

GHS Classification

Flammable liquids : Category 3

Acute toxicity (Inhalation) : Category 4

Skin irritation : Category 2

Carcinogenicity : Category 2

Specific target organ toxicity - single exposure : Category 3 (Central nervous system)

Specific target organ toxicity - repeated exposure : Category 2 (Liver, thymus, Bone)

Aspiration hazard : Category 1

GHS Label element

Hazard pictograms :

Signal word : Danger

Hazard statements : H226 Flammable liquid and vapour.
H304 May be fatal if swallowed and enters airways.
H315 Causes skin irritation.
H332 Harmful if inhaled.
H336 May cause drowsiness or dizziness.
H351 Suspected of causing cancer.
H373 May cause damage to organs (Liver, thymus, Bone) through prolonged or repeated exposure.

Precautionary statements : **Prevention:**
P201 Obtain special instructions before use.
P202 Do not handle until all safety precautions have been read and understood.
P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P233 Keep container tightly closed.
P240 Ground/bond container and receiving equipment.
P241 Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242 Use only non-sparking tools.
P243 Take precautionary measures against static discharge.
P260 Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264 Wash skin thoroughly after handling.
P271 Use only outdoors or in a well-ventilated area.
P280 Wear protective gloves/ eye protection/ face protection.
P281 Use personal protective equipment as required.
Response:
P301 + P310 IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician.
P303 + P361 + P353 IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340 + P312 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.

P308 + P313 IF exposed or concerned: Get medical advice/ attention.
P331 Do NOT induce vomiting.
P332 + P313 If skin irritation occurs: Get medical advice/ attention.
P362 Take off contaminated clothing and wash before reuse.
P370 + P378 In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
Storage:
P403 + P233 Store in a well-ventilated place. Keep container tightly closed.
P403 + P235 Store in a well-ventilated place. Keep cool.
P405 Store locked up.
Disposal:
P501 Dispose of contents/ container to an approved waste disposal plant.

Potential Health Effects

Primary Routes of Entry	:	Eye contact Ingestion Inhalation Skin contact Skin Absorption
Target Organs	:	Skin Eyes Respiratory Tract
Inhalation	:	May cause respiratory tract irritation. Inhalation may cause central nervous system effects. Symptoms and signs include headache, dizziness, fatigue, muscular weakness, drowsiness and in extreme cases, loss of consciousness.
Skin	:	Causes skin irritation.
Eyes	:	Causes eye irritation.
Ingestion	:	Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhoea. Aspiration hazard if swallowed - can enter lungs and cause damage.
Aggravated Medical Condition	:	None known.

Carcinogenicity:

IARC	No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
ACGIH	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.
OSHA	No component of this product present at levels greater than or

equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

NTP

No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Pure substance/mixture : Mixture

Hazardous components

Chemical Name	CAS-No.	Concentration (%)
kerosine (petroleum), hydrodesulfurized	64742-81-0	70 - 100 %
kerosine (petroleum)	8008-20-6	
fuels, diesel	68334-30-5	
fuel oil no. 2	68476-30-2	
Alkanes, C10-20-branched and linear	928771-01-1	0 - 25 %
Soybean oil, Methyl ester	67784-80-9	0 - 5 %
Rape oil, Methyl ester	73891-99-3	
Fatty acids, tallow, Methyl esters	61788-61-2	

SECTION 4. FIRST AID MEASURES

If inhaled : Move to fresh air.
Artificial respiration and/or oxygen may be necessary.
Seek medical advice.

In case of skin contact : In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.
Wash skin thoroughly with soap and water or use recognized skin cleanser.
Wash clothing before reuse.
Seek medical advice.

In case of eye contact : Remove contact lenses.
Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.
Obtain medical attention.

If swallowed : Rinse mouth with water.
DO NOT induce vomiting unless directed to do so by a physician or poison control center.
Never give anything by mouth to an unconscious person.
Seek medical advice.

Most important symptoms : First aider needs to protect himself.

and effects, both acute and delayed

SECTION 5. FIREFIGHTING MEASURES

Suitable extinguishing media	:	Dry chemical Carbon dioxide (CO2) Water fog. Foam
Unsuitable extinguishing media	:	Do NOT use water jet.
Specific hazards during firefighting	:	Cool closed containers exposed to fire with water spray.
Hazardous combustion products	:	Carbon oxides (CO, CO2), nitrogen oxides (NOx), sulphur oxides (SOx), sulphur compounds (H2S), smoke and irritating vapours as products of incomplete combustion.
Further information	:	Prevent fire extinguishing water from contaminating surface water or the ground water system.
Special protective equipment for firefighters	:	Wear self-contained breathing apparatus for firefighting if necessary.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Use personal protective equipment. Ensure adequate ventilation. Evacuate personnel to safe areas. Material can create slippery conditions.
Environmental precautions	:	If the product contaminates rivers and lakes or drains inform respective authorities.
Methods and materials for containment and cleaning up	:	Prevent further leakage or spillage if safe to do so. Remove all sources of ignition. Soak up with inert absorbent material. Non-sparking tools should be used. Ensure adequate ventilation. Contact the proper local authorities.

SECTION 7. HANDLING AND STORAGE

Advice on safe handling	:	For personal protection see section 8. Smoking, eating and drinking should be prohibited in the application area. Use only with adequate ventilation. In case of insufficient ventilation, wear suitable respiratory equipment. Avoid spark promoters. Ground/bond container and

equipment. These alone may be insufficient to remove static electricity.
Avoid contact with skin, eyes and clothing.
Do not ingest.
Keep away from heat and sources of ignition.
Keep container closed when not in use.

Conditions for safe storage : Store in original container.
Containers which are opened must be carefully resealed and kept upright to prevent leakage.
Keep in a dry, cool and well-ventilated place.
Keep in properly labelled containers.
To maintain product quality, do not store in heat or direct sunlight.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Components	CAS-No.	Value type (Form of exposure)	Control parameters / Permissible concentration	Basis
kerosine (petroleum), hydrodesulfurized	64742-81-0	TWA	200 mg/m3	ACGIH
kerosine (petroleum)	8008-20-6	TWA	100 mg/m3	NIOSH REL

Engineering measures : Use only in well-ventilated areas.
Ensure that eyewash station and safety shower are proximal to the work-station location.

Personal protective equipment

Respiratory protection : Use respiratory protection unless adequate local exhaust ventilation is provided or exposure assessment demonstrates that exposures are within recommended exposure guidelines. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Filter type : organic vapour cartridge or canister may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits. Protection provided by air-purifying respirators is limited. Use a positive-pressure, air-supplied respirator if there is any potential for uncontrolled release, exposure levels are unknown, or any other circumstances where air-purifying respirators may not provide adequate protection.

Hand protection

Material : neoprene, nitrile, polyvinyl alcohol (PVA), Viton(R). Consult your PPE provider for breakthrough times and the specific glove that is best for you based on your use patterns. It should be realized that eventually any material regardless of their imperviousness, will get permeated by chemicals. Therefore, protective gloves should be regularly checked for

		wear and tear. At the first signs of hardening and cracks, they should be changed.
Remarks	:	Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.
Eye protection	:	Wear face-shield and protective suit for abnormal processing problems.
Skin and body protection	:	Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place.
Protective measures	:	Wash contaminated clothing before re-use.
Hygiene measures	:	Remove and wash contaminated clothing and gloves, including the inside, before re-use. Wash face, hands and any exposed skin thoroughly after handling.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Bright oily liquid.
Colour	:	Clear to yellow (This product may be dyed red for taxation purposes).
Odour	:	Mild petroleum oil like.
Odour Threshold	:	No data available
pH	:	No data available
Pour point	:	No data available
Boiling point/boiling range	:	150 - 371 °C (302 - 700 °F)
Flash point	:	> 40 °C (104 °F) Method: closed cup
Auto-Ignition Temperature	:	225 °C (437 °F)
Evaporation rate	:	No data available
Flammability	:	Flammable in presence of open flames, sparks and heat. Vapours are heavier than air and may travel considerable distance to sources of ignition and flash back. This product can accumulate static charge and ignite.
Upper explosion limit	:	6 %(V)
Lower explosion limit	:	0.7 %(V)
Vapour pressure	:	7.5 mmHg (20 °C / 68 °F)

Relative vapour density	:	4.5
Relative density	:	0.8 - 0.88
Solubility(ies)		
Water solubility	:	insoluble
Partition coefficient: n-octanol/water	:	No data available
Viscosity		
Viscosity, kinematic	:	1.3 - 4.1 cSt (40 °C / 104 °F)
Explosive properties	:	Do not pressurise, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Runoff to sewer may create fire or explosion hazard.

SECTION 10. STABILITY AND REACTIVITY

Possibility of hazardous reactions	:	Hazardous polymerisation does not occur. Stable under normal conditions.
Conditions to avoid	:	Extremes of temperature and direct sunlight.
Incompatible materials	:	Reactive with oxidising agents and acids.
Hazardous decomposition products	:	May release COx, NOx, SOx, H2S, smoke and irritating vapours when heated to decomposition.

SECTION 11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure	Eye contact Ingestion Inhalation Skin contact Skin Absorption

Acute toxicity

Product:

Acute oral toxicity	Remarks: No data available
Acute inhalation toxicity	Remarks: No data available
Acute dermal toxicity	Remarks: No data available

Components:

kerosine (petroleum), hydrodesulfurized:

Acute oral toxicity	LD50 (Rat): > 5,000 mg/kg

Acute inhalation toxicity	LC50 (Rat): > 5.2 mg/l Exposure time: 4 hrs Test atmosphere: dust/mist
Acute dermal toxicity	LD50 (Rabbit): > 2,000 mg/kg
kerosine (petroleum):	
Acute oral toxicity	LD50 (Rat): > 5,000 mg/kg
Acute inhalation toxicity	LC50 (Rat): > 5 mg/l Exposure time: 4 h Test atmosphere: dust/mist
Acute dermal toxicity	LD50 (Rabbit): > 2,000 mg/kg
fuels, diesel:	
Acute oral toxicity	LD50 (Rat): 7,500 mg/kg
Acute dermal toxicity	LD50 (Mouse): 24,500 mg/kg
fuel oil no. 2:	
Acute oral toxicity	LD50 (Rat): 12,000 mg/kg
Acute inhalation toxicity	LC50 (Rat): 4.1 mg/l Exposure time: 4 h Test atmosphere: dust/mist

Skin corrosion/irritation

Product:

Remarks: No data available

Serious eye damage/eye irritation

Product:

Remarks: No data available

Respiratory or skin sensitisation

No data available

Germ cell mutagenicity

No data available

Carcinogenicity

No data available

Reproductive toxicity

No data available

STOT - single exposure

No data available

STOT - repeated exposure

No data available

SECTION 12. ECOLOGICAL INFORMATION

Ecotoxicity

Product:

Toxicity to fish	:	Remarks: No data available
Toxicity to daphnia and other aquatic invertebrates	:	Remarks: No data available
Toxicity to algae	:	Remarks: No data available
Toxicity to bacteria	:	Remarks: No data available

Persistence and degradability

Product:

Biodegradability	:	Remarks: No data available

Bioaccumulative potential

No data available

Mobility in soil

No data available

Other adverse effects

No data available

SECTION 13. DISPOSAL CONSIDERATIONS

Disposal methods

Waste from residues	:	The product should not be allowed to enter drains, water courses or the soil. Offer surplus and non-recyclable solutions to a licensed disposal company. Waste must be classified and labelled prior to recycling or disposal. Send to a licensed waste management company. Dispose of as hazardous waste in compliance with local and national regulations. Dispose of product residue in accordance with the instructions of the person responsible for waste disposal.
Contaminated packaging	:	Do not re-use empty containers.

SECTION 14. TRANSPORT INFORMATION

International Regulation

IATA-DGR

UN/ID No.	:	1202
Proper shipping name	:	Diesel fuel
Class	:	3
Packing group	:	III
Labels	:	3
Packing instruction (cargo aircraft)	:	366

IMDG-Code

UN number	:	1202
Proper shipping name	:	DIESEL FUEL
Class	:	3
Packing group	:	III
Labels	:	3
EmS Code	:	F-E, S-E
Marine pollutant	:	no

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

49 CFR

UN/ID/NA number	:	1202
Proper shipping name	:	Diesel fuel
Class	:	3
Packing group	:	III
Labels	:	3
ERG Code	:	128
Marine pollutant	:	no

Special precautions for user

Not applicable

SECTION 15. REGULATORY INFORMATION

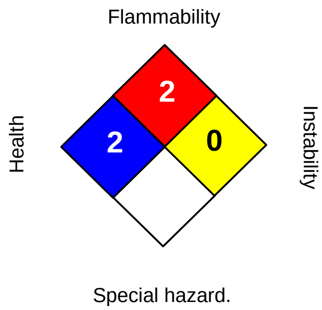
The components of this product are reported in the following inventories:

DSL	On the inventory, or in compliance with the inventory
TSCA	All chemical substances in this product are either listed on the TSCA Inventory or are in compliance with a TSCA Inventory exemption.
EINECS	On the inventory, or in compliance with the inventory

SECTION 16. OTHER INFORMATION

Further information

NFPA:



HMIS III:

HEALTH	2
FLAMMABILITY	2
PHYSICAL HAZARD	0
PERSONAL PROTECTION	H

0 = not significant, 1 =Slight,
2 = Moderate, 3 = High
4 = Extreme, * = Chronic

For Copy of (M)SDS : Internet: www.petro-canada.ca/msds
Canada-wide: telephone: 1-800-668-0220; fax: 1-800-837-1228
For Product Safety Information: 1 905-804-4752

Prepared by : Product Safety: +1 905-804-4752

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

APPENDIX D – MBK-ENV-0013

1.1 - Agnico Pre-discharge and Spill Response Sea Can checklists
1.2 - OHF Ship to Shore Fuel Discharge Procedure
1.3 - 2015 Mock Spill Minutes
1.4 - 2016 Meeting Minutes of Fuel Transfer Procedure Revision Meeting

Agnico Eagle Mines: Meadowbank Division
Environment Department

AGNICO EAGLE MEADOWBANK

Pre-discharge Checklist for AEM's Oil Handling Facility in Baker Lake

Date: ______________________ **Inspected By:** ____________________

Time: ____________________ **Vessel Unloading:** _________________

Pre-Discharge Check List	Conform	Non-Conform	Comments
Is there two way communications between the OHF and the off-loading Vessel?			
Has a review of response material checklist been completed?			
Current Copy of OPEP and Declaration at the OHF.			
Prior to discharge have the certification of the transfer conduits been received?			
Has there been secondary containment placed underneath each connection of Conduit?			
Is lighting in place at the transfer flange to provide illumination during any transfers taking place during the low to no light hours.			
Prior to discharge has the Vessels Ship/Shore checklist been reviewed and a completed copy received by AEM.			
Prior to discharge inform H&S and Environment Departments that fuel transfer will commence.			
Has the emergency response equipment been reviewed with all personnel and contractors on shore.			

Comments/Recommendations:____
____
____
____
____
____
____
____

Signature : ________________________________

Agnico Eagle Mines: Meadowbank Division
Environment Department

Inventory report for Spill Response Sea Can at AEM's Oil Handling Facility in Baker Lake

Date: ______________________________ **Inspected By:** _________________________

Time: _________________________ **Vessel Unloading:** _____________________

Subject	Conform	Non-conform	Comments
Is the material and PPE stored in a manner that is organized and accessible in order to easily respond to spill?			
Are the sea cans in physically good shape? Easy to open?			
Are the sea cans identified as "Environmental Emergency Sea Can"?			
Is all the spill material in place? Nothing Missing?			
3 x Empty drums (sealed)			
2 x Mini Berm 36"x 36"			
2 x 4 Drums Berm 4'x 8'			
4 x Tarp 20'x 30'			
4 x Tarp 30'x 50'			
10 x Oil Spill Absorbent Pads			
5 x Universal Absorbent Boom 5"x 10' (For Hydro-soluble Chemical)			
5 x Universal Absorbent Boom 8"x 10' (For Hydro-soluble Chemical)			
5 x Petroleum base Absorbent Boom 5"x 10' (for Petroleum product)			
4 x Maritime Barrier (Baffle)			
5 x ABS pipe: 10' long x 4" diameter			
2 x Cell-U-Sorb (Absorbent)			
2 x Amerisorb Peat moss (Absorbent)			

1

Agnico Eagle Mines: Meadowbank Division
Environment Department

AGNICO EAGLE
MEADOWBANK

2 x Oil Gator Absorbent			
1 x Plug Patties			
4 x Quatrex bags			
2 x Fork Lift Crate			
4 x Hand Shovel			
1 x Cro Bar Chisel			
1 x Ice Breaker Chisel			
1 x Sledge hammer			
15 x Rod bar 4'			
1x ½ drum containment			
100 feet of rope			
Knife to cut rope			
Emergency Boat			
18ft Lund boat			
20 HP motor			
Fresh gasoline in jerry can			
Boat Safety Kit			
2 Mustang Suits			
2 Paddles			
Anchor with 30 feet of rope			
Additional 20 feet of rope			
Is all the PPE material in its place?			
3 x Rain gear -- Pants and Top (L & 2-XL)			
3 x Rubber boots (size 8, 10,12)			
6 x Rubber gloves			
3 x Goggles			
3 x Tyvex suits (L & 2 XL)			

Agnico Eagle Mines: Meadowbank Division
Environment Department

3 x Safety glasses			
3 x Leather gloves			

Comments/Recommendations:____

____
____
____
____
____
____
____

Signature : ______________________________________

3

OHF / Ship to Shore Fuel Discharge

	PROCEDURE NUMBER:	**MBK-ENV-0013 Rev. 2**	
People concerned	• **Environment** • **Site Services** • **Procurement and Logistics** • **Health and Safety**	**Prepared by**	**Environment Department**
		Authorized by	**Jeffrey Pratt – Environment Coordinator**
Effective :	**July 8, 2015**	***"Safety First, Safety Last … Safety Always!"*** ***"No Repeats" – Our Stepping Stone to ZERO HARM***	

This procedure corresponds to the required minimum standard. Each and every one also have to comply with the rules and regulations of the Nunavut Government in terms of health and safety at work.

Objective:

- To ensure that prior to the discharge of any fuel into the Agnico Eagle Baker Lake Tank Farm or Agnico Eagle Baker Lake Oil Handling Facility (OHF) that all proper steps are in place to ensure compliance with Canadian Shipping Act, as well as Nunavut Water Board License and Nunavut Impact Review Board Certificate.

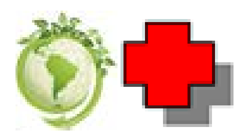
Concerned departments:

Environment | Health & Safety | Site Services | Procurement and Logistics

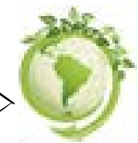
Risks/ Impacts Legend

Health & Safety | Process/quality | Legal Requirement | Environment

Prior to the beginning of the annual fuel discharge the following must be completed.

Procedure	*Risks/ Impacts*
1. The Oil Pollution Emergency Plan (OPEP) must be reviewed on an annual basis and updated prior to the first annual discharge. This will include but not limited to: a) Reviewing the Phone numbers for emergency's b) Updating maps c) Review and if necessary update equipment lists d) Review roles and responsibilities e) Update Declaration This is the responsibility of the Environment department.	
2. Contact Canadian Coast Guard and Transport Canada Pollution Prevention and make them aware of plans for transferring of fuel into our OHF for that season. This is the responsibility of the Environment department.	
3. Complete *Inventory report for Spill Response Sea Can at AEM's Oil Handling Facility in Baker Lake*. (*Inventory Checklist found on Page 6) This is the responsibility of the Environment department.	
4. Ensure Woodward (Shipping Company) has provided Transfer Conduit Annual certification. This is the responsibility of Environment Department.	
5. All personnel who will be a part of the fuel transfer (including Baker Lake Supervisor and third part contractor Intertek) must review the OPEP and be familiar with preventive measures to take and with the steps to take in the case of a spill event while fueling. This is the responsibility of Procurement and Logistics	
6. Install secondary containment underneath each connection of conduit on land. This is the responsibility of Environment Department	

7. Monitor secondary containment underneath each connection of conduit on land. This is the responsibility of Procurement and Logistics	
8. Ensure there is two way functional communications between the OHF and the off-loading Vessel. This is the responsibility of Procurement and Logistics	
9. Ensure there is lighting in place at the transfer flange to provide illumination during any transfers taking place during the low to no light hours. This is the responsibility of Procurement and Logistics	
10. Prior to any discharge AEM must receive a copy of the Ship/Shore checklist completed by Woodward. And should verify this has been completed (as much as realistically possibly without boarding the ship). This is the responsibility of Procurement and Logistics	
11. Contact must be made with both the H&S and Environmental Departments prior to the discharge of fuels. Meadowbank Health & Safety meadowbank.healthandsafety@agnicoeagle.com Meadowbank Environment meadowbank.environment@agnicoeagle.com This is the responsibility of Procurement and Logistics	
12. The *Pre-discharge Checklist for AEM's Oil Handling Facility in Baker Lake* must be completed, signed and provided to the Environment department prior to discharge. (*Checklist found on Page 5) This must be done for each fuel tanker for each campaign. This is the responsibility of Procurement and Logistics	
Transfer	
1. Once the above points are completed, the ship to shore transfer can commence.	
2. Photos of the complete fuel transfer process should be taken, visually proving that all above procedures have been reached. This is the responsibility of Environment department and Procurement and Logistics.	

3. During the ship-to-shore transfer, AEM will have competent personnel on location at all times to monitor the fuel transfer and maintain contact with the tanker's crew. This is the responsibility of Procurement and Logistics.	 
4. Monitor the fuel transfer at the beginning of each transfer and after that on an hourly basis checking the manifold, conduit, tank, and any connection points on land for spills and/or leaks. Communication between shore and ship should take place on an hourly basis. This is the responsibility of Procurement and Logistics.	 
5. We are required by law to have a fuel spill scenario every two years. However, since we have shift work at Meadowbank, to ensure adequate training annually we will do mock spill/training and switch shifts each year. This way each shift completes every second year. This is the responsibility of Environment Department in conjunction with ERT to plan and execute.	

AGNICO EAGLE

Environmental, P&L and E&I Departments
Ship to Shore Fuel Discharge Meeting Agenda
Agnico-Eagle Mines Limited
Meadowbank Project

Date:	April 19, 2016
Prepared By:	Environment Department
Meeting Lead By:	Robin Allard and Erika Voyer
Attendees:	Monique Cossette (P&L), Christian Soucy (E&I), Alex Arcand (E&I), Robin Allard (ENV), Erika Voyer (ENV)
Distribution:	Meadowbank Environment, Meadowbank Procurement and Logistic, Meadowbank Energy and Infrastructure

E&I – Energy and Infrastructures, P&L – Procurement and Logistics, ENV - Environment

Procedure MBK-ENV-0013 Review		Task Owner	Due Date
1	**OPEP Review**	ENV	May 9th (+60 days prior to transfer)
2	**Contact Canadian Coast Guard and Transport Canada Pollution Prevention**	ENV	May-June
3	**Complete Inventory report for spill response c-can**	ENV	May-June
4	**Ensure that Woodward provide Transfer Conduit Annual certification (Hose Cert.)**	ENV	Prior to first transfer – in OPEP
5	**All personal to review the OPEP and be familiar with preventive measures.** (OPEP will be provided by Env.)	All	Prior to first transfer – July 1st
6	**Install secondary containment underneath each connection of conduit on the land** - *For Jet A hose installation – collaboration between P&L and E&I*	ENV	Prior to first transfer
7	**Monitor secondary containment underneath each connection of conduit on land.**	P&L (Intertek)	Before and during transfer
8	**Ensure there is two way functional communications between the OHF and the off-loading Vessel**	P&L	Before and during transfer
9	**Ensure there is lighting in place at the transfer flange to provide illumination during any transfers taking place during the low to no light hours**	P&L/ E&I (if repairs is required)	Before and during transfer
10	**Prior to any discharge AEM must receive a copy of the **<u>Ship/Shore checklist completed by Woodward</u>. And should verify this has been completed (as much as realistically possibly without boarding the ship).**	P&L	Prior to each transfer

11	**Contact must be made with both the H&S and Environmental Departments prior to the discharge of fuels (generally by email)**	P&L	Prior to each transfer
12	**The <u>Pre-discharge Checklist for AEM's Oil Handling Facility in Baker Lake</u> must be completed, signed and provided to the Environment department prior to discharge.** **This must be done for each fuel tanker for each campaign.**	P&L (Intertek)	Prior to each transfer
During Transfer Procedure review			
1	**Once the above points are completed, the ship to shore transfer can commence** - *Valve opening and sequence for tank filling will be completed by E&I*		
2	**Photos of the complete fuel transfer process should be taken, visually proving that all above procedures have been reached**	ENV. and P&L	Prior and during transfer
3	**During the ship-to-shore transfer, AEM will have competent personnel on location at all times to monitor the fuel transfer and maintain contact with the tanker's crew.**	P&L (Intertek)	During transfer
4	**Monitor the fuel transfer at the beginning of each transfer and after that on an hourly basis checking the manifold, conduit, tank, and any connection points on land for spills and/or leaks. Communication between shore and ship should take place on an hourly basis**	P&L (Intertek)	During transfer
5	**We are required by law to have a fuel spill scenario every two years. However, since we have shift work at Meadowbank, to ensure adequate training annually we will do mock spill/training and switch shifts each year. This way each shift completes every second year.**	ENV and ERT	Summer, during period of transfer
Miscellaneous			
1	**Document required prior to fuel transfer** - Hose certifications (Hydrostatic test) – Woodwards (will be included in OPEP) - **Notice of readiness, Floating hose Ship/Shore Cargo checklist , Cargo preparation checklist - Woodwards - OHF Ship to Shore Fuel Discharge AEM Checklist prior to transfer - AEM	P&L	

2	**Intertek role and responsibility** Intertek is the contractor under the responsibility of P&L hired for the fuel transfer. Intertek must be aware of the required procedure for the fuel transfer and have received the proper documents (OPEP, OHF / Ship to Shore Fuel Discharge AEM procedure). Intertek will complete some tasks related to P&L responsibilities during transfer.	P&L	
3	**Management of the wildlife monitors to be on the barge** - ENV will contact Woodwards for lodging on the boat - ENV will contact Comm. Affairs in BL for management of the monitors this summer	ENV/Comm. Affairs	
4	**Inspection by Environment**	ENV	Prior and during transfer

Time	Actions	Comments
8:26	Spill started (Fruit Loops on water) 	
8:29	Alex + Intertek crew (x3) walk down to spill Spill seen Alex ask if crew is safe and ask if anybody around Vessel notified. Alex ask them to close manifold	ask for confirmation
8:32	Code 1 called by Alex to BL Dispatch Dispatch confirm info	radio silence?
8:33	Alex + Intertek access spill response c-can on beach 	
8:34	Alex Arcand calls to confirm that he is aware	
8:35	Boom taken out on beach from c-can  Environment confirmed on the way	some problem with connecting barriers
8:36	BL dispatch calls for no traffic on tank farm road	
8:39	Alex ask if Environment is on the way	
8:41	Jeff calls to send Enviro crew to spill Boat brought on beach	ATV a good tool, need helmet?
8:43	Jeff ask Alex for update wind? spill size?	pads, mini boom could have been installed?
8:47	Still working on putting boat on water	
8:50	Jeff ask for confirmation if vessel stopped pumping	
8:54	Boat on water 	make sure to do a walk-around of boat beforehand.
8:59	Jeff calls for update Boom on water? shore affected? no smoking?	
9:04	Boom deployment on water  	
9:06	Environment on site	
9:10	Enviro ask Jeff to access DFO spill response c-can	
9:13	Confirmation for use of DFO equipment	
9:15	Boom looped from shore to shore	

9:18	Jeff ask Enviro tech to observe shore from barge to BL hamlet		
9:25	Boom set-up ok. Spill contained		still need to install anchors to secure maritime barrier.
9:26	Confirmation of no visual sheen on BL side		
9:33	Jeff calls mock spill over.		

Spill response went smoothly. Alex Ouellet was aware of situation and responded quickly to the events. Intertek crew seemed to be waiting for direction. But acted on Alex's directive. When calling vessel for stoppage of pumping, make sure to receive confirmation. Communication could have been better with road traffic communications on-going. Radio silence or Emergency channel?? It is not ideal for first responder to be also the responsible on site. Not able to direct crew from response boat and so forth. Communication with shore needs some thinking. Does crew on site at BL have PCO card to operate boat? There were some issues with the response boat as it did not have a functional reverse. Better paddles and/or boat gear would help with deployment. Scene protection is something that can be improved as some traffic/vehicles were seen at the office area. Make sure to wear proper PPE for response (rubber gloves, rain suits etc.).

APPENDIX E – COASTAL SHIPPING LTD.

1.1 – SHIP TO SHORE CHECKLIST

1.2 – CARGO PRE ARRIVAL

Ship / Shore Cargo Checklist

Vessel: ______________________
Port: ______________________
Date: ______________________

Instructions for Completing form: Answer affirmative by ticking (✔) the appropriate box. If an affirmative answer is not possible, then the reason given and an agreement reached upon appropriate precautions to be taken between the ship and the terminal. If the question is not applicable then a note is inserted in the remarks column.

Letter Codes

A Any procedures and agreements should be in writing in the remarks column of this checklist or other mutually acceptable form. In either case, the signature of both parties is required

P In the case of a negative answer, the operation should not be carried out without the permission of the port authority.

R Items to be rechecked regularly, not exceeding the time specified in the declaration

General cargo considerations:

Item	Ship	Shore	Code	Comments
Is the vessel securely moored?			**R**	Stop Cargo at _______ knts wind velocity Disconnect at _______ knts wind velocity Unberth at _____ knts wind velocity
Are emergency towing wires correctly positioned?			**R**	
Is there safe access between the ship and the shore?				
Is the ship ready to move under it’s own power?			**P R**	
Is there an effective deck watch in attendance on the ship and adequate supervision on shore?			**R**	
Is the agreed ship/shore communication system operative?			**A R**	
Has the emergency signals to be used by the ship and shore been explained and understood?			**A**	
Have the procedures for cargo bunkering and ballast been agreed upon?			**A R**	
Have the hazards associated with toxic substances within the cargo being handled been identified and understood?				
Has the emergency shutdown procedure been agreed?			**A**	
Are fire-hoses and fire fighting equipment on board and ashore positioned and ready for immediate use?			**R**	
Are cargo and bunker hoses/arms in good condition, properly rigged and appropriate for intended use?				
Are scuppers effectively plugged drip tray valves closed both on board and ashore?			**R**	
Are unused cargo and bunker connections properly secured with blank flanges fully bolted?				
Are Sea and overboard discharge valves closed when not in use?				
Are all cargo and bunker tank lids closed?			**A R**	
Is the agreed tank venting system being used?				
Has the operation of P/V valves been verified?				
Are flashlights in use of an approved type?				
Are portable VHF/UHF radios of and approved type?				
Are the ships MF/HF radios grounded, VHF radios set to low power and 10 cm radars shut off?				
Is any portable electrical equipment disconnected?				
Are all external doors and ports in the accommodation closed?			**R**	
Are air intakes, which may permit the entry of cargo vapours, closed?				
Is the galley staff informed of loading/discharged operations?				
Are Smoking regulations being observed?			**R**	
Are naked light rules being observed?			**R**	

Ship / Shore Cargo Checklist

Date: ____________________

Is there provision for an emergency escape?				
Are there sufficient personnel on board and ashore to deal with an emergency?			R	
Are adequate insulating means in place in the ship shore connection?				
Is the pumproom ventilation adequate?			R	
Have the requirements for closed loading been agreed?				
Has a vapour return line been connected?				
If a vapour return line has been connected have the operating parameters been agreed?				
Are ship emergency fire control plans located externally?				
Are appropriate signals being displayed?				

Inert Gas Systems (if in use):

Item	Ship	Shore	Code	Comments
Is the Inert Gas System Fully operational and in good working order?			P	
Are deck seals in good working order?			R	
Are Liquid levels in P/V breakers Correct?			R	
Have Fixed and Portable Oxygen Analysers been calibrated and are they working properly?			R	
Are IG pressure and Oxygen recorders working properly?			R	
Are all Cargo tanks at positive pressure with oxygen content of 8% or less by volume?			P R	
Are all IG Tank valves correctly set and locked?			R	
Are all the persons in charge of cargo operations aware that in the case of failure of the Inert Gas Plant, discharge operations should cease and the terminal be advised?			R	

Tank Cleaning (if planned while ship is at berth):

Item	Ship	Shore	Code	Comments
Are tank-cleaning operations planned during the ships stay alongside the shore installation?	Y / N			
If so have port authority and terminal authority been informed?	Y / N	Y / N		

Additional comments or conditions:

Declaration:

We the undersigned have checked, where appropriate jointly the items on this checklist and are satisfied that the entries made are to the best of our knowledge correct.

We have also made arrangements to carry out repetitive checks as necessary and agreed that those items with the letter **R** in the column **Code** should be rechecked at intervals not exceeding __________ hours.

Signatures:

For Vessel

Name: ______________________

Rank: ______________________

Signature: ______________________

Date & Time: ______________________

For Shore

Name: ______________________

Rank: ______________________

Signature: ______________________

Cargo Pre-arrival Checklist

Vessel: ____________________
Port: ____________________
Date of Survey: ____________________

Prior to entering a port or place of destination, weather permitting:

Item	Completed
A survey which must include visual examination of the emergency towline, the anchor releasing mechanism, and mooring lines to determine that the equipment is ready for use and in good condition.	

Prior to cargo transfer operations an examination and testing of items listed in chapters 6, 7 and 10 of ISGOTT and especially:

Item	Completed
All external doors, ports, and similar openings which lead directly from the tank deck to the accommodation and machinery spaces are closed.	
P/V valves and the venting system have been inspected and properly set for the transfer operation.	
Pumproom strainer covers, inspection plates, and drain plugs are properly positioned and secure.	
Flange connections have all bolts used and tightened with no improvised arrangements using 'C' clamps or similar devices.	
Visual examination of all hoses before use.	
Hoses are properly supported by bridles and saddles and protected from hot surfaces.	
Terminal advised to give warning to vessel of any forecast of imminent adverse weather conditions such as high winds and electrical storms which may require operations to be stopped or loading or discharge rates reduced.	
Sea and overboard discharge valves, when not in use, are securely closed, lashed and sealed.	
A list of responsible vessel officers on duty during transfer is posted and readily available.	
Communications system is operative and established co-ordination between Terminal and Ship.	
All cargo transfer valves are operational and fully opened as may be required.	
Emergency shut down plan has been discussed and understood by ship and shore personnel.	
Void and ballast spaces monitoring carried out during loaded passage.	
Plan in place for failure of IGS system, if fitted.	

Prior to getting underway from a dock or an anchorage:

Item	Completed
A survey which must include visual examination of the emergency towline, the anchor releasing mechanism, and mooring lines to determine that the equipment is ready for use and in good condition.	

Additional comments or conditions:

Survey Conducted by:

Name:	____________________	Name:	____________________
Rank:	____________________	Rank:	____________________
Signature:	____________________	Signature:	____________________

APPENDIX F – Agnico Internal Spill Report Form

Agnico Eagle Mines Meadowbank Project:
Internal Spill Reporting Form

(Spills greater than the *Reportable Volume*, see Spill Contingency Plan, require the completion and submission of the *Nunavut Spill Report Form*)

AGNICO EAGLE	Meadowbank Project	Spill report #.
Date and time of spill :		
Location of spill :		
First responder name :		
Company Name:		
AEM Contact:		
Nature of contaminant :		
Volume/quantity of the container / tank (L)		
Quantity spilled (L) :		
Cause of the spill :		
Contaminant collected by :		
Follow-up done by :		
Actions taken :		
Report completed by:		Date :
Incident investigation recommended :	YES ☐	NO ☐
Government agency notified :	YES ☐	NO ☐
Date of notification to government agency :		
Date of report :	Signature of environmental personnel :	

APPENDIX G – The Central and Arctic Regional Response Plan (2008)

Canadian Coast Guard
Central & Arctic Region

Regional Response Plan

December 2008

LETTER OF PROMULGATION

The *Central & Arctic Regional Response Plan (2008)* replaces the *Central & Arctic Region Contingency Chapter (2006)* and the *Arctic Response Strategy (1999)*. This plan is a component of the *Canadian Coast Guard National Response Plan* which is the responsibility of the Director of Safety and Environmental Response Systems, Ottawa. It establishes the framework and the procedures by which Central & Arctic Region will prepare for, assess, respond to and document actions taken in response to pollution incidents in this Region.

The saving of life is of paramount consideration and the Plan is subordinate to the operational requirements of marine search and rescue.

The Plan has been reviewed by the internal partners identified in Section 3.3 in context to the services they may provide and by the external partners identified in Sections 3.4 and 3.5 to confirm their mandated response authorities.

Responsibility for the *Regional Response Plan* lies with the Assistant Commissioner Coast Guard Central & Arctic Region. The Central & Arctic Region Environmental Response branch is the custodian of the plan. The responsibility for specific sections is identified in Section 7 - Plan Maintenance and Custodians. Comments, recommendations and communications relating to the various sections are clearly identified in this section.

REVISION RECORD

CENTRAL & ARCTIC REGIONAL RESPONSE PLAN			
Section	Replace	Transmittal No.	Description of Changes
Entire Plan	All	December 1, 2005	Complete revision of Central & Arctic Regional Response Plan
Entire plan	All	April 1, 2006	Complete revision of Central & Arctic Regional Response Plan
7.1 Maintenance Process	Page 7-1	May 8, 2007	Update address to 520 Exmouth Street
8.3 CCG ER Phone List	Page 8-1	June 4, 2007	Update address to 520 Exmouth Street
Entire Plan	All	December 2008	Complete revision of Central & Arctic Regional Response Plan

LETTER OF PROMULGATION i

REVISION RECORD ii

SECTION 1 – INTRODUCTION
Authority 1-1
Purpose 1-1
Area of Responsibility 1-1
Safety Policy 1-2
Links to the National Response Plan 1-2
Regional Response Plan Structure 1-2
Linkages to International Joint Plans 1-3
Linkages to International Joint Plans ……………………………….1-3

SECTION 2 – AGREEMENTS & MEMORANDA OF UNDERSTANDING
Overview 2-1

SECTION 3 – ORGANIZATION
General Application 3-1
Environmental Response Branch (DFO/CCG/ER) 3-1
Internal Partners – Fisheries and Oceans 3-3
Internal Partners – Other Federal Departments 3-5
External Partners 3-8
Clients 3-9
External Resources 3-10

SECTION 4 – PREPAREDNESS
Overview 4-1
Response Management System (RMS) 4-1
Planning 4-4
Training Program and Curriculum 4-6
Exercise Program 4-12
Inventory Management, Maintenance and Infrastructure 4-14

SECTION 5 – RESPONSE OPERATIONS
Pattern of Response 5-1
Spill Potential or Pollution Risk Assessment 5-5
Notification 5-5
Verification 5-5
Spill Assessment 5-6
Activation of Canadian Coast Guard Response Resources 5-11
Response Implementation 5-11
Summary Report and Post Incident Review 5-16

SECTION 6 – CLAIMS AND COST RECOVERY
Purpose 6-1
Policy Guidelines 6-1
Responsibilities 6-2
Process 6-2
Documentation 6-2
References 6-4
Third Party Claims 6-4

SECTION 7 – PLAN MAINTENANCE AND CUSTODIANS
Maintenance Process 7-1
Canadian Coast Guard Custodians 7-1
Plan Distribution 7-2

SECTION 8 – CONTACTS
Pollution Reports for Canadian Coast Guard (CCG), Central & Arctic Region (C&A) 8-1
Other Lead Agencies that Maintain Spill Report Lines 8-1
Environmental Response Branch Phone List 8-1

SECTION 9 – REFERENCES AND ANNEXES
References 9-1
Annexes 9-1

Section 1 - INTRODUCTION

1.1. Authority

This plan is based upon the policy and guiding principles set forth in the *National Response Plan* of the *Canadian Coast Guard National Response Strategy*.

1.2. Purpose

The *Central and Arctic Regional Response Plan* is designed as a guide to Canadian Coast Guard staff and relevant stakeholders involved in marine spill responses. It outlines the Regional application of the various roles of On-Scene Commander (OSC) (active response), Federal Monitoring Officer (FMO) (ensuring the Responsible Party fulfills their obligations), and as a Resource Agency (in assistance to other Lead Agencies).

It contains the specific information and activities that are pertinent to all spill response activities within Central & Arctic Region (C&A Region).

1.3. Area of Responsibility

For the purposes of marine pollution response Central & Arctic Region is defined geographically as:

- The contiguous waters of the Canadian Arctic (North of 60^{o} Latitude) to the limits of the International Boundary, including the North Slope Area of the Yukon Territories, and internal waters of the Northwest Territories and the Territory of Nunavut; and

- The waterways contained within the provinces of Alberta, Saskatchewan, Manitoba, Ontario, and a western portion of Quebec commencing at the east wall of the Beauharnois Lock in the St. Lawrence River.

(see Figure 1-1 Fisheries and Oceans Central & Arctic Region)

Significant waterways include the Canadian Great Lakes and interconnecting waterways to the international Boundary with the United States, Hudson and James Bays, Lake Winnipeg, Lake Athabasca and interconnecting waterways, Great Slave Lake, Mackenzie River and the Northwest Passage in the Canadian Arctic.

There are also a number of specific geographic locations which, although not excluded from Canadian Coast Guard's mandate, require coordination between the managing authorities and this plan. These areas include the waters associated with the various Port Authorities (Hamilton, Thunder Bay, Toronto and Windsor) and the St. Lawrence Seaway Authority (Welland Canal, St. Lawrence Locks) as defined by the *Canada Marine Act, 1998*.

Figure 1-1: Fisheries and Oceans Central & Arctic Region

1.4. Safety Policy

Safety is the first and foremost consideration in any pollution response in Central & Arctic Region. This commitment is expressed throughout this and other documents as well as in the programs relied on by the Environmental Response (ER) branch to prepare for such spills (i.e. training and exercising programs). General safety procedures and considerations to be followed by all members of the Regional Response Team are identified in Section 5.7 of this plan.

1.5. Links to the National Response Plan

The Guiding Principles and Mandate (including legislative, interdepartmental, intergovernmental and international agreements) as well as designation of Lead and Resource Agency roles are contained in the *National Response Plan Section 1 – Introduction.* The mechanism for activating the Environmental Response National Response Team is also defined in the *National Response Plan*.

1.6. Regional Response Plan Structure

The Regional Response Plan is structured to reflect the three fundamental phases of Environmental Response activities. These are:

1) Preparedness - through the regional application of Contingency Planning (resulting in specific response strategies), Training (state of personnel readiness), Exercising (state of system readiness) and Inventory Maintenance and Management (state of mechanical/equipment readiness).

2) Response Operations - identifying the mechanisms for:
   - *Initiating* (through a dedicated Duty Officer and Assessment process),
   - *Sustaining* (Operational functions as Lead or Resource Agency),
   - *Controlling* (using the Response Management System), and
   - *Finalizing* the response activity (decommissioning and reporting).

3) Claims, Recovery and After-action activities - for the documentation and recovery of spent resources from the polluter, their agents, national or international funding conventions.

Surrounding these fundamentals are the specifics of the Environmental Response Program in Central and Arctic Region that are too cumbersome to be included in the main text of this Response Plan. They include: Regional Agreements and Memoranda of Understanding, Regional Organization and the specific Annexes which support the program. Finally, the Response Plan includes the preliminary and supplementary matter such as Letter of Promulgation, Record of Revision and the Identification of Custodians and the Plan Maintenance process.

1.7. Linkages to other Response Plans in the Region

When a pollutant is spilled into the water, the Canada Shipping Act is not the only legislation that applies. Recognizing that being designated Lead Agency for pollution response to mystery spills and spills from vessels does not preclude other agencies from completing their mandate CCG acknowledges that the Internal and External Partners listed in Sections 3.4 and 3.5 have plans that are active within Central & Arctic Region.

1.8. Linkages to International Joint Plans

International Joint Plans and agreements affecting Central & Arctic Region include:

- Canada-United States Joint Marine Pollution Contingency Plan
- Canada-Denmark Agreement for Co-operation Relating to the Marine Environment, Annex B (Joint Marine Contingency Plan concerning Incidents resulting from Shipping Activities)
- Great Lakes Water Quality Agreement, Annex 9
- International Boundary Waters Treaty Act

The Canadian Coast Guard Environmental Response Branch also provides technical support for the Emergency Prevention, Preparedness and Response (EPPR) Working Group of the Arctic Council. The EPPR Working Group exchanges information on best practices for preventing spills, preparing to respond to spills should they occur, and practical response measures for use in the event of a spill.

The Arctic Council is an intergovernmental forum of the eight circumpolar countries (Canada, Denmark, Finland, Iceland, Norway, Sweden, the Russian Federation and the United States of America) that provides a mechanism to address the common concerns and challenges faced by the Arctic governments and the people of the Arctic.

Some work has been initiated with the Russian Federation for the development of a Joint Pollution Response Plan. To date no agreements have been signed.

Section 2 - AGREEMENTS AND MEMORANDA OF UNDERSTANDING

2.1 Overview

The Canadian Coast Guard (CCG), both Central & Arctic and National Headquarters, maintain numerous memoranda and letters of understanding and agreement between other government departments which outline shared responsibilities in pollution response. A brief description of the major agreements is listed below.

- Letter of Agreement between Canadian Coast Guard, Environmental Response Branch and Canadian Coast Guard, Operational Services and Canadian Coast Guard, Technical Services regarding the use of Environmental Response First Response Units (FRUs) by non-environmental response staff. This agreement concerns the use of FRUs at the various CCG facility sites (bases, sub-bases and search and rescue stations).

- Northwest Territories/Nunavut Spills Working Agreement. This agreement formalizes procedures whereby spill investigation and monitoring in the Northwest Territories (NT) and Nunavut (NU) can be coordinated.

- Fisheries & Oceans (DFO) and Environment Canada (EC) Letter of Agreement respecting transfer of responsibility as lead agency for mystery spills from Environment Canada (EC) to the Canadian Coast Guard/Fisheries & Oceans Canada (July 1996)

- Transport Canada (TC) and Fisheries & Oceans (DFO) Memorandum of Understanding respecting Marine Transportation Safety & Environmental Protection (May 1996). This MOU outlines the responsibilities transferred from TC to DFO in accordance with the *Public Service Rearrangement and Transfer of Duties Act*. Those pertinent to this plan include:
    a) The responsibility for ensuring the provision of pollution clean up services
    b) The authority to take actions to mitigate or prevent pollution from ships

- Letter of Understanding between the Canadian Coast Guard and the Hamilton Port Authority to outline the roles that the CCG and the HPA will play in the event of a pollution incident which falls within the mandate of the Canadian Coast Guard.

- Letter of Understanding between the Canadian Coast Guard and the Thunder Bay Port Authority to outline the roles that the CCG and the TBPA will play in the event of a pollution incident which falls within the mandate of the Canadian Coast Guard.

- Letter of Understanding between the Canadian Coast Guard and the Toronto Port Authority to outline the roles that the CCG and the TPA will play in the event of a pollution incident which falls within the mandate of the Canadian Coast Guard.

- Letter of Understanding between the Canadian Coast Guard and the Windsor Port Authority to outline the roles that the CCG and the WPA will play in the event of a pollution incident which falls within the mandate of the Canadian Coast Guard.

Some memoranda of understanding and letters of agreement have been rendered defunct by virtue of the dissolution or reorganization of the entities that signed the original document. It is the Region's intent to assess the need for an MOU and in those cases where renewal is needed, to draft a new MOU and submit to the partner organization the request for re-entry into that agreement. For further information on these memoranda, please contact the Environmental Response Planning Section.

Section 3 - ORGANIZATION

3.1 General Application

This section describes the primary working relationships between Fisheries and Oceans (DFO), Canadian Coast Guard, Environmental Response branch (CCG/ER) and the various internal and external partners, clients and external resources.

Internal partners include: Other DFO sectors, directorates and branches, and other federal departments which provide direct assistance or have specific mandates which directly affect response activities.

External partners include those entities that share the burden of pollution response for their specific area of responsibility. These agencies include the provincial and territorial government ministries with the generic mandate of pollution response.

Clients include those entities that are specifically identified by the *Canada Shipping Act (CSA)* and have direct involvement in the response regime; they include Oil Handling Facilities (OHF), Legislated Ships and Non-legislated Ships.

External resources are those resources outside of the government that the Canadian Coast Guard may engage while conducting spill response activities. These include the Response Organizations (RO) certified by Transport Canada and other independent contractors which may perform more specific functions.

3.2 Fisheries and Oceans, Canadian Coast Guard - Environmental Response Branch (CCG/ER)

The Assistant Commissioner, Canadian Coast Guard through the Maritime Services Directorate and the Superintendent of Environmental Response (ER) directs the Regional Environmental Response Team. This team represents one facet of the overall crisis management structure within Central and Arctic Region and performs the function of the Lead Response Agency for pollution incidents as defined in the *National Response Plan – Section 1* of the *Canadian Coast Guard National Response Strategy.* The branch consists of approximately seventeen (17) full time employees (FTEs).

Internally, the Environmental Response Branch is made up of five (5) distinct but integrated functions:

1) *Direction and Administration* - providing the overall guidance, management and liaison with Headquarters. The Superintendent holds the responsibility for escalating a response and/or dedicating resources.
2) *Planning* - providing the design and management of plans and procedures to facilitate the preparedness posture of the Region (responsible for developing and maintaining intradepartmental, interdepartmental, client and regime stakeholder relationships).

3) *Operations and Inventory Maintenance & Management* - provide the management and maintenance of equipment to ensure the operational response readiness of the Region.
4) *Training* - provides the coordination and delivery of educational materials, to internal as well as external partners and clients, in support of the overall preparedness posture of the Region.
5) *Exercising* - provides the management and coordination of internal and external partners and clients to validate, practice and reinforce all aspects of the Response readiness of the Region.

In addition to these core functions, each staff member is required to actively participate in the operational aspects of the response regime based upon their skill and ability levels. This includes assuming various roles within the Response Management Structure acting as Duty Officer (DO) and supporting the overall emergency preparedness structure within the Region (not necessarily related exclusively to oil spills or pollution).

In the context of this Plan, the Environmental Response Branch is tasked to:

- Fulfill the Canadian Coast Guard's obligations as Lead Agency in an OSC or FMO posture in responding to marine pollution incidents from ships in waters of Canadian interest as well as from unknown sources.
- Act as a Resource Agency in support of a response led by another agency when requested.
- Staff a Duty Officer position on a 24/7 basis which, together with other agency representatives, will assess or direct the assessment of spill reports.
- Ensure that an appropriate response to pollution incidents is initiated on a timely basis.
- Provide initial response capabilities throughout the region.
- Monitor response and clean-up priorities when polluter has accepted responsibility.
- Ensure international commitments in spill preparedness and response are fulfilled.
- Provide a pollution response capability for lightering, salvage and offshore recovery operations.
- Provide Regional and HQ briefings on status of emergency operations.
- Evaluate, acquire and maintain specialized marine emergency countermeasures equipment and develop deployment techniques.
- Develop, distribute and maintain the *Central and Arctic Regional Response Plan* of the *Canadian Coast Guard National Response Strategy* (including area annexes) on behalf of Fisheries and Oceans.
- Review and comment on other government as well as industry pollution response plans upon request.
- Provide pollution response related training to Canadian Coast Guard and civilian personnel.

- Conduct spill response exercises according to the Canadian Coast Guard National Exercise Program (NEP) standards.
- Provide detailed explanations of response operations and policies to representatives of the media, interest groups, industry, police and Provincial and Municipal governments.
- Provide a centre of expertise for pollution concerns.
- Develop and foster a good working relationship with other authorities, shipping and oil/chemical handling communities.
- Working with Environmental Response Headquarters and the Chemical Industry to develop, implement and maintain a corresponding and complimentary regional capability for spills of hazardous and noxious substances other than oil.

3.3 Internal Partners – Fisheries and Oceans

Other branches and directorates within Fisheries and Oceans which directly and in a continuous active way support preparedness and response activities include:

Marine Traffic and Communications Branch (MTCS) – CCG/Marine Programs Directorate

Marine Traffic and Communications Services operates a marine VHF/MF/HF communications system (depending on location) primarily for the provision of marine safety information, distress coordination and marine traffic regulation. MCTS will support Environmental Response (ER) activities by:

- Establishment of Movement Restriction Areas (MRA's) or exclusion zones as directed by the Federal Monitoring Officer (FMO) or On Scene Commander (OSC).
- Providing communications/radio equipment operators in support of off-site ER operations.
- Dissemination of marine information and issuing marine Notices to Shipping (NOTSHIPS).
- Providing vessel tombstone information including, but not limited to, vessel name, call sign, nationality, tonnage, dangerous cargo type and quantity.

Regional Operations Centre (ROC) and Fleet Resources – CCG/Operational Services Directorate

<u>Regional Operations Centre</u>

The ROC provides notification to the Environmental Response Duty Officer (ERDO) when notified of a spill or an occurrence which may result in a spill. Upon receiving information regarding a spill, the ROC confirms the report using reliable resources and agencies. When the incident has been confirmed the Operation Centre begins the alerting and notification procedure. A schedule of ERDOs, approved by the Superintendent Environmental Response Canadian Coast Guard, will be maintained by the ER Regional Emergency Operations Officer (REOO) and forwarded to ROC for distribution.

The Regional Operations Centre will support the Environmental Response Branch during a marine pollution incident by:

- Maintaining up to update contact lists for Canadian Coast Guard and other government agencies for use as incidents progress.
- Coordinating the allocation of CCG resources as required by the FMO or the OSC to respond to a marine pollution incident.
- Provide communications support (when necessary).

Fleet Resources

Fleet Resources may be called upon to provide a host of support and/or lead services depending upon the type and severity of the situation and limitations or constraints of the vessel. Commanding Officers maintain full responsibility for the operation and safety of their vessel and personnel and therefore, will/may:

- Be called upon to be interim On-scene Commander.
- Be the principal point of contact aboard ship for the Environmental Response Duty Officer or On Scene Commander.
- Investigate spill reports for the purpose of confirmation.
- Provide surveillance and monitoring of third party (or pollutant) as required.
- Initiate early spill response; containment, boom or sorbent material deployment, clean up and recovery procedures.
- Provide site safety, (i.e. fire fighting, first aid and crowd control).

Fleet does maintain their own limited capabilities to respond to their needs as required.

Canadian Coast Guard Bases

In preparation for and during a pollution incident, CCG bases may also provide resources for response. These resources are generally within the scope of normal base activities and include:

- Small vessel use
- Base facilities (boardrooms, workshops)
- Helicopter landing pads
- Boat launch and docking slips
- Staging areas

Safety, Security and Emergency Services Branch – DFO Corporate Services

For large spills of a significant nature the Regional Manager of Safety, Security & Emergency Services may provide the following:

- Advice and recommendations to the On Scene Commander on issues of site and employee safety and the application of departmental security policy measures.
- General occupational health & safety and security advice to the On-Scene Commander/Deputy On-Scene Commander as per the departmental Loss Control Manual.

- A Health & Safety Officer to perform the functions of the Heath & Safety Officer described in the Response Management System User Guide. This person will report directly to the OSC or FMO throughout the duration of the response.

On occasions when the Regional Manager of Safety & Security (or delegate) is not available, or when spills are of a minor nature, the On-Scene Commander shall appoint a member of the response team to fulfill the general duties required.

Communications Branch – DFO Communications
Communications team manages the media (external) handling inquiries from print, radio, television and internet news organizations through the application of *Fisheries & Oceans Crisis Communications Plan*. Communications branch coordinates all aspects of information being released to ensure the public is getting the most relevant, accurate information as soon as practicable.

Legal Services
The DFO Legal Services in CCG Headquarters section will provide legal advice and guidance in the event of a marine pollution incident where CCG may or has been engaged. This especially includes advice on the issuance of Letters of Undertaking (LOUs) and in situations where Canadian Coast Guard may have to take command and control of an incident away from the Polluter.

Other DFO Resources
Indirectly, but just as significant in the event of a spill, is the availability of other DFO resources. This includes any and all appropriate functions including, but not limited to the following:

- Trenton Joint Rescue Coordination Centre – CCG, Maritime Services Directorate, Search and Rescue Branch (SAR)
- Finance and Administration – Human Resources and Corporate Services Directorate
- Human Resources - Human Resources and Corporate Services Directorate
- Facilities – Real Property
- Other Technical Resources – CCG, Integrated Technical Services Directorate
- Fish Habitat Branch – Habitat Fisheries and Oceans Management

3.4 Internal Partners – Other Government Departments

Other federal departments which provide direct assistance or have specific mandates which directly affect response activities include:

Environment Canada (EC)
There are two (3) Environment Canada regions located within Central & Arctic region. They are Ontario, Prairie and Northern and Pacific and Yukon Regions.

The Environmental Emergencies Section provides:

- In Ontario, the Co-chair (with the Ontario Ministry of the Environment (MOE)) of the Regional Environmental Emergencies Team (REET).
- In the Arctic (consisting of the three Territories), the Co-chair (with the relevant Territorial Government, Department of Environment) for the Arctic Regional Environmental Emergencies Team.
- Coordination of the Shoreline Cleanup and Assessment Teams (SCAT).
- Advice concerning environmental impacts associated with vessel source spills, resource sensitivity and prioritization, environmental forecasting, spill and cleanup monitoring and clean up techniques and priorities
- Sampling assistance, identification and characterization of materials

The REET serves as a mechanism for the provision of consolidated, coordinated and comprehensive environmental information and advice concerning the fate and effects of hazardous and noxious substances, spill trajectories, resources and shoreline protection strategies, clean up priorities, physical and chemical counter measures, remedial endpoints, damage assessment, and the management of hazardous wastes generated during a spill and other matters which arise while planning and responding to emergency events which affect or risk environmental quality. In the planning mode REET members meet to improve contingency plans, resolve regional preparedness issues and exchange new scientific and response ideas.

In Ontario Region, Environment Canada has divided the province into eighteen (18) REET areas and plans to hold one (1) REET meeting per area per year, consolidating some areas where possible and maintaining annual meetings in the higher risk areas (Windsor, Sarnia, Sault Ste. Marie).

Two of three primary Arctic REET (AREET) areas are in Prairie and Northern Region: the Northwest Territories and Nunavut Territory. There is no REET established in Alberta, Saskatchewan and Manitoba.

The Meteorological Service of Canada (part of EC and REET) provides:

- Meteorological forecasting

The Canadian Wildlife Service (part of EC and REET) provides

- Advice on wildlife protection, rescue and rehabilitation
- Permits for wildlife hazing and capture

Transport Canada (TC)

The Environmental Response Systems Division in Ottawa is responsible for Canada's Marine Oil Spill Preparedness and Response Regime. It:

- works with other federal agencies and departments, such as Fisheries and Oceans Canada, the Canadian Coast Guard and Environment Canada to establish guidelines and regulatory framework for preparedness and response to oil spills and spills of noxious and hazardous substances into Canada's marine environment.

- Manages the National Aerial Surveillance Program

There are two Transport Canada regions located within Central & Arctic region. They are Ontario and Prairie and Northern regions.

The Aircraft Services Directorate provides:

- Aerial surveillance as part of the Prevention mandate within Transport Canada, and can provide aerial spill tracking, recording, and personnel transport.

The Marine Safety Branch provides:

- Technical advice and recommendations to the On-Scene Commander or the Ship Owner regarding, but not limited to, lightering, damage assessment and salvage.

  Note: The MOU between Transport Canada and Fisheries & Oceans Respecting Marine Transportation Safety & Environmental Protection (May 1996) Annex D – E-5 states that “Transport Canada and Fisheries and Oceans will jointly approve salvage operations, emergency lightering or discharge of cargo.” After discussing this clause with two senior surveyors, they both agree – Marine Safety does not approve salvage plans. Marine Safety advises and recommends only.
- Restriction of transit or movement of a vessel following a damage assessment.
- Spill investigation and enforcement of the various aspects of the pollution prevention conventions and legislation in Canada
- Regional planning, in conjunction with EC and CCG, for the selection of Places of Refuge. Note: in the Great Lakes and connecting channels, selection of a place of refuge will be determined in conjunction with the USCG and USEPA.
- Monitoring of the spill preparedness activities of Oil Handling Facilities (OHFs) and certified Response Organizations (ROs) through a review and audit process.

Indian and Northern Affairs Canada (INAC)

Canadian Coast Guard (CCG) works most closely with INAC in Nunavut (NU) and the Northwest Territories (NT). INAC has lead responsibilities in the Arctic for spills on water which do not originate at federal facilities, exploration facilities or from ships and barges. INAC also, by letter of agreement, will investigate ship-source spills on behalf of CCG. INAC is also a member of the Beaufort Sea Emergency Preparedness Working Group, along with CCG/DFO, EC, TC and other appropriate agencies.

National Energy Board (NEB)

Based in Calgary, Alberta, the National Energy Board is an independent Agency that reports to parliament through the Ministry of Natural Resources. The NEB is the

Lead Agency for spills that occur at offshore and nearshore oil and gas exploration and production facilities.

In the event of a marine pollution incident where CCG is requested for assistance as a resource agency, CCG is available to provide pollution response expertise as indicated under Section 7.2 of the *National Response Plan* as it relates to NEB.

Public Safety Canada

Public Safety Canada is the federal coordinating department responsible for engaging relevant federal departments in an integrated Government of Canada response to an emergency.

For emergencies requiring an integrated Government of Canada response, federal support is based on a regional “single- window” concept. This concept is intended to facilitate regional interdepartmental and intergovernmental coordination, while not unduly restricting operations. Coordination includes sharing of pertinent information in order to maintain situational awareness.

The Government Operations Centre (GOC) is a 24/7facility where an integrated Government of Canada response is managed. It is the focal point of information management flow and provides strategic-level activities. It’s permanent staff includes watch officers, duty officers specializing in national communications as well as a geomatics team to map incidents.

Indirect support from other federal departments in the form of advice or resources also comes from: Heritage Canada (Parks Service) in the form of support to REET, National Defense regarding assistance and resources, RCMP with respect to investigations and those sections or departments specifically identified in the various Memorandums of Understanding (MOU) as outlined in Section 2 of this chapter.

3.5 External Partners - Provincial and Territorial Ministries and Departments

In general, liaison with provincial and territorial concerns is facilitated through REET (Regional Environmental Emergencies Team), which is chaired by Environment Canada (EC) or, in the case of the Province of Ontario, is co-chaired by Environment Canada and the Ontario Ministry of the Environment (MOE). The following agencies have the primary mandate for marine or freshwater pollution response in their province or territory of jurisdiction:

Territory or Province	Department
Northwest Territories	Environment and Natural Resources
Nunavut	Department of Environment
Alberta	Alberta Environment
Saskatchewan	Saskatchewan Environment

Manitoba	Manitoba Conservation
Ontario	Ontario Ministry of the Environment

In emergency situations conflicts sometimes arise with respect to legal and administrative jurisdiction and application of standards and common practices. To facilitate these issues the various Ministries related to emergency measures are usually contacted to provide coordination and clarify where necessary the concerns. These include:

- Government of Nunavut – Department of Community of Government Services, Emergency Management Division
- Government of the Northwest Territories – Department of Municipal and Community Affairs – Emergency Services Division
- Government of the Yukon Territories – Department of Community Services, Emergency Measures Organization
- Government of Ontario - Ministry of the Community Safety & Correctional Service, Emergency Measures Ontario
- Government of Manitoba –Manitoba Emergency Measures Organization
- Government of Saskatchewan – Resource Management and Corrections & Public Safety, Saskatchewan Emergency Measures Organization
- Government of Alberta – Ministry of Municipal Affairs, Public Safety Division, Emergency Management Alberta

Provincial Governments can provide consolidated access to local, municipal and provincial resources.

Central & Arctic Region recognizes that First Nations have a vested interest in response operations that may occur in their territory and will ensure that they are represented on the REET or have access to the Federal Monitoring Officer or On Scene Commander through the CCG Liaison Officer.

3.6 Clients

With respect to ship-source pollution incidents, there are three major groups the Canadian Coast Guard will be directly engaged with. These are Oil Handling Facilities, Legislated Ships and Ships as defined in *Part XV* of the *Canada Shipping Act.*

Oil Handling Facilities (OHF)

Operators of facilities that transfer oil to or from oil tankers over 150 gross registered tonnes or other vessels over 400 gross registered tonnes are required by the Canada Shipping Act (2001) to:

- Have an Oil Pollution Emergency Plan (OPEP) on site.
- Have a declaration conforming to the regulations on site.
- Take reasonable measures to implement their required oil pollution emergency plan in the event of an oil pollution incident.

- Have on site the resources required to contain a spill of oil equal to the facility's rated capability within one hour.
- Begin recovery/cleanup operations of oil equal to the facility's rated capability within 6 hours.
- Have an arrangement with a certified Response Organization (RO) that permits the handling of spills beyond the rated capabilities of the Oil Handling Facility.[1]

Legislated Ships
In Canadian waters, ships over 400 gross registered tonnes and oil tankers over 150 gross registered tonnes are required to have a Shipboard Oil Pollution Emergency Plan (SOPEP) and an arrangement with a certified Response Organization (RO) to respond to an oil pollution incident of an amount equivalent to the maximum amount of product that the vessel can carry as fuel and/or as cargo up to a maximum of 10,000 tonnes.[1]

Other ships as defined by Part XV of the Canada Shipping Act (CSA)
Any ship that is less than 400 GRT or any tanker less than 150 GRT is still covered by the *Canada Shipping Act (2001)* in that it must report the potential or actual pollution incident to a Pollution Response Officer, or in the case of an incident in Canadian Arctic Waters as defined by the Arctic Waters Pollution Prevention Act to a Pollution Prevention Officer. The ship must take immediate steps to mitigate or remedy the situation. These ships are not required to have a Shipboard Oil Pollution Emergency Plan nor an arrangement with a certified Response Organization.

3.7 External Resources

There are two main categories of external resources that the Canadian Coast Guard (CCG) will engage. These are the Response Organizations certified by Transport Canada under the *Canada Shipping Act (2001)* and other contractors.

Response Organizations (ROs)
Response Organizations are privately established pollution response companies certified by Transport Canada. These companies hold a certificate of designation to handle oil spills of up to 10,000 tonnes (T). Response Organizations can provide the polluter or any lead agency with the resources, trained personnel and operational management structure to deal with a marine oil pollution incident within its identified Geographical Area of Response (GAR).

The Eastern Canada Response Corporation (ECRC) is the only certified response organization in Central & Arctic Region. The company is certified to ten thousand tonnes (10 000T) and two of its three regions cover Central & Arctic Region.

[1] There is no requirement for an Oil Handling Facility nor a Legislated Ship to have an arrangement with a Response Organization certified by Transport Canada in Canadian waters north of 60° North Latitude

1) ECRC Great Lakes Region is managed from the Response Centre in Corunna, Ontario. Its area of coverage includes all waters
   - south of 60 degrees north in the provinces of Alberta, Saskatchewan, Manitoba and Ontario to that portion of the St. Lawrence River in the Province of Ontario
   - to a line drawn between Butternut Bay (Latitude 44 31' 12" north and Longitude 75 46' 54" west) on the Canadian side
   - to Oak Point (Latitude 44 30' 48" north and Longitude 75 45' 20" west) on the US side of the St. Lawrence River.

2) ECRC Quebec Region (also known as Societé d'Intervention Maritime Est du Canada - SIMEC) is managed from the Response Centre in Quebec City, Quebec and has staffed Response Centres in Verchères, Quebec and in Sept-Iles, Quebec. Their coverage includes:
   - James Bay, Ungava Bay and in Hudson Bay south of the sixtieth parallel North and that portion of the St. Lawrence River in the Province of Ontario
   - to a line drawn between Butternut Bay (Latitude 44 31' 12" North and Longitude 75 46' 54" West) on the Canadian side to Oak Point (Latitude 44 30' 48" north and Longitude 75 45' 20" West) on the US side of the St. Lawrence River.

There are no certified response organizations established north of 60° N latitude.

Although resources from the Response Organizations in the south may be made available for use north of 60°, they must obtain the necessary approvals to move equipment from their designated area of response.

Contractors

Private sector contractors may be engaged by the CCG as required. All standard government contracting rules apply.

Section 4 – PREPAREDNESS

4.1 Overview

Oil spill preparedness is defined by the advanced planning used to create systems to effectively and efficiently combat the range of spills likely to be encountered.

In Central and Arctic Region, preparedness involves:

- The development of regional procedures to be followed in the event of an incident, coordinated by the Planning section.
- The implementation, training and maintenance of the Response Management System (RMS) to manage and combat the incident.
- The identification of priorities, development of strategies, logistics and tactics necessary to fulfill those priorities, lead by the Planning section.
- The liaising with internal and external partners, clients and resources that may be involved in pollution response activities, lead by the Planning section.
- The training and continued maintenance and upgrading of skills, coordinated through the Training specialist.
- The exercising and quality assurance activities required to continuously reinforce the training and contingency planning activities, facilitated through the Exercise specialist.
- The asset management including the acquisition, lifecycle maintenance, operational readiness and storage of equipment lead by the Operations section and Inventory specialist.
- The integration of other Canadian Coast Guard Assets and Human Resources, when necessary, through the Training and Exercising processes.

The Memorandum of Understanding (MOU) between the Director General/Maritime Services (MS) and the Director General/Integrated Technical Support (ITS) of the Canadian Coast Guard (March 2004) specifies that the ITS Directorate will be the single CCG focus for the life cycle management of all CCG physical assets and for the development of all technical solutions. It is unknown when ITS will assume the services of design, procurement, in-service support and disposal of all equipment and systems required to satisfy ER's mandate. In the interim, ER will remain the focal point.

4.2 Response Management System (RMS)

The Canadian Coast Guard uses the Response Management System (RMS) as its emergency management system. It is based on, and operates under the same principles as the Incident Command System (ICS) which was developed in the U.S. to coordinate multi-agency responses to large forest fires. The system was adjusted to reflect the current marine oil spill response regime and Canadian law. The Canadian Coast Guard does not implement the ICS principle of unified command, but will participate in any command structure used by the Polluter or Other Lead Agency.

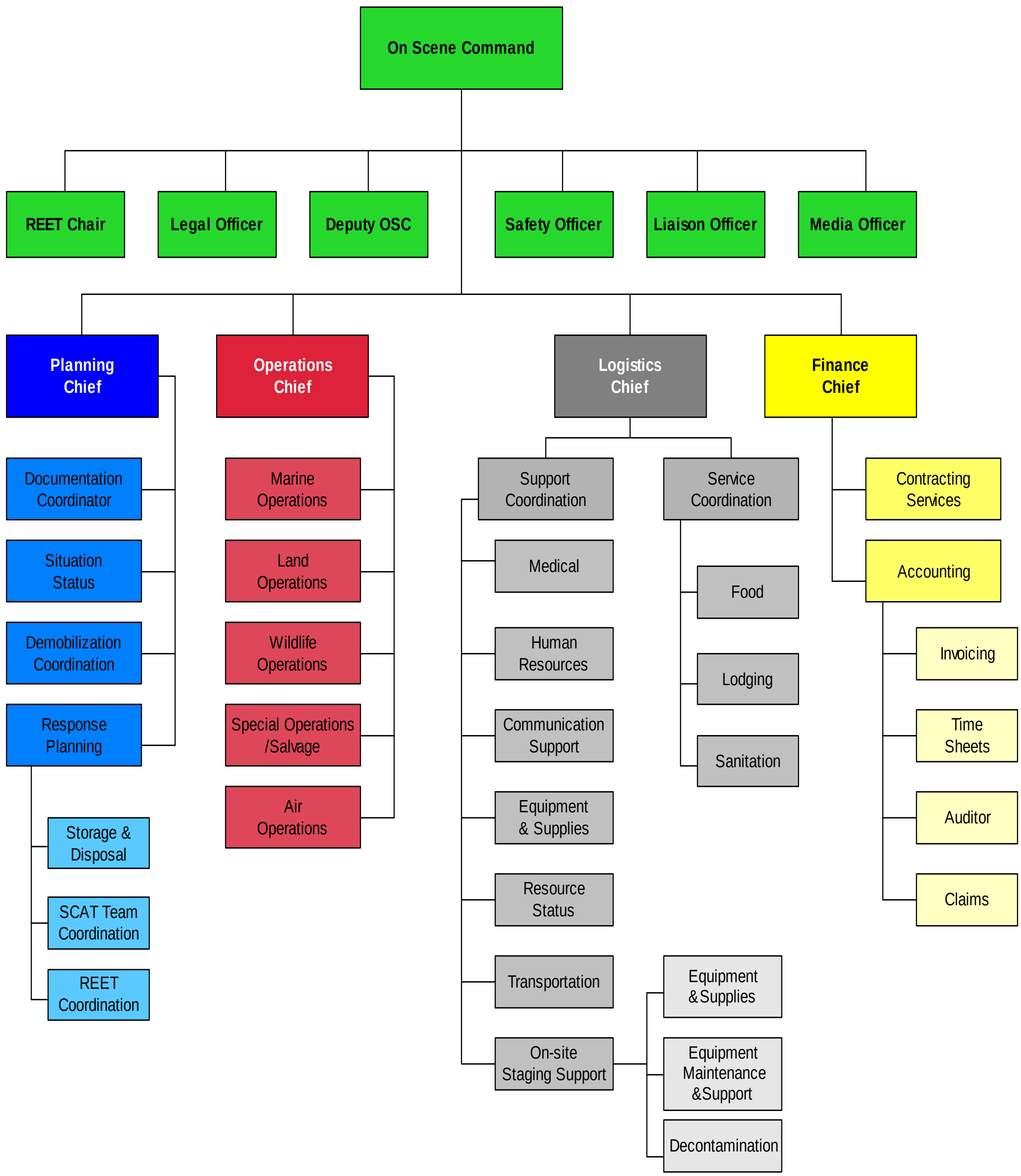
The RMS uses a “management by objectives” approach. It outlines the roles and responsibilities of individual positions, identifies the reporting structure, establishes a common set of terminology and uses standardized forms and paperwork. The central document in the RMS process is the Incident Action Plan, which documents the existing conditions and outlines objectives and strategies for recovery and response.

The system structure is designed to expand or contract to best fit the specific circumstances of the incident. Not all positions within the system will be staffed for every incident; in those cases the supervising position shall be responsible for all subordinate tasks/roles. Regional staff members have been designated as members of the Regional Response Team and may be called upon to fill specified roles in this management system (see Figure 4.1 for a fully expanded system design).

The system also contains management tools that can be used by the On Scene Commander and response personnel to better manage the system and the spill incident. These tools include a field operations guidebook, forms, reports, established meeting schedules and agendas. The RMS will also be used by the Federal Monitoring Officer and their Incident Monitoring Team while monitoring the Polluter’s response to an incident.

The detailed RMS process is contained in a separate document referenced in Section 9.1 of this plan (Response Management Systems User’s Guide, Version 3.0 (May 2006)).

Figure 4.1 - CCG RMS Command Structure



4.3 Planning

Area Plans

To facilitate an effective and efficient response, Canadian Coast Guard administers 16 area plans as an annex to the Central & Arctic Regional Response Plan. They are Keewatin, Baffin, Beaufort Sea & Amundsen Gulf, Great Slave Lake, Hudson & James Bay, Kitikmeot, Mackenzie River & Delta, Inland Waters S of 60, Lake Erie, Lake Huron, Lake of the Woods, Lake Ontario, Lake Superior, St. Lawrence, St. Mary's and St. Clair & Detroit areas. These plans incorporate detailed response information for specific manageable geographic areas or response communities. The normal operating period for an area plan is the first 12-24 hours of a spill response.

They are developed and maintained as follows:

1) Risk Analysis
   The risk analysis determines which communities or areas are most likely to be endangered by a potential oil spill and why, their associated environmental sensitivities, plus the typical type of spill that could be expected. When considering the environmental sensitivities, the focus is on what is most likely to be impacted and to consider as many factors as are applicable. A single factor discovered in the risk assessment is just one of many layers in the decision to make a site a priority.

2) Priority Identification/Verification
   Current priorities are discussed with members of the Regional Environmental Emergencies Team (REET) at planning meetings. It provides the opportunity for additions, deletions or modifications. Where there are no REET meetings held, community consultations are organized by the Planning section.

3) Strategy and Tactics Development
   Canadian Coast Guard determines RMS objectives for the agreed upon priorities. Strategies are designed, that name the activities relative to those objectives. Those activities may be response actions to be implemented, or may be the type of resources that could be affected by the spill. For area plan development, tactics provide the detail for implementing the selected strategies. Tactics then specify the resources, both human and equipment, to facilitate, to install or to maintain the strategy.

4) Updating
   Area plans are reviewed and updated annually.

Regional Procedure Development

Regional procedures for notification, verification, activation and cost recovery of a response are all described in the *Central & Arctic Regional Response Plan* of the *Canadian Coast Guard National Response Plan*. Supporting documentation in the form of Standard Operating Procedures and supplementary plans (e.g. Health & Safety Plan and Media Relations Plan) are not included in the Regional Response Plan but are referenced in Section 9.

Liaison with External and Internal Partners, Clients and Resources

To ensure that all partners, clients and resources are aware of the Canadian Coast Guard's mandate and responsibilities as they pertain to pollution preparedness and response, the Environmental Response Planning Section takes the initiative to:

- Work with Internal Partners within Fisheries & Oceans to communicate the branch's needs in the event of a pollution incident.

  Exception: Coordination of the Duty Officer (DO) function between Environmental Response (ER) and the Regional Operations Centre (ROC) is coordinated by the Regional Emergency Operations Officer REOO).
- Work with other government departments that have a mandate for pollution response within their jurisdiction to communicate the role that Canadian Coast Guard plays in marine and freshwater pollution incidents and to share what resources Canadian Coast Guard maintains for pollution response activities and the mechanism to access these resources in the event that another Lead Agency may require them for a non-CCG mandated spill or other type of emergency.
- Liaise with potential clients (oil handling facilities, shipping companies and other operators) so that CCG expectations in the event of an incident are understood.
- Provide copies of area plans to CCG vessels that are relevant to their area of operations. CCG ER will brief Operations at the pre and post season conferences on any changes to the plans and/or to the captain and/or crew's responsibilities.
- Maintain a network of contractors that can provide services to Canadian Coast Guard in the event of a pollution incident that exceeds the resource capability of the region.
- Upon request of the Regional Advisory Councils (RACs) or Secretariat (Transport Canada) on Marine Oil Spill Response, provide information on Central & Arctic Region's preparedness and spill response activities.

Arctic Community Emergency Plans

The Canadian Coast Guard is committed to assisting Arctic communities in the development of the marine pollution component of their Community Emergency Plans. This commitment was made in 1999 when the CCG Arctic Response Strategy (ARS) was published. The Arctic Response Strategy has since been re-assessed and viable components have been incorporated into the text of this Plan.

4.4 Training Program and Curriculum

Introduction

The Training Curriculum of the Environmental Response Branch is focused on providing the necessary skills and knowledge for responders to function effectively during a spill response operation. As the competencies required for an effective spill response are described and organized within the Response Management System (RMS), so too can the training curriculum be described in the context of RMS.

With RMS as the framework for spill response, all response team members will be trained in theory and application of RMS. The level of training complexity will vary by level of individual responsibility, but all members will have fundamental knowledge of the structure and processes that drive the RMS.

In addition to the training curriculum described in this section, it is understood that there are competencies and certifications required that are not specific to ER or spill response. These would include driver's licenses, radio operator's licenses, and familiarity with basic electronic equipment such as phones, fax machines, cell phones and laptop computers.

Training Curriculum

Command Staff

During a spill response operation, the command staff will vary depending on the size and complexity of the spill.
On a smaller spill, senior ER staff members may be appointed to command positions with few subordinate or supporting positions.
On larger scale spills, the OSC may be the Director of Maritime Services, or Assistant Commissioner Canadian Coast Guard, with multiple support positions from ER staff, CG fleet, base personnel and contractors.

To adequately prepare personnel for the management functions of spill response, the following curriculum has been identified:

On Scene Command Course (OSC)
This course trains participants in all aspects of spill response including planning, implementation, and supervision. Other topics include legislation, legal issues, financial responsibilities, and media relations. Prerequisites include BOSRC, MSROC, PPO designation, media relations and management training.

Response Management System Course (RMS)
The current RMS curriculum is an introductory two-day course on the system and its user's guide. It is anticipated that future development will include multiple levels of training which will include organizational structure and

responsibilities, as well as in-depth requirements of each position within this emergency management structure.

Federal Monitoring Course (FMO) - Proposed
Subject to national development, this course will augment the On Scene Command Course to provide those persons designated as Canadian Coast Guard Federal Monitoring Officers the necessary skills and knowledge to perform FMO duties.

Operations Section
During a spill response operation, the operations section of the RMS may be populated by regional ER staff, CCG fleet officers and crew, CCG/DFO base personnel or contractors. The resident knowledge of this group will vary, and a comprehensive ER training program exists to train responders in spill response operations. Training for members of the CCG Regional Response Team (RRT) personnel is offered in the following three areas:

(a) Safety Training
(b) Operational Training
(c) Specialty Training

(a) Safety Training
Health and Safety training is required to ensure compliance with federal and provincial legislation with the ultimate goal of ensuring the health and safety of response personnel. Additional video and printed reference material is available through the Canadian Coast Guard ER Training Officer.

Site Safety Course
The Site Safety Course is designed for response personnel prior to commencing work on a response site. Topics include employer and employee responsibilities, classification and hazards of petroleum products, and the safety practices and considerations associated with both water-based and shore-based operations. Site safety training is mandatory for Regional Response Team members and all volunteers or short time workers who may be employed during a response.

Workplace Hazardous Materials Information System (WHMIS)
This 3-hour course is provided to Canadian Coast Guard employees to ensure compliance with appropriate worker safety legislation. It was developed to ensure workers have the necessary information to work safely with hazardous materials in their workplace.

First Aid/CPR
This 16 hour course provides the participants with the skills and knowledge to successfully obtain the St. John Ambulance Standard First Aid Certificate. The primary focus of this 14-hour course is to provide adequate knowledge

and level of skill to persons in positions of responsibility to provide for persons suffering from respiratory and circulatory arrest. Preventative measures are discussed.

Small Non-Pleasure Vessel Basic Safety Course - MED A3

The 8-hour MED A3 course is *required by regulation* for crewmembers of small non-pleasure vessels of not more than 150 GT operating not more than 20 miles offshore. Topics include marine hazards and emergencies, marine firefighting, lifesaving appliances and abandonment and survival and rescue skills.

Transportation of Dangerous Goods (TDG)

This 6-hour course provides personnel with the responsibility for the transportation of dangerous goods to be aware of and comply with safety measures and appropriate legislation concerning TDG.

(b) Operational Training

There are various levels of oil spill response courses designed for response team members, ships crews and other responders who may be expected to assist with marine oil spill response. Operational training related to the assessment and response to petroleum spills is delivered by ER while training for response to hazardous and noxious materials spills is obtained outside of the Branch.

First Responder Oil Spill Training (FROST)

This 1 day course is designed specifically for CCG personnel in Central & Arctic Region who are designated custodians of First Response Units (FRUs), and may be tasked with deployment of the pollution countermeasures equipment. It has also been adapted for use in communities north of 60° where Arctic Community packs function as first response units.
It teaches First Responders to:

- assess an oil spill according to its extent, possible source and likely behavior
- deploy boom for containment and protection purposes and in support of response activities
- work safely at the spill site

Basic Oil Spill Response Course (BOSRC)

This 20 hour course instructs First Responders how to:

- assess an oil spill according to its extent, possible source and likely behavior
- deploy boom for containment and protection purposes and in support of response activities
- operate oil recovery equipment
- undertake basic shoreline cleanup operations
- work safely at the spill site

Marine Spill Response Operations Course (MSROC)

This 40-hour course will enable trained and experienced personnel to coordinate and supervise the response operations of a marine oil spill. It is intended to train individuals to be On Scene Commander (OSC) for small (tier 1) spills, or operations section chief on larger spills. Topics include legislative framework, safety, equipment suites and strategies, media relations, RMS, shoreline assessment and cleanup techniques, and disposal. Prerequisites include BOSRC, a Radio Operator License and current or future deployment to a spill response team.

Environmental Response Duty Officer (ERDO) Training

This 15 hour course is a prerequisite for duty officers for the ER branch and the regional operations centre. It introduces the participant to CCG mandate, lead agency responsibilities and introductory spill assessment techniques. It also integrates delivery of training on the Marine Pollution Incident Reporting System (MPIRS), the database used to capture spill report and response information.

Pollution Response Officer (PRO) Training

This three day course is currently provided by the Environmental Response Branch of the Canadian Coast Guard and is required training for all Environmental Response personnel. Participants who successfully complete this course earn the designation of Pollution Response Officer under Part 8 of the Canada Shipping Act (2001). This course examines the powers of a PRO, specific procedures related to vessel directions and detentions and the legal framework and implications surrounding the execution of those powers. Course participants also learn sampling procedures and gain an understanding of the role of other government agencies involved in a marine pollution incident.

Pollution Prevention Officer (PPO) Training

This 40 hour course is currently provided by the Marine Safety Branch of Transport Canada. It is a prerequisite for any officer of the Canadian Coast Guard to be delegated Pollution Prevention Officer (PPO) powers under the *Arctic Waters Pollution Prevention Act*. Participants learn the existing pollution prevention and response regime, the powers of a PPO and the specific tasks of prevention, control, investigation and prosecution.

Small Vessel Operator Proficiency

This 21-hour course meets the training needs of the small vessel master. This course is required by regulation (for vessels less than 5GT on sheltered and near coastal voyages) and teaches participants to effectively manage safety of those on board, protect the vessel from damage and protect the marine environment.

Basic Barge Operator Training
This course was developed and is delivered by regional ER staff. Through both classroom and practical sessions, the course introduces participants to safe boating practices and procedures, rules of the road, collision regulations, load plans for pollution response vessels, safe deployment of oil spill response equipment and basic trailer towing and maneuvering.

Single Side Sweep System
The single side sweep is an equipment suite designed to allow one vessel to perform oil containment and recovery, and allow for temporary storage. This two day training session is provided to some ER staff and crews of Canadian Coast Guard vessels that can support this equipment. This training typically is conducted with crews who have previously completed BOSRC.

HAZMAT Awareness
This 6-hour course is intended for First Responders on the scene of a hazardous materials incident and shows how to assess the incident. Topics include; First Responder's role and responsibilities, scene safety, recognizing and identifying hazardous materials, incident management, and sources of assistance.

HAZMAT Technicians Level
This 40-hour course is designed for responders to releases or potential releases of hazardous substances. The focus is on recognizing and evaluating a hazardous materials incident, organizing the response team, protecting response personnel, identifying and using response resources, implementing basic control measures, decision-making, and protecting the public and environment. Emphasis is on hands-on use of equipment practically applying lecture information through exercises. Participants will wear fully encapsulating suits.
Prerequisite: Hazmat Awareness.

(c) Specialty Training
Specialty training includes training that only select members of the Regional Response Team (RRT) will have to apply.

Shoreline Clean up and Assessment (SCAT)
This 24-hour course covers how oil impacts the shoreline. Specific topics include shoreline types and effects of oil, wind, waves and ice on shorelines. Shoreline protection and cleanup methods are described in depth. Field exercises are conducted as part of the training.

Media Training
This 16-hour course is designed to provide participants with the skills and knowledge to communicate effectively and proficiently with various forms of media. Topics include; developing and disseminating incident information to

news media, incident personnel, other appropriate agencies and organizations.

Communications System Training
This 8 hours hands-on course provides participants with the knowledge and skills to provide communications in support of a spill response. Topics include; mobile telephone, fax, and intercom set up, preparing communication plans, and internal/external spill response communications.

Wildlife Rehabilitation
The capture and treatment of oiled wildlife is typically assigned to the trained experts at Canadian Wildlife Service (CWS). This CWS training is periodically made available to outside agencies, and some ER staff may participate to facilitate a better understanding of each others' role at the time of a spill.

Financial Management
This training is provided by the Public Service Commission (PSC) and teaches government spending and cost accounting principles. It is imperative that any response team member who may have to purchase assets or manage contracts be familiar with these practices and procedures.

Planning Section

During a spill response operation, the planning section of the RMS will likely be populated with ER staff whose substantive positions are as Planning Officers within the branch. Therefore, the planning skills and training required to effectively and efficiently perform these tasks should be resident within our branch staff.

Should additional personnel be required to fulfill these roles, they would require training in RMS, as well as Site Safety (as required by OSH regulation). The required planning skills and spill response knowledge may be acquired through various training or experience factors, and would be assessed prior to assignment on the response team. In addition to planning skills, preferred training might include SCAT, FROST and/or BOSRC, and MSROC.

Logistics Section

During a spill response operation, the logistics section of the RMS will likely be populated with ER staff whose substantive position involves the tracking of spill response equipment inventory and human resources within the region. Therefore, the skills and training required to efficiently and effectively perform the logistics function should be resident within our regional ER staff.

Should additional personnel be required to fulfill these roles, they would require training in RMS, as well as Site Safety (as required by OSH regulation). The required logistical skills may be acquired through various training or experience factors (knowledge of IRCMS and TMA, BOSRC training) and would be assessed prior to assignment on the response team.

Finance Section

During a spill response operation, the finance section of the RMS will likely be populated by regional finance staff whose substantive positions involve government expenditure and cost accounting knowledge and application. Therefore, the skills and knowledge required to effectively and efficiently perform the finance function should be resident within regional Canadian Coast Guard staff. These personnel will require RMS and Site Safety training prior to deployment on a spill response team.

Training Records

Records for personnel trained in spill response and/or emergency management are maintained by the Region.

4.5 Exercise Program

Introduction

Under the guidelines of the National Exercise Program (NEP), the Environmental Response Branch will implement a Regional Exercise Program. This program will be conducted over a three-year cycle. Coordination of the program will be the responsibility of the Regional Exercise Officer (RXO) of the Environmental Response Branch. Exercises will be designed and conducted in coordination with departmental staff, CCG base staff and CCG vessels on a regular basis. The purpose of the Regional Exercise Program is to validate environmental response training and regional emergency preparedness standards, policies and procedures.

Canadian Coast Guard will, through regional and area-specific exercising, ensure high priority initiatives such as exercising complex equipment (i.e. Lori Brush skimmers, sweep systems and command/communications facilities) are undertaken and will use industry and private sources of personnel where possible and/or appropriate.

Exercise Planning Matrix

The matrix below represents a typical three year exercising cycle followed by Canadian Coast Guard. The program cycle is designed to test all 17-response functions as outlined under NEP as well as including the different types of exercises. It includes internal, external (with other government departments as well as private sector organizations) and international exercises.

Table 4.1 *- Central & Arctic Region Exercise Matrix*

EXERCISE TYPE	YEAR1	YEAR2	YEAR3
Notification	Quarterly	Quarterly	Quarterly
Management	2	2	2
Operational drills	3	3	3
Combined Functional	1	1	1
Full Scale	0	1	0

Notification exercises will test the regional call-out system. Some of these exercises will be internal to the branch, some will be a full regional call-out to all CCG and DFO staff as well as to external resources (eg: freight contractors to check their availability to move Marine Emergency Response Trailers (MERTs) or First Response Units (FRUs).

Management exercises will focus on the development of the spill through the Response Management System (RMS).

Operational Drills will focus on equipment deployments in packages (i.e. a First Response Unit, NOFI V-Sweep).

Combined Functional exercises will be an equipment deployment (operational drill) with the goal of implementing a tactic designed in one of the Region's Area Plan Annexes.

A *Full Scale* exercise will incorporate a management-type exercise with the concurrent deployment of a spill countermeasure system (system = pollution containment, recovery, primary and secondary storage devices)

Exercising Partnership

Canadian Coast Guard will endeavor to participate, by request and on a situation by situation basis, in exercises lead by Oil Handling Facilities (OHFs), certified Response Organizations (ROs) and other government agencies throughout the Region.

Central and Arctic Region is a part of the Canadian Coast Guard response community and as such is also part of the International Response Community. Canadian Coast Guard's regional boundaries are in such close proximity with our United States neighboring response communities that joint exercising is a high priority. Specifically this region conducts joint exercises in the geographic areas of the Great Lakes and the Beaufort Sea with the United States Coast Guard's (USCG) (9^{th}) ninth (Great Lakes) and (17^{th}) seventeenth (Alaska) districts, respectively.

Exercise Evaluation and Shared Learnings

An important part of the National Exercise Program is the evaluation and use of subsequent findings. Four types of information can be learned from an exercise, all of which lead to improvement of overall response capability.

1) Contingency planning
2) Response techniques
3) Response training
4) Exercise program development

The primary sources of the information and learning will be the formal exercise evaluation report that is produced for every exercise by the evaluation team. This formal exercise report will follow the format laid out in Section 11 of the *Canadian Coast Guard National Exercise Program Planning and Evaluation Guide*.

4.6 Inventory Management, Maintenance and Infrastructure

Inventory Response Control Management System

To ensure that a nationally consistent and effective state of preparedness is maintained, an Inventory Response Control & Management System (IRCMS) has been implemented which utilizes The Management Authority database as its main tool. CCG HQ administers this system in concert with regional IRCMS Officers. In this region the program is administered by the Logistics and Statistics Officer in the Operations Section.

This system has been developed to:

- Maintain a real time record of the location and quantity of resources;
- Maintain a proper state of readiness through a pro-active approach using work orders and preventative maintenance;
- Assist in keeping response managers informed about Environmental Response's state of preparedness;
- Assist in the tracking of National Response Team personnel or equipment assigned to National or International incidents

Pre-positioned Equipment Caches and Depots

Central and Arctic Region covers an extremely large geographical and culturally diverse portion of Canada. There are, in essence, two zones of operation which are entrenched in the *Canada Shipping Act*. These are:

- the <u>Arctic Zone</u>, or all areas of Canadian jurisdiction north of 60^0 North Latitude; and
- the <u>Central Zone</u>, dominated in a marine transportation sense by the Great Lakes, but which include the southern portions of Hudson and James Bay, along with the major waterways and watersheds of Lake Winnipeg, Winnipegosis, Lake of the Woods, and Lake Athabasca.

The Environmental Response (ER) Branch has pre-positioned equipment to facilitate and maintain an effective response operation. Response strategies in each of the two zones (Central or Arctic) are based upon identification of local and regional response. This is means that the equipment generally required for such a spill size is contained within the Region. This capacity is supplemented by nationally available resources, which would be "cascaded" from/to other regions when and if required. Preparedness capacities in other regions are identified in their respective Regional Response Plans.

Arctic Zone

Arctic Community Packs (ACPs) are placed in northern communities for rapid (local) initial response. Canadian Coast Guard provides initial response training to members of the communities so that they may effectively deploy equipment in the ACPs in the event of a spill. Access (keys) for the ACPs have been given to an official in each community in most cases. The Senior Response Officer (ER-Hay River) maintains the current key holder listing.

The inventory for each Canadian Coast Guard Arctic Community Pack location is listed in Table 4-2. The program has received funding under the Health of the Oceans Initiative to proceed with placing Arctic Community Packs in additional sites. The equipment profiles at the existing Arctic Community Pack sites will be changed to reflect characteristics of the community. The inventory at all communities will be "site specific" and will coincide with response strategies designed by the ER planning group. The locations for the proposed additional Arctic Community Packs are: Baker Lake, Broughton Island (Qikiqtarjuaq), Chesterfield Inlet, Churchill, Hall Beach, Kimmirut, Iqaluit, Pangnirtung, Tuktoyaktuk and Yellowknife.

The main base of operations with Environmental Response dedicated personnel is located in Hay River, Northwest Territories. This base is home to a Rapid Air Transportable (RAT) cache of equipment known as the "RAT150". The RAT150T used in conjunction with the "Delta" (Δ) 1000T meets planning standards for a 1000 tonne (T) response. The selection of equipment for the RAT150 must meet pumping rates / capacities of 1000T thresholds and be complimentary[2] to the equipment held in the Δ1000T depots.

The response package, warehoused in Hay River, will be maintained in 100% readiness during the shipping season. The equipment will be broken down and be containerized such that it will fit through the smallest cargo door of any of the selected aircraft. Equipment will be TDG compliant, be palletized as appropriate, and labelled for ease of selection and loading.

[2] The logistics of moving large bulky items (ISO containers) in the arctic necessitates a LCM, deck barge, cargo vessel, icebreakers or any combination thereof. Consequently it is estimated that the 1000T design capacity would be available staged on-scene in 5 - 7 days. Following the doctrine *something sooner rather than everything later* having 150T of the 1000T equipment suite air-lifted within 48 hours is preferable to having nothing until the entire 1000T capacity arrives a week later.

Table 4-2 *- Canadian Coast Guard Arctic Community Pack Locations*

LOCATION	EQUIPMENT SUMMARY			
	Boom (24")	**Skimmers**	**Boats**	**Storage**
Arctic Bay (Ikpiarjuk)	3,650'	TDS-118	16' Aluminum	Open top Tank
Cambridge Bay (Ikaluktutiak)	1,350'	TDS-118	16' Aluminum	Open top Tank
Cape Dorset (Kinngait)	1500'	TDS-118	16' Aluminum	Open top Tank
Clyde River (Kangiqtugaapik)	4,500'	TDS-118	16' Aluminum	Open top Tank
Coppermine (Kugluktuk)	1,350'	TDS-118	16' Aluminum	Open top Tank
Coral Harbour (Salliq)	1,500'	TDS-118	16' Aluminum	Open top Tank
Gjoa Haven (Uqsuqtuuq)	1,350'	TDS-118	16' Aluminum	Open top Tank
Holman (Ulukhaktok)	1,500'	TDS-118	16' Aluminum	Open top Tank
Rankin Inlet (Kangiqsiniq)	2,200'	TDS-118	16' Aluminum	Open top Tank
Resolute (Qausuittuq)	1,350'	TDS-118	16' Aluminum	Open top Tank
Hay River FRU +	1,000'	-	37' Seatruck 42' Cutter	-

In combination with the RAT150T, equipment found in the ∆1000T depots will be at a 1000T capacity. Hence, the delta or "∆" is the difference between the RAT150T and a full 1000T. The ∆1000T depots will have containerized heavier equipment (not suitable for air transport to smaller communities) augmenting the RAT150T to a 1000T capacity, ready to be loaded on deck barge, Canadian Coast Guard icebreaker or freighter. While response personnel cascade in to the spill site pre-identified local, CCG base and available ER personnel will mobilize to the centres and load the equipment on suitable marine transport.

Three ∆1000T depots are strategically located in the northern communities of Tuktoyaktuk (NorthWest Territories), Iqaluit (Nunavut), and in Churchill (Manitoba). For the purposes of response in Central & Arctic Region, Churchill is included in the Arctic Zone of operations despite it being south of 60° North Latitude due to the similarities in response characteristics that it shares with locations north of 60° North Latitude.

Table 4-3 *- Canadian Coast Guard Arctic Design Inventory*[3]

PCM equipment	Description	Hay River RAT150T	Tuk ∆1000T	Iqaluit ∆1000T	Churchill ∆1000T
Skimmers	Light to medium product /disk type	3	1	1	1
	Heavy product /weir type	0	2	2	2
Boom	24” river type	0	10000’	10000’	10000’
	24” lay-flat type	5000’	0	0	0
Land storage	4T Open top tank	0	0	0	0
	8T Open top tank	7	3	3	3
	45T shore bladders	3	0	0	0
O/w storage	Total (in 5-25T Seaslugs)	50	250T	250T	250T
Pumps	2” low pres / volume style	4	1	1	1
	4” trash	5	1	1	1
	3” positive displacement	6	1	1	1
Vessels	“Car-topper” + 9.9hp	0	0	0	0
	Seatruck	0	2	2	2
	RAT RHI	2	0	0	0
Generators	5KW gas	7	2	2	2
Pressure washer	Larger hot water type	1	1	1	1
	Small cold water type	3	1	1	1
Incinerator	Sorbent	2	0	0	0
	Liquid waste	2	0	0	0

Central Zone

The Central zone is dominated by the Great Lakes and has well defined road transportation infrastructure.

Local / first response inventories have been established at all regional Canadian Coast Guard shore-side facilities that have fleet assets or a significant number of program vessels and that have operational personnel to deploy the equipment. Standardized inventory consists of a 20-24’ trailer with a 1000’ (nominal) of 24” boom and related accessories.

The 2500T Rapid Road Transportable cache is centred around the St. Mary’s River and from time to time in major CCG facilities in Ontario. The response package warehoused in a series of 45’ transport trailers will be maintained in 100% readiness during the shipping season. The primary purpose of the RRT 2500T system is significant containment of resources; shoreline, sheltered, and off-shore sweep and recovery ability; and staging and storage transfer area equipment.

[3] Inventories in Tuktoyaktuk and Iqaluit are at 95% completion. The Churchill Depot is at about 50% (pending the construction of a new and adequate facility) with the bulk of the inventory in storage at the Thundar Bay Coast Guard base. The RAT 150 needs an evaluation of the command and control component as well as storage for the second Saccke burner.

***Table 4-4** Canadian Coast Guard RRT 2500T Design Inventory*

PCM equipment	Description	BOOMERT #1-5 (each)	SKIMMERT #1 and #2[4]	Softside
Skimmers	Light to medium product/ disk type	-	3	
	Heavy product/ weir type	-	1	1
Boom	24" river type	4000'		
Sweep	36" Nofi V-sweep	-		1
Land storage	4T Open top tank	-	7	1
O/w storage	25T Towable bladders	-	4	4
Pumps	3" positive displacement	-	4	1
Generators	5KW gas	-	2	

***Table 4-5** Canadian Coast Guard locations for First Response Units (FRUs)*

Location	Relevant Area Plan(s)	Primary custodian	Secondary custodian
Amherstburg	Lake Erie/St. Clair-Detroit	SAR crew	ITS field services
Cobourg	Lake Ontario	SAR crew	
Gimli	Lake Winnipeg	SAR crew	
Goderich	Lake Huron	SAR crew	
Kenora	Lake of the Woods	ITS field services	
Kingston	Lake Ontario	SAR crew	
Meaford	Lake Huron	SAR crew	
Parry Sound	Lake Huron	ER personnel	ITS field services
Port Dover	Lake Erie	SAR crew	
Port Weller	Lake Ontario	SAR crew	
Prescott	St. Lawrence River	ER personnel	ITS field services
Selkirk	Lake Winnipeg	ITS field services	
Thunder Bay	Lake Superior	SAR crew	ITS field services
Tobermory	Lake Huron	SAR crew	
Hay River	Mackenzie River & Delta	ER personnel	ITS field services

[4] An additional SkimMERT is being added this year to accommodate additional hoses. The exact configuration of each SKIMMERT is not known yet so the inventories will remain listed together for this year.

Section 5 - RESPONSE OPERATIONS

5.1 Pattern of Response

Based upon the principles outlined in the *National Response Plan*, *(Sections 1.3, 1.5 & 4.4),* Central and Arctic Region assesses, notifies relevant parties, and initiates the tasking/deployment of necessary resources. This is based upon the determination of CCG's role as Lead or Resource Agency and the appropriate CCG Posture. The Duty Officer (DO) is tasked with this initial assessment, which is then verified by the Superintendent, Environmental Response. The appropriate response is activated by the Superintendent who in turn assigns an On-scene Commander (OSC) or Federal Monitoring Officer (FMO) and notifies Canadian Coast Guard (CCG) Management. Upon termination of the incident cost recovery actions are undertaken. To illustrate the generic process see Figure 5-1-Typical Sequence of Events and Table 5-1-Typical Functions Descriptions has been provided.

CCG Expectations of Ships for Response

In most instances when a spill occurs the initial report will trigger the mobilization of local response organizations. It is not normally practical for ship personnel to be directly involved in the clean up activities.

<u>Small Spills</u>

Ships are expected to take whatever actions listed in their Shipboard Oil Pollution Emergency Plan (SOPEP) that are reasonable and necessary to prevent the oil from escaping over the side and having done so, to take action to clean-up the oil contained on deck. Spilled oil should not be washed overboard, nor should degreasers or dispersants be used on spilled oil in the water. Once the oil is in the water, the ship's ability to respond in a practical manner is greatly reduced. It is Canadian Coast Guard's expectation that a response organization or other competent contractor be called upon to provide operational response capability at the discretion of the Polluter.

Where there is no availability of local response contractors or where there is a delay in response activation, the Master of the vessel should consider the use of available materials to contain and clean up the spilled oil by, for example, using ship-stocked absorbent material or utilizing mooring ropes or air filled hoses as makeshift booms.

<u>Large Spills</u>

The ship is restricted as to what action it can take to respond to a major spill. In the case of a casualty the safety of the ship and crew take priority. Therefore the ship's actions will be limited to reporting the incident details to the appropriate authorities and to ensure that a response is initiated. In large spills it is Canadian Coast Guard's expectation that the Polluter appoint an On-Scene Commander (OSC) which may be a representative of the company that owns the ship or the ship's insurer.

Canadian Coast Guard needs to be kept informed as to the escalating response costs accrued by the Polluter during a response in order to prepare for the possibility that the Polluter will cease their response activities once their Limit of Liability is reached.

CCG expectations of Oil Handling Facilities (OHF) for Response

In most instances when a spill occurs, the initial report will trigger the mobilization of the facility response team. It is normal, in most cases, for the oil handling facility personnel to be the initial responders when a spill occurs.

<u>Small Spills</u>

For the purpose of this plan, a small spill will be defined based on the maximum oil transfer rate of the oil handling facility (i.e. what Level it is assigned under the *Canada Shipping Act, 2001),* which directly links to the minimum spill size to which it must be prepared to respond to within one hour. Oil handling facilities are required to have the resources on site to contain a spill of a minimum size within one hour and have the resources required to recover, or where the oil cannot be recovered the resources to control a spill of a minimum spill size within six hours. Response organizations may be called upon to provide additional operational response capability at the discretion of the Polluter.

<u>Large Spills</u>

For the purposes of this plan, any spill above the facility's minimum spill size will be characterized as a large spill. Oil handling facility personnel are still expected to deploy their on-site equipment. Response organizations will likely be called upon to provide additional operational response capability at the discretion of the Polluter.

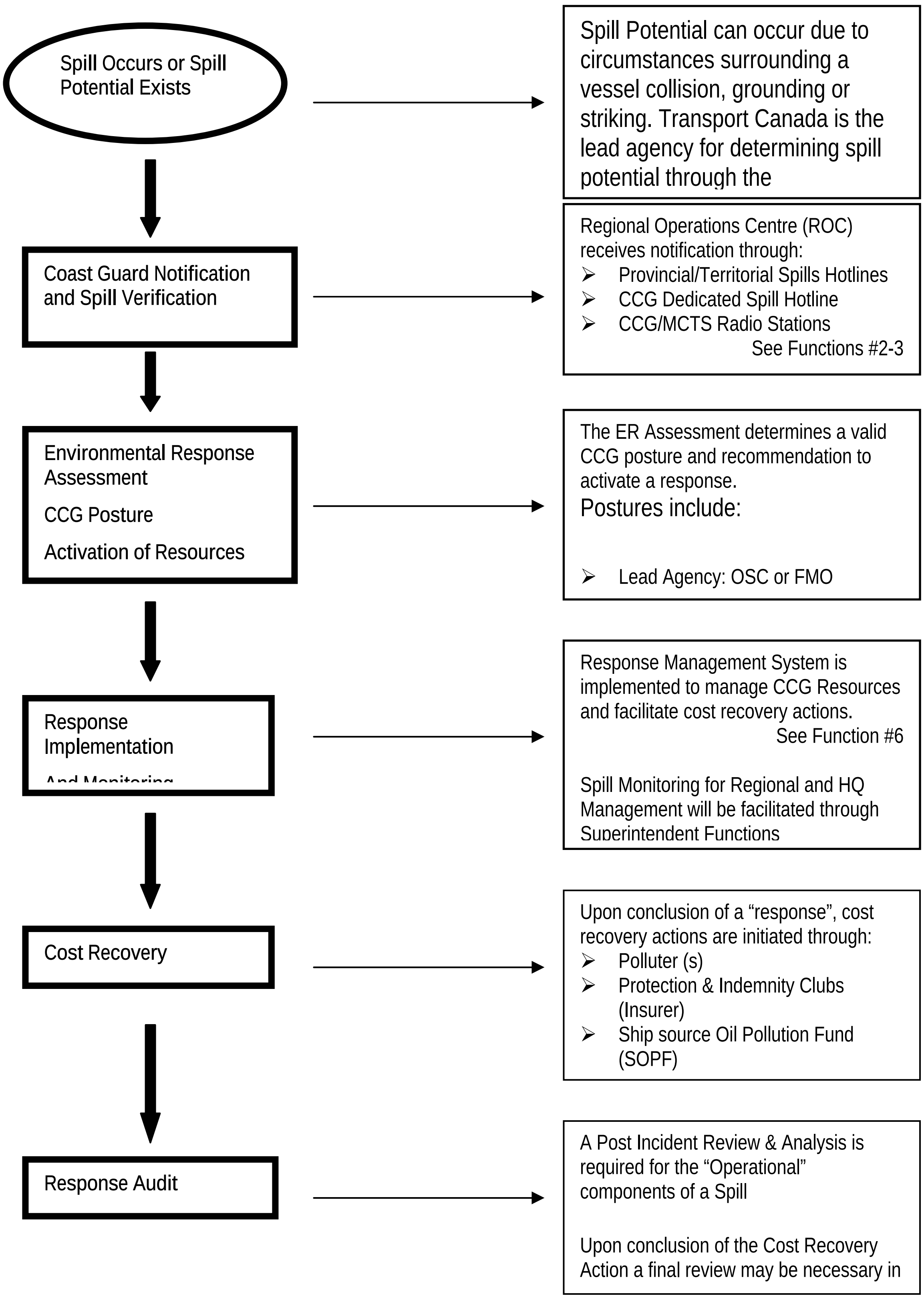


***Figure 5-1** - Pattern of Response – Typical Sequence of Events*

Table 5-1 *- Pattern of Response – Function Descriptions*

Function		Description
1	**Responsible Party/Third Party Functions** *(Spill occurs or sufficient potential risk exists)*	• Spill is sighted/reported. Spill reports originate from source (to regulatory body) or by third party (to various emergency or dedicated pollution hotlines) • Transport Canada is responsible for determining potential risk
2	**Spills Hotline Functions** *(Canadian Coast Guard Notification)*	• Assessment for dissemination • Dissemination (fan out according to applicable procedures) to relevant parties, calls from other spill hotlines are received by CCG-ROC.
3	**CCG-ROC Duty Officer Functions** *(Canadian Coast Guard Spill Verification)*	• Spill Assessment-pollution verification ➢ Mandate Confirmation ➢ Pollution Verification ➢ Source Credibility • Notification to ERDO • Dissemination • Initiation of MPIRS
4	**ER Duty Officer Functions** *(Environmental Response Assessment – CCG Posture)*	• Spill Assessment-response analysis • Source Control/Mitigation • Safety Issues • Tactical & Logistical Issues • Recommendation to Superintendent of likely Response Posture • Documentation – MPIRS
5	**Superintendent Functions** *(Environmental Response Assessment – Activation of CCG Resources)*	• Response Posture Evaluation ➢ Potential Risk to CCG Personnel and Equipment ➢ Propriety of request ➢ International Implications • Identification of OSC/FMO • Obtain an Order-In-Council (Arctic) • Obtain a Finance Code & Regional File Number • Notification of Senior Management and ongoing monitoring • MPIRS documentation • Obtain AC CCG sign off on MPIRS situation report
6	**OSC/FMO Functions** *(Response Implementation*	• Management or monitoring of response using the Response Management System (RMS). Escalation or de-escalation in accordance with needs of the incident. • Consolidation of all documentation upon conclusion of the response for Cost Recovery purposes. • Coordinate final debrief to facilitate future improvements to the systems and processes in place.
7	**Chief Financial Officer Function** *(Cost Recovery)*	• Utilizing CCG Ship-source and Marine Pollution Response Costing Principles and Documentation Standards (DFO 6332) compile pollution response costs recovery claim.

8.	**Internal Review Team Functions** *(Audit)*	• Utilizing the National Exercise Program Planning and Evaluation Guide, a Team is selected to complete the Post-Incident Review of an incident. • Improvements & corrective actions are to be documented

5.2 Spill Potential or Pollution Risk Assessment

Given an actual spill (i.e. pollutant in the water), the activities specified in this plan are rather obvious. However, in the event of vessel grounding, striking or collision that does not immediately result in a release, the responsibility for determining the risk of pollution rests with a Pollution Prevention Officer (PPO) within the Marine Safety (MS) branch of Transport Canada (TC). Should TC-MS be unable to make that determination, the Canadian Coast Guard (CCG), Environmental Response Duty Officer (ERDO) will complete that requirement. In some cases this may involve engaging a marine architect as no accredited expertise for vessel stability assessment resides within the ER section.

For all other areas where Canadian Coast Guard is the Lead Agency, this activity shall be considered the responsibility of the Canadian Coast Guard, Environmental Response Duty Officer.

5.3 Notification

To facilitate the notification of Canadian Coast Guard, and in addition to the existing Marine Communications system, a series of call-out or “Spill Hotline” agreements with the Province of Ontario, Nunavut and Northwest Territories and other Federal Departments within the Region have been implemented.

In addition, Central and Arctic Region, provides a 24 hr public access spills hotline:

24 hour toll free - Spills Hotline:
1-800-265-0237

Notification may occur through various mechanisms, depending upon the manner in which the spill (incident) occurs.

5.4 Verification

In all cases, spill information is initially processed and verified through the Regional Operations Centre (ROC) located in Sarnia, Ontario (See Section 3.3 – Organization). The ROC Officer on duty:

1. Determines whether the pollution is within Canadian Coast Guard’s mandate as Lead Agency or as a potential Resource Agency
2. Establishes the credibility of the source

3. Identifies the following:
    - Incident name (nature of incident)
    - Time of call (local / UTC)
    - Time of spill (local/UTC) *(if available)*
    - Reported by / call back particulars
    - Source determination
    - Incident background and description of clean-up activities (if any)
    - On-scene environmental/atmospheric conditions
    - Pollutant type and quantity
    - Verifying party contact information (as applicable)
4. Initiates an MPIRS entry for the following cases:
    - Originally pursuing verification as Canadian Coast Guard mandate but additional information about source changes lead to another agency
    - Canadian Coast Guard mandate and verified no pollution
    - Canadian Coast Guard mandate and verified pollution
    - Likely to impact on / impacting on foreign waters
    - Significant impact on region, though not falling under Canadian Coast Guard mandate.
    - Request for Canadian Coast Guard as a resource agency.
5. Enters information into MPIRS (indicated in #3 above) as well as name of paged ERDO.

This information is then relayed to the Environmental Response Duty Officer to determine Canadian Coast Guard posture. It should be noted that all spill incidents, irrespective of CCG's mandate, may require Canadian Coast Guard resources if requested (see Resource Agency Role in Section 1.5 of the *National Response Plan).*

By agreement, spill verification will be completed by the Regional Operations Centre (ROC) Duty Officer*.* The verification will be complete when the ER Duty Officer is advised where Canadian Coast Guard is Lead Agency. (see Figure 5.2 Pollution Verification Process and Figure 5.3 Response Analysis Process)

5.5 Spill Assessment – Environmental Response Duty Officer

To facilitate the requirement for efficient and rapid notification and assessment of incidents, Central and Arctic Region, in accordance with the *National Response Plan,* Section 4.4, has instituted a 24-hr year round monitoring regime integrated with the Regional Operations Centre (ROC). The following sections identify the context in which this activity is carried out.

Coordination

The coordination of the ER Duty Officer is the responsibility of the ER Regional Emergency Operations Officer (REOO). These duties include assigning shifts in an equitable manner, keeping records of the duty officer schedules, maintaining equipment required to perform ER Duty Officer functions, reviewing individual ER Duty Officer performance, reviewing ER Duty Officer procedures, and liaising with the ROC and National HQ.

Performance

The ER Duty Officer function shall be performed by the following positions provided sufficient experience, appropriate training, and at the discretion of the Superintendent ER:

- ✓ Senior Officers
- ✓ Those in capacity to act for Senior Officer.

Review

The ER Duty Officer procedures shall be reviewed in reaction to:

- Changes at the Regional Operations Centre (ROC) affecting the ER Duty Officer function
- Changes in Canadian Coast Guard (CCG) policy on the response to ship source pollution
- In consideration of accepted recommendations stemming from exercises and operational responses.

The individual officer performance shall be reviewed in context of their execution of a spill assessment.

Responsibilities

At the beginning of the ER Duty Officer's shift the following are required:

- Functioning communication equipment (pager, cell phone/Blackberry);
- The necessary analytical tools (e.g. spill assessment forms, Greenwood's Guide to Great Lakes Shipping, Area Plans, Oil Spill Response Field Guide, OSH reference tools, and the CANUTEC Emergency Response Guide book.)

During the ER Duty Officers shift the following are required to be complete:

- MPIRS cases for any spill reports that required ER Duty Officer analysis by noon of the next business day;
- Extra Duty Reports;
- Notification of the next ER Duty Officer and the ER Regional Emergency Operations Officer of any on-going cases.

Availability

The availability of the ER Duty Officer is 24 hours/7 days a week. Pages must be responded to within 10 minutes of notification. Should the ER Duty Officer (DO) be unable to fulfill their duties at any time during the shift, they are required to notify the ER Regional Emergency Operations Officer (REOO) immediately who will notify the ROC of any changes immediately. The following activities conflict with the performance of the ER Duty Officer function:

- travel out of country / region / pager range;
- inability to respond immediately due to performance of other job functions (instructing a course, running an exercise, delivering a presentation, involved in a maintenance run that would be too difficult to reschedule, chairing a meeting, or participating in any activity that requires attendance or would be inappropriate to leave);
- inability to respond immediately due to personal reasons (vacation, sickness, etc.).

Should an individual become unavailable for a significant portion of the shift for reasons noted above, that shift may be assigned to another officer at the discretion of the ER Regional Emergency Operations Officer.

Function

The primary function of the ER Duty Officer is to complete an initial incident assessment and analysis, making a recommendation to the Superintendent of ER as to the appropriate course of action. [**]

The initial assessment will be complete for the following cases:

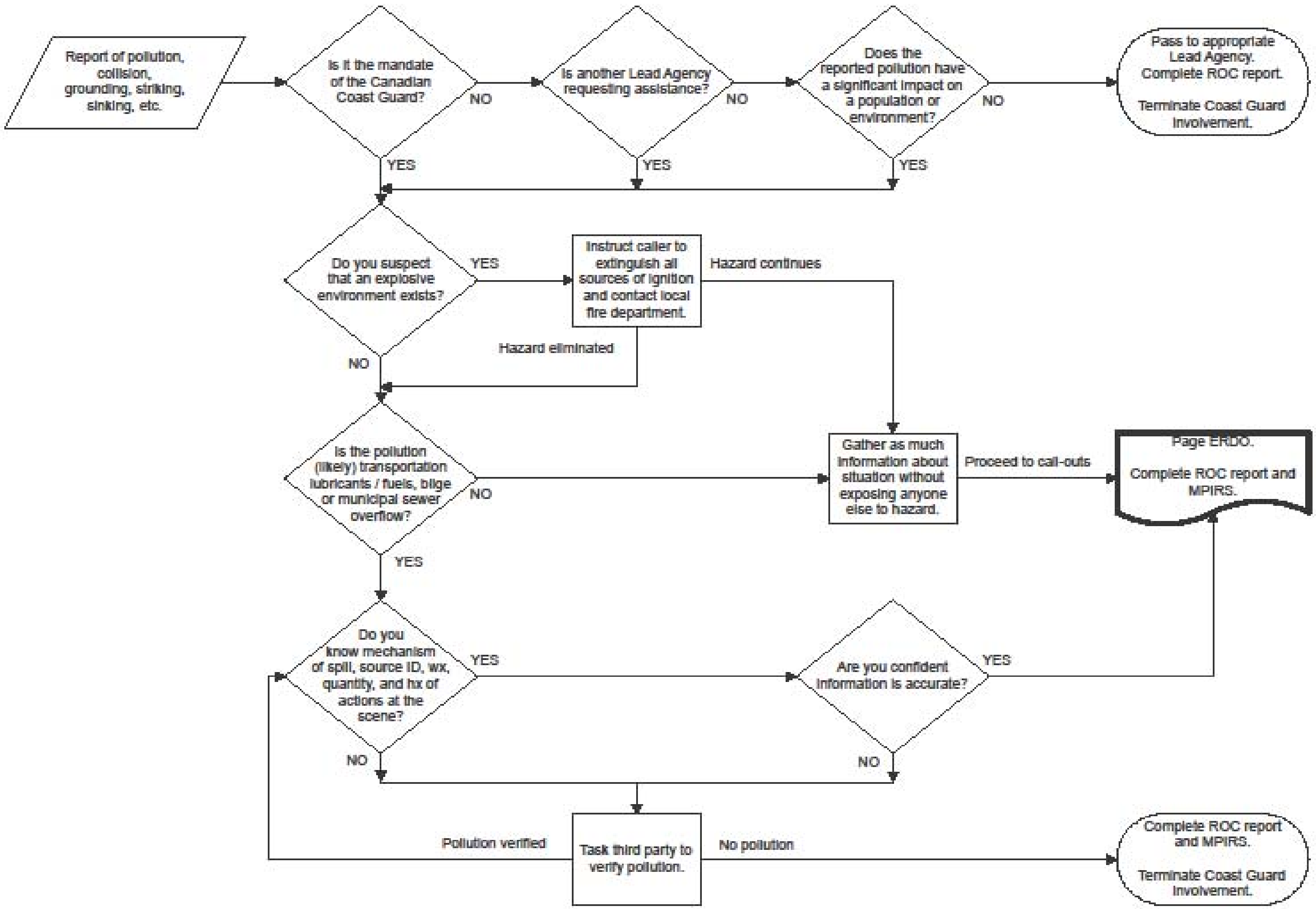
- Canadian Coast Guard mandate and verified pollution
- Likely to impact on / impacting on foreign waters
- Significant impact on region, though not falling under Canadian Coast Guard mandate.
- Request for Canadian Coast Guard as a resource agency.

The analysis function is complete when the Superintendent ER is informed and advised of the recommended course of action that will consider the following (see flow chart):

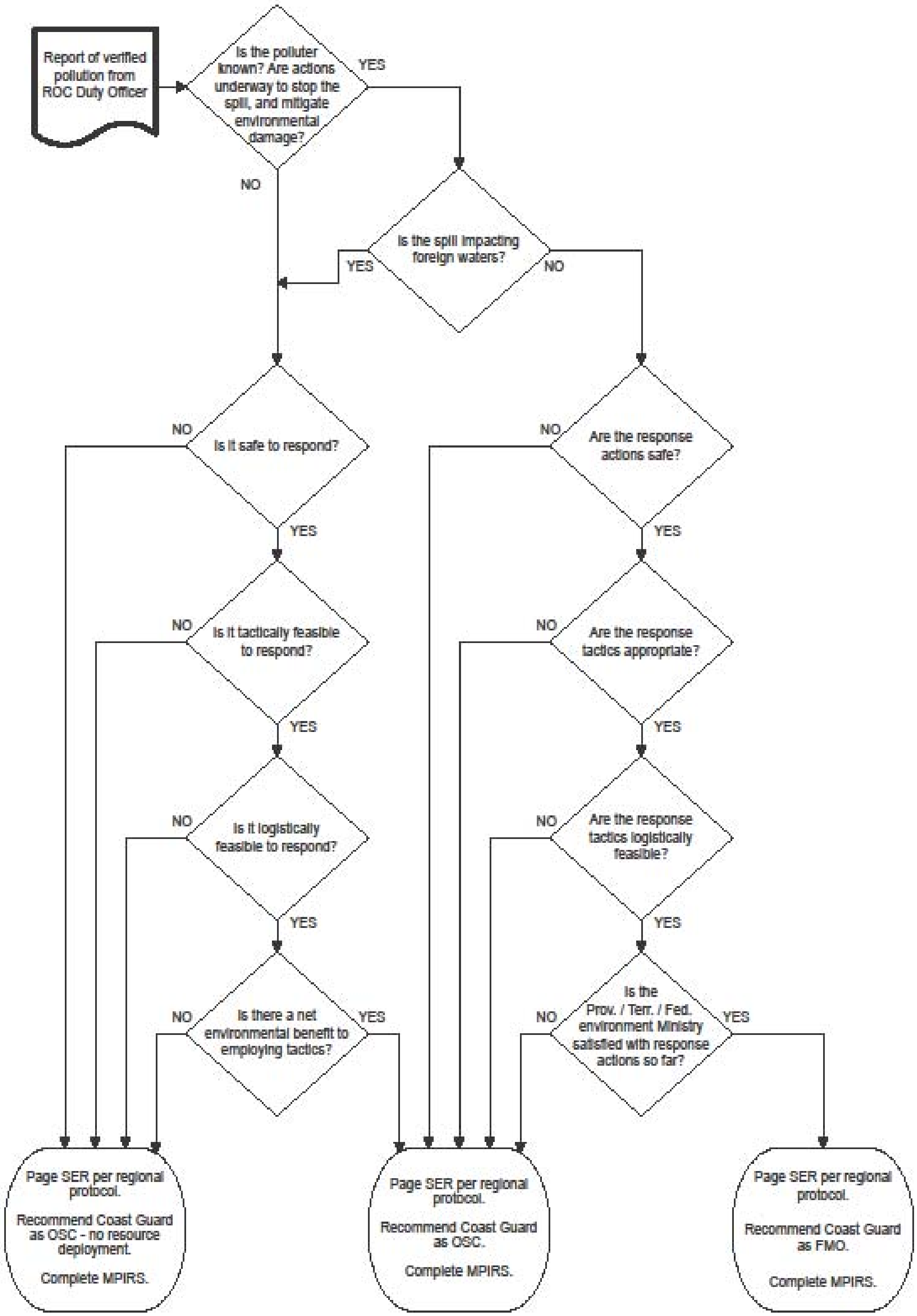
- polluter's actions and intentions (if applicable);
- safety concerns, tactical, logistical, and environmental feasibility of any response.

[**] The ER Duty Officer does not need to notify the Superintendent of any incidents that require "no activation" of CCG resources (assets/personnel) in monitoring/clean-up activity.

Spill assessment: *pollution verification process*



Spill assessment: *response analysis process*



5.6 Activation of Canadian Coast Guard Response Resources

In the event of small (0-150 T) to medium size (150-1000 T) spill incidents, the Superintendent, Environmental Response, acting upon the assessment provided by the Duty Officer, initiates/activates the appropriate response. This entails, but is not limited to, the following activities:

- Identification of overall health and safety risks to response personnel.
- Establishing the propriety of the recommended response posture. This includes the verification of international issues in border areas.
- Verification of Canadian Coast Guard capability to respond, impact on normal regional operations and, if necessary, the potential requirement for the notification and activation of the National Response Team.
- Assignment of the designated On-Scene Commander (OSC) or Federal Monitoring Officer (FMO). SROs are typically assigned as FMO/OSC for incidents occurring within their geographic area.
- Obtaining the necessary Order-in-Council, for spills in Arctic Waters
- Obtaining the financial project code, and forwarding it to the OSC/FMO.
- Signing a contract with the Response Organization (RO) in accordance with PWGSC contracting rules.
- Creation and dissemination of initial situation report to Regional and National management in accordance with the *Safety and Environmental Response Systems (SERS) – Incident Notification Guidelines*.
- Completion of MPIRS to document above activities.

For significantly larger spill incidents (1000T and above) the Superintendent, Environmental Response shall immediately assume the OSC/FMO role, notify Regional and National management of the situation and initiate the Response Management System (RMS) (and activation of the National Response Team, if necessary) in addition to the above activities. Upon stabilization of the immediate emergency, the Assistant Commissioner, Canadian Coast Guard, Central and Arctic Region and/or Director General, Canadian Coast Guard shall assess the requirement for assigning a new OSC/FMO.

5.7 Response Implementation

As stated previously (Section 4 - Preparedness), the Canadian Coast Guard will employ the Response Management System (RMS) as its primary management and operational tool. At the heart of this system is the development of clear obtainable objectives and the implementation of the supporting tactical deployment. This is achieved through the creation of incident action plans spanning specified operational time periods. For small spills these plans can be rather informal. As spill size and impacts increase, so to will the complexity of operational assignments and hence a need for greater formalization of the Incident Action Plan.

All operations shall be carried out in accordance with the Guiding Principles set out in *Section 1.3* of the *National Response Plan* and the *Oil Spill Response Field Guide* (ISBN 0-660-16112-5).

Central and Arctic Region covers an extremely large geographical and culturally diverse portion of Canada. There are, in essence, two zones of operation which are entrenched in the *Canada Shipping Act*.
These are the:

- <u>Arctic zone</u>, or all areas of Canadian jurisdiction north of 60^0 N Latitude;
- <u>Central zone</u>, dominated in a marine transportation sense by the Great Lakes, but which include the southern portions of Hudson, James and Ungava Bay, along with the major waterways and watersheds of Lake Winnipeg, Winnipegosis, Lake of the Woods, and Lake Athabasca.

<u>Arctic zone</u> – first response
The highest risk of pollution in the arctic is during a ship fuel transfer to facilities in Canada's northern communities. Should pollution occur, the vessel and oil handling facility have responsibilities to implement their Oil Pollution Emergency Plans (OPEP) that deal with source control. The next step would be for the community to respond using its response plan, protecting the identified priority area(s) and employing the response equipment in an Arctic Community Pack, if so equipped.

<u>Arctic zone</u> – escalation
If the pollution is beyond the ship, facility, and community response then the Rapid Air Transportable (RAT)150T will be the first line Canadian Coast Guard ER response (Arctic icebreakers or Special River Nav-aid Tenders may have been on-scene first). Upon activation of the RAT150T, standing offers with aviation contractors will be called up. Closest ER personnel will be dispatched to the community to assess, plan, assemble (and train) responders, while preparing to stage the in-coming equipment. The Hay River base personnel will transport the pallets to the airport where they will be loaded into the awaiting airframe. Upon arrival the pallets will be unloaded and a trailer tongue and wheels affixed to the pallet to facilitate movement (by ATV if necessary) to a forward staging area and ultimately to a beach site. The timeframe for full forward staged capacity with personnel at any community with suitable runways is under 48 hours.

The hospitality industry of Arctic communities can be rapidly overwhelmed with the influx of as little as 10 people. Experience has shown that these communities could only support 10-15 additional personnel and only offer 10-15 community responders. Consequently, the RAT was designed considering the amount and type of equipment that is most easily handled by a combination of trained

Canadian Coast Guard personnel and community responders. The RAT150T response is predicated on an in-community response with the following positions identified in the table below:

Table 5-2 *Anticipated personnel usage for the RAT150T in an Arctic community*

Position	Canadian Coast Guard responder	Community responder
OSC	X	
OSC support		X
Chief Ops & Planning	X	
Logs – services	X	X
Logs – support	X	X
Ops skimming (A)	X	X
Ops skimming (B)	X	X
Ops shoreline (A)	X	X X X X
Ops shoreline (B)	X	X X X X
Ops booming vessel (A)	X	X
Ops booming vessel (B)	X	X
Transfer / disposal	X	X
Totals	**11**	**16**

Upon escalating beyond a RAT150T response, the ∆1000T will be stood up. Standing offers / arrangements with local contractors will be activated to move the containers / seatrucks to a location where they can be transferred to a ship / barge. If required, closest Canadian Coast Guard base personnel will be dispatched to the depot to assist. The closest suitable marine transportation asset will also be contracted to move the equipment to the spill site. The timeframe for full forward staged capacity with personnel is estimated at one week.

As the 150T response is predicated on an in-community response a larger spill would have to be supported by a Canadian Coast Guard icebreaker, rented camp barge, or flown in from surrounding communities.

Table 5-3 *Anticipated personnel usage for the 1000T in an Arctic community.*

Position	Canadian Coast Guard ER responder	CCG Fleet or professional contractor	Community responder
OSC	X		
OSC support		X	X
Chief of Planning	X		
Plan – response	X		
Plan – demobilization	X		
Chief of Logs	X		
Logs – services		X	X
Logs – support	X X	X X X	
Chief of Ops	X		
Air Ops		X	
Ops on-water	X X	X X X X	
Ops shoreline	X X		X X X X X X X X X X
Ops booming	X X	X X X X	
Transfer / disposal	X	X	X
Totals	**14**	**13**	**13**

Central Zone – first response

The highest risk of pollution occurring in the region is found in the Great Lakes. Statistically the areas in the Great Lakes of highest risk are the connecting channels due to volumes, numbers of transits, and convergence factors (existing VTS / navigational aid systems recognize this). Areas with traditionally high pleasure craft and small commercial craft traffic experience frequent (though low in volume) pollution incidents.

If the pollution is in the local vicinity of a Canadian Coast Guard Search and Rescue (SAR) station or facility with operational staff, a First Response Unit (FRU) may be deployed as an initial attempt at containment. If more equipment sweeps systems or recovery units are required then the Rapid Road Transportable (RRT) 2500T will be activated.

Transfer of Lead Agency

Transfer of Lead from CCG
Should an incident initially appear to fall within the jurisdiction of the Canadian Coast Guard yet later is determined to be another government agency's

responsibility, the CCG-appointed OSC or FMO will verbally acknowledge the transfer of Lead Agency responsibility followed by written confirmation on the terms of the transfer (this may require time for termination of a response contract with CCG and the establishment of a response contract with the appropriate Lead Agency.) When the Lead is transferred from CCG to another Lead Agency, CCG will submit an invoice of its response costs to the Lead Agency for response activities undertaken up to the time of transfer recognition.

Should the Lead Agency wish to retain CCG as a Resource Agency, the criteria in Section 7 of the *National Response Plan* of the *CCG National Marine Spills Response Plan* will apply.

<u>Transfer of Lead to CCG</u>

When the Lead is transferred to Canadian Coast Guard from another agency, the Canadian Coast Guard will incorporate the appropriate costs borne by the other agency in the initial stages of the spill into its claim to the Polluter or to the Ship Source Oil Pollution Fund, (SOPF) as the case may be.

Safety Procedures and Considerations

All petroleum cargoes are considered hazardous substances. Canadian Coast Guard command, clean-up, monitoring and verification personnel have protective equipment and training available to them up to Level “D”. All Environmental Response branch staff have been issued with a variety of personal protective equipment (PPE) and are expected to deploy to a spill site (includes exercises and training) with all appropriate gear. Safety glasses and rain suits with rubber boots and gloves are appropriate for Canadian Coast Guard's traditional verification of and response to oil pollution.

Bulk chemical carriers, rail cars, road trailers, sour (H2S) petroleum products or BTX (benzene, toluene, xylene) carried on oil tankers are all sources of substances for which Canadian Coast Guard personnel are not readily equipped for. In most cases where the pollutant reported is suspected to be from one of these sources Canadian Coast Guard assets should not be tasked to verify. If it falls within Canadian Coast Guard mandate the ER program personnel will get directly involved in the verification, likely looking to other government departments or contractors to continue with the assessment and response.

When the pollution is reported to the ROC by a member of the public, or by a credible professional as a mystery spill, closer examination of the circumstances or probable cause of the pollution will occur as part of spill verification. During the conversation with the individual reporting the incident the ROC Duty Officer will want to find out what it is that they observed. These are:

- Colour [typical petroleum silvery to rainbow to dark purple / brown or is it frothy, green organic matter, rusty, etc.]
- Odour [does it smell like gas, diesel, rotten eggs, no odour]
- Proximity to any likely source [vessel, industrial outfall, municipal outfall, midlake, mid channel, washed up industrial storage drum]

- Volumes [football field sized, shopping mall parking lot big, or a thin ribbon]
- Other factors [heavy rainfall in last 12 hours; seasonal conditions / times / areas known for algae blooms; fish or animal kills].

By picking up on any "flags" during an assessment it can be reasonably determined whether the pollution should not/should be classified as a hazardous substance (for which CCG personnel are unable to respond to). The ER duty officer will consult with experts in Environment Canada (EC), Spills Action Centre (SAC), and CANUTEC, as appropriate to determine the safety for personnel.

Alternative countermeasures

Alternative countermeasures are those non-mechanical techniques utilized in oil spill response operations such as in-situ burning, dispersant application, and shoreline cleaner application.

<u>Central Zone</u>
The likelihood of approval of in-situ burning operations on the Great Lakes or in connecting channels or inland lakes is minimal. The use of dispersants in the Great Lakes, connecting channels or in inland waterways will not be considered. Shoreline cleaner agents approved by Environment Canada may be considered.

<u>Arctic Zone</u>
In view of the difficulties associated with mounting an effective response in the Arctic, the CCG has recommended that further research be done in the areas of in-situ burning, the use of dispersants (reference Quebec paper) and other oil in ice recovery methods. This research should be operational R&D and assume that the product spilled is Arctic diesel and that the spill occurs during the Arctic shipping season.

5.8 Summary Report and Post Incident Review

It is regional policy to provide a Summary Report and/or conduct a formal Post Incident Review for incidents deemed noteworthy or valuable by the OSC/FMO or Assistant Commissioner, Canadian Coast Guard.

Summary Report

The summary report shall contain at minimum the following, but can include any information deemed relevant by the OSC/FMO.

<u>Summary Incident Report Format</u>

(a) Overview of Crisis Event

- spill source (not cause), initial environmental conditions and assessment of situation

(b) Spill chronology
- spill response activities and climate/wind /sea condition data
- key response objectives (success and failures in implementation), major shifts in tactics, other agencies involvement

(c) Costs and cost recovery issues
- total estimated cost summary
- identification of Cost Recovery requirements and options

(d) References
- Situation Reports

Post Incident Review

The main objective of a Post Incident Review is the evaluation of the incident to ultimately improve Canadian Coast Guard's effectiveness at spill response. To that end, this requirement is essentially similar to the principles of exercise evaluation. Therefore, when required, the review shall be conducted in accordance with the principles contained in the *National Exercise Program – Evaluation guidelines, Chapter 11*.

This entails six distinct tasks:

1) Brief the Evaluation Team
2) Brief the Response Team
3) Evaluate the Incident
4) Prepare a Preliminary Summary of Key Observations
5) Hold an Incident Debriefing Session
6) Prepare an Official Post Incident Evaluation Report

Post Incident Evaluation Report Format

(a) Executive Summary -Summarizes overall findings and observations

(b) Overview of Incident Objectives -Briefly describes the key objectives, environmental conditions and initial situation assessment

(c) Evaluation Techniques and Criteria - Describes the technique(s) (i.e. self, peer or independent evaluation) and the major evaluation criteria used

(d) Assessment of Key Incident Objectives - This provides a critical appraisal of the incident objectives or major shifts in tactics. Each key objective assessment will include the following:

Findings – A summary statement describing key positive and negative findings.

Specific Observations - Observed decisions and tasks noted during the incident by responders, management and interested parties.

Conclusions - Assessment of the impact of the finding on overall achievement of the incident objective(s)

Recommendations – A description of potential corrective or follow-up action required to implement the findings to improve overall marine spill response preparedness.

(e) Appendices or Attachments - May or may not be required

Section 6 – CLAIMS & COST RECOVERY

6.1 Purpose

The purpose of this section of the *Regional Response Plan* is to outline the requirements and regional processes to assist in the creation of a claim to the relevant fund or directly to a polluter.

The ability of Canadian Coast Guard to recover or pursue recovery of response expenses or costs associated with monitoring activities is set out in the *Marine Liability Act, Part 6, "Liability and Compensation for Pollution"*. This ability to recover costs is seen as the embodiment of the polluter-pay-principle set out in the *National Response Plan, Guiding Principles, Section 1.3*.
Note: That at this time there is no mechanism to recover monitoring costs from an oil handling facility.

In addition to the above and recognizing the potential financial risks and impacts to Canada, Canadian legislation also provides for the creation and maintenance of a Ship-Source Oil Pollution Fund, (SOPF). This fund, in addition to the International Oil Pollution Compensation Fund (IOPCF) and the Protection & Indemnity (P&I) Clubs, provides for the assessment of claims/loss against member ships and/or shipping companies. Neither of these funds hinder nor otherwise limit Canadian Coast Guard's ability to lay claims directly against a Polluter. However, the Polluter is only required to reimburse a claim up to its Limit of Liability. This limit is calculated using the guidelines established in the *Convention on Limitation of Liability for Maritime Claims (LLMC), 1976*.

6.2 Policy Guidelines

The following points serve as regional guidelines for pursuing cost recovery activities:

- The decision to seek cost recovery should be made based on common sense and in consultation with other operational and finance team members.
- Cost recovery should be avoided in situations where the administrative costs of recovery action exceed the dollars expected to be recovered.
- Cost recovery embodies the "Polluter Pays" principle.
- Costs incurred while acting as a resource agency must be recovered from the lead agency.
- Costs incurred while acting as OSC/FMO are recoverable from either the polluter, its P&I Club, the Ship-Source Oil Pollution Fund or from the International Oil Pollution Compensation Fund.

6.3 Responsibilities

On-Scene Commander/Federal Monitoring Officer (OSC/FMO)

The OSC/FMO is responsible for ensuring that complete and accurate documentation is provided for a timely and effective cost recovery process. The OSC/FMO is responsible for preparing all documentation necessary to initiate cost recovery.

Regional Finance Staff

Response, monitoring and administrative costs must be calculated in accordance with national financial accounting and recording practices. Senior administrative officers within Maritime Services may be called upon to provide expert advice as required. It is recommended that a regional finance representative be on-scene as soon as possible to help establish procedures, to safeguard documentation, and to ensure the integrity of the costing process.

Environmental Response Headquarters

The Environmental Response Senior Advisor for Cost Recovery and Claims will submit those claims that are intended for the Ship-Source Oil Pollution Fund and to International Fund Conventions in accordance with the guidelines specified by each. The Advisor will also issue equipment charge-out rates periodically for use by all regions.

6.4 Process

The Response Management System (RMS) documentation (field notes, Incident Action Plans, Minutes and meeting records, time sheets and any and all expense records, invoices/requisitions etc.) shall form the basis of data for the Cost Recovery action.

The Region will initiate cost recovery actions against the Polluter. Should the Polluter be unable or unwilling to pay the costs, the Region will forward the claim to HQ Senior Advisor for Cost Recovery and Claims for submission to the Ship-Source Oil Pollution Fund. Should the costs of the response exceed the Limit of Liability of the Polluter, reimbursement of costs will be through the SOPF and then through the IOPCF. Claims associated with mystery spills will be submitted directly to HQ for a claim against the SOPF.

6.5 Documentation

Proper documentation alleviates the need to reconstruct the incident after the fact, reduces the volume of questions, and adds credence to the claim. The key source of information that enables various parties to determine the degree of reasonableness of the actions taken and the costs claimed is the part of the cost recovery summary known as a “narrative”. That justification is considered to be a critical component to successful and timely claims.

The regional guideline for producing cost summaries and documentation handling is as follows:

Incidents of <u>minimum complexity</u> and limited expenditures (under $15K)

- Expenditures may be summarized within the body of the Final Report, including any description of "calculated" values (i.e. administration costs)
- Original invoices shall be kept on the dedicated spill file.

Incidents of <u>medium complexity</u> and moderate expenditures (up to $50K)

- Expenditures will be summarized in a single table by Cost Element within the body of the Final Report.
- A supporting cost summary document or appendix shall be created to provide a detailed cost summary by date. Copies of the expenditure documentation will be included.
- Original invoices shall be kept on the dedicated spill file organized by date.

Incidents of <u>high complexity</u> and significant expenditures ($50K plus)

- Expenditures will be summarized in a single table by Cost Element within the body of the Final Report. (similar to medium complexity incidents)
- A supporting cost summary document will be created summarizing the daily expenditures by individual cost element, followed by a cumulative summary of each cost element (spreadsheet of all daily summaries). The sum total of all cost elements will then be summarized for use in the final report.
- Due to the volume of transactions, copies of the expenditure documents will not be provided in the supporting cost summary document.
- Original invoices will be kept in their original state, filed by date and archived when feasible to a dedicated file.

Table 6.1 Sample Cost Element Table

Cost Element	Description
Personnel	Includes hourly regular and overtime costs associated with CCG Staff (includes EBP)
Equipment	Includes cost of all CCG assets, based upon established charge out rates
Purchases/Expendables	Includes expendables such as office supplies and PPE
Travel	Includes meals and accommodation costs incurred by CCG staff accordance with TB travel directive.
Contractors	Includes the costs of all private sector contractor/goods and services.
Administration	Includes the cost of CCG administration.
Total Estimated Cost	

6.6 References

- CCG Ship Source and Marine Pollution Response Costing Principles and Documentation Standards DFO2004-6332
- Cost Recovery of Ship Source and Marine Pollution Response Directive # D-4010-2001-01
- Cost Recovery Related Policies, Memorandum dated October 26, 1998, File AWE 1001-5-2-1 (AWEA)

6.7 Third Party Claims

While monitoring or responding to an incident, Canadian Coast Guard will refer all inquiries regarding third party claims to the Polluter. In the case of a mystery spill, the Canadian Coast Guard will encourage claimants to submit a claim directly to the Ship Source Oil Pollution Fund.

Section 7 - PLAN MAINTENANCE AND CUSTODIANS

7.1 *Maintenance Process*

Responsibility

The *Regional Response Plan* of the *Canadian Coast Guard Marine Spills Response Plan* for Central & Arctic Region is the responsibility of:

Assistant Commissioner, Canadian Coast Guard
Central & Arctic Region
520 Exmouth Street
Sarnia, Ontario
N7T 8B1
fax (519) 383-1991

Revision Requests

All requests or suggestions for revision to this plan should be forwarded, in writing, to the above noted address and should include the following information:

- Originator (including return address and telephone number)
- Date
- Subject (i.e. request for revision)
- Suggested change (including section and page number references)
- Reason for revision

All formally received requests will be acknowledged in writing and assessed for inclusion into the plan. Upon approval the revision will be distributed accordingly.

Revision Record

Upon receiving a revision transmittal, recipients are requested to ensure that its number is next in sequence to the previous issue, process the amendments according to the transmittal instructions and complete the revision record in this section.

Should there be any discrepancies or questions, the recipient should contact the Canadian Coast Guard, Assistant Commissioner, Central & Arctic Region at the above address.

The onus is on the plan holder to maintain a current plan.

7.2 *Canadian Coast Guard Custodians*

This document is structured to reflect the fundamental phases of Environmental Response (ER) activities and hence reflects the co-operative nature of each aspect of the Central and Arctic Region Environmental Response organization. In conjunction with this, each component has been assigned to a specific section within the branch (e.g. training is the responsibility of the Training Officer). The Assistant Commissioner – Canadian Coast Guard, Central and Arctic Region retains the overall responsibility for the document's implementation. The Emergency Plan Development Officer (EPDO) facilitates the physical management and co-ordination of this document.

These custodial relationships herein are designed to facilitate the annual review and maintenance of the *Regional Response Plan*.

Letter of Promulgation	Emergency Plan Development Officer
Record of Revision	Plan Holders
Section 1 – Introduction	Emergency Plan Development Officer
Section 2 - Agreements & Memoranda of Understanding	Emergency Plan Development Officer
Section 3 – Organization	Emergency Plan Development Officer
Section 4 – Preparedness 4.2 RMS	 Regional Training Officer
4.3 Planning	Emergency Plan Development Officer
4.4 Training	Regional Training Officer
4.5 Exercising	Regional Exercise Officer
4.6 Inventory Maintenance & Management	Regional Emergency Operations Officer
Section 5 – Response Operations	Regional Emergency Operations Officer
Section 6 – Claims & Cost Recovery	TBD
Section 7 - Plan Maintenance & Custodians	Emergency Plan Development Officer
Section 8 – Contacts	Emergency Plan Development Officer
Section 9 – References & Annexes	Responsibility for each annex is assigned in each Annex.

All unassigned sections shall be considered the responsibility of the Emergency Plan Development Officer unless otherwise indicated.

7.3 Plan Distribution

The *Regional Response Plan* shall be distributed to all holders of the *Canadian Coast Guard Marine Spills Response Plan*, in accordance with the Area of Responsibility set in Section 1 - Introduction. This includes the relevant Federal and Provincial Lead Agencies as described in the National Response Plan Section 1, sub-section 1.5; all Canadian Coast Guard Management; Facilities and Vessels; all Oil Handling Facilities and relevant certified Response Organizations by request and in accordance with Transport Canada-Marine

Safety, Compliance and Enforcement division. All subsequent revisions will be automatically distributed to these plan holders.

Any member of the general public wishing to obtain a copy may do so through the Fisheries and Oceans, Canadian Coast Guard, National Headquarters. These plan holders will not be advised of revisions.

Section 8 – CONTACTS

8.1 Pollution Reports for Canadian Coast Guard, Central & Arctic Region

To report a pollution emergency anywhere within Central & Arctic Region telephone the Canadian Coast Guard, Regional Operations Centre (ROC) toll free at:

1-800-265-0237

or report via

Marine Radio on VHF, Channel 16.

8.2 Other Lead Agencies that Maintain Spill Report Lines

- Ontario Ministry of the Environment - Spills Action Centre: 1-800-268-6060
- Territorial Spills Line – Arctic Alarm: 1-867-920-8130
- Manitoba Conservation: 1-204-944-4888
- Saskatchewan Environment - Saskatchewan Spill Centre: 1-800-667-7525
- Alberta Environment: 1-800-222-6514

8.3 Canadian Coast Guard, Environmental Response Branch (CCG/ER) Phone List – Regular Office Hours

Regional Office, Canadian Coast Guard **520 Exmouth Street** **Sarnia, ON N7T 8B1**	
Title	**Telephone**
Superintendent, Environmental Response	519-383-1954
Emergency Plan Development Officer	519-464-5126
Assistant Contingency Planning Officer	519-383-1953
Regional Exercise Officer	519-383-1978
Regional Emergency Operations Officer	519-383-1956
Environmental Training Officer	519-383-1957
Administrative Assistant	519-383-1951

Canadian Coast Guard Base 42037 McKenzie Highway Hay River, NT X0E 0R9	
Title	**Telephone**
Senior Response Officer	867-874-5557
Response Specialist	867-874-5558
Response Specialist	867-874-5559

Canadian Coast Guard Base PO Box 1000, 401 King Street Prescott, ON K0E 1T0	
Title	**Telephone**
Senior Response Officer	613-925-2865 x 157
Response Specialist (2)	613-925-2865 x 262
Logistics and Statistics Officer	613-925-2865 x 126

Canadian Coast Guard Base 28 Waubeek Street Parry Sound, ON P2A 1B9	
Title	**Telephone**
Senior Response Officer	705-746-2196 x 228
Response Specialist	705-746-2196 x 270
Response Specialist	705-746-2196 x 201

Section 9 – REFERENCES & ANNEXES

9.1 References

The following list includes those documents which supplement the Regional Response Plan.

Supplement	Custodian
Environmental Response Manual – Standard Operating Procedures and Directives	Canadian Coast Guard, Environmental Response, Headquarters
Response Management System User's Guide, version 3.0 (May 2006)	Canadian Coast Guard, Environmental Response, Headquarters
Environmental Response Superintendent's Manual	Superintendent, Environmental Response, Regional Office
Environmental Response Regional Health & Safety Plan	Environmental Response, Regional Emergency Operations Officer
National Exercise Program (NEP) Manual	Canadian Coast Guard, Environmental Response Headquarters
Inventory Control and Response Management System – TMA database	Regional Logistics and Statistics Officer, Environmental Response
DFO Crisis Communications Plan	DFO Corporate Services, Communications Branch

9.2 Annexes

The following Area Plans make up the Annexes to the Regional Chapter:

1) St. Lawrence River and Lake Francis
2) Lake Ontario
3) Lake Erie
4) St. Clair and Detroit River
5) Lake Huron, Georgian Bay and North Channel
6) St. Mary's River
7) Lake Superior
8) Lake of the Woods
9) Inland waters (South of 60°N Latitude)
10) Hudson and James Bay
11) Baffin Region
12) Keewatin Region
13) Kitikmeot Region
14) Great Slave Lake Region
15) Mackenzie River and Delta
16) Beaufort Sea and Amundsen Gulf

MEADOWBANK DIVISION

Habitat Compensation Monitoring Plan

In Accordance with Fisheries Act Authorizations NU-03-0190, NU-03-0191.3, NU-03-0191.4, NU-08-0013, and NU-14-1046

Prepared by:
Agnico-Eagle Mines Limited – Meadowbank Division

Version 4
February 2017

EXECUTIVE SUMMARY

General Information

This Habitat Compensation Monitoring Plan (HCMP) defines the sampling methods and criteria for success of the fish habitat compensation features described in Meadowbank's No Net Loss Plan (October, 2012) and subsequent addendum (Fish Habitat Offsetting Plan: Phaser Lake; November, 2016). In consultation with DFO, this HCMP is designed to meet monitoring and reporting requirements related to habitat compensation/offsetting as described in DFO Fisheries Act Authorizations: NU 03-0190 (All Weather Access Road, Condition 5), NU 03-0191.3 (Second and Third Portage Lakes, Condition 3 and 6),NU 03-0191.4 (Vault Lake, Condition 3 and 6), and NU-14-1046 (Phaser Lake, Condition 5). This plan will be updated to reflect conditions of future project authorizations and related offsetting plans.

Record of Changes

A record will document all significant changes that have been incorporated in the HCMP subsequent to the latest annual review. The record will include the names of the persons who made and approved the change, as well as the date of the approval.

Distribution List

Agnico Eagle Mines Limited will maintain a distribution list for the HCMP, providing information about all parties that receive the plan including mine personnel, departments, and outside agencies.

IMPLEMENTATION SCHEDULE

The implementation schedule for this plan is effective immediately subject to any modifications proposed by DFO as a result of the review and approval process.

DISTRIBUTION LIST

AEM - Environmental Superintendent

AEM – Environmental Coordinator

AEM – General Mine Manager

AEM – Site Services Superintendent

AEM – Field Services Supervisor

AEM – Engineering Superintendent

DFO Arctic Region Representative

DOCUMENT CONTROL

Document Control

Version	Date (YMD)	Section	Page	Revision
1	05/08			Initial document (Azimuth Consulting Group Inc.)
	26/03/09			Further detail by technical memorandum (Azimuth Consulting Group Inc.)
2	06/13	All	All	Document re-written to reflect updated NNLP (AEM, 2012b)
3	03/14	Added Section 4.3	15, 22-29	In consultation with DFO, AEM changed timing and frequency of monitoring back to the original DFO authorization timing.
4	02/17	All		Monitoring added for Phaser Lake in accordance with Fisheries Act Authorization NU-14-1046; Monitoring schedule amended for Portage and Vault Lakes

Version 4

Prepared By: Meadowbank Environment Department

TABLE OF CONTENTS

EXECUTIVE SUMMARY .... **II**

IMPLEMENTATION SCHEDULE .... **III**

DISTRIBUTION LIST .... **III**

DOCUMENT CONTROL .... **IV**

SECTION 1 • INTRODUCTION **1**

1.1 Background 1
1.2 Objectives 2

SECTION 2 • HABITAT OFFSETTING FEATURES **2**

2.1 Re-flooding of Dewatered Basins and Pits 3
2.1.1 Portage Lakes Area 3
2.1.2 Vault Lake and Phaser Lake Area 3
2.1.3 Dogleg System 7
2.2 Finger Dikes 7
2.3 Wally Lake Access 9
2.4 AWAR Fisheries compensation 9

SECTION 3 • HISTORICAL MONITORING **11**

3.1 AWAR Monitoring 11
3.2 Portage Area Monitoring 11
3.2.1 Interstitial Water Quality 11
3.2.2 Periphyton Community 12
3.2.3 Fish Use 12

SECTION 4 • MONITORING COMPONENTS AND METHODS **12**

4.1 Physical Components 13
4.2 Ecological Components 14
4.2.1 Interstitial Water Quality 15
4.2.2 Open Basin Water Quality 15
4.2.3 Periphyton Community 16
4.2.4 Fish Use 16

4.2.4.1 Portage Lakes, Dogleg Ponds, Vault Lake 16
4.2.4.2 Phaser Lake Monitoring 16
4.2.4.3 AWR R02 Compensation Monitoring 17
4.3 Frequency 18

SECTION 5 • QA/QC AND CRITERIA FOR SUCCESS 18

5.1 Laboratory QA/QC 18
5.2 Field QA/QC 18
5.3 Criteria for Success 19
5.3.1 Physical Structure 19
5.3.2 Interstitial Water Quality 19
5.3.3 Open Basin 20
5.3.4 Periphyton Community 20
5.3.5 Fish Use 20
5.3.5.1 Portage area, Dogleg Ponds and Vault Lake 20
5.3.5.2 Phaser Lake Monitoring 21
5.3.5.3 AWR R02 Compensation Monitoring 21

SECTION 6 • REPORTING AND PLAN REVIEW 21

SECTION 7 • REFERENCES 21

TABLES 21

LIST OF FIGURES

Figure 1. Conceptual drawing of habitat compensation features in the Bay-Goose Basin area 4
Figure 2. Location of pits, dikes and roads in the Vault Lake area 5
Figure 3. Potential finger dike locations 7
Figure 4. Aerial Photo of R02 Habitat Compensation Feature- Taken in September 2009 9

LIST OF TABLES

Table 1. Estimated timeline for the construction of fish habitat structures (adapted from Table 4-10 in AEM, 2012b). 21
Table 2. Example comparison of NNLP designs and as-built physical properties of habitat compensation features. 22
Table 3. Summary of monitoring methods, analytical parameters, sampling frequency and number of samples for dike faces and finger dikes (under MMER Schedule II TSF and DFO NU-03-0191.3). *Dike as-built designs were incorporated into the 2012 NNLP. Flooding is estimated to be completed in 2023 22

Table 4. Summary of monitoring methods, analytical parameters, sampling frequency and number of samples for compensation features constructed in the Portage basin (Under MMER Schedule II and DFO NU-03-0191.3). Year of re-flooding completion est. 2023 (F). Year of dike breach est. 2025. 27

Table 5. Summary of monitoring methods, analytical parameters, sampling frequency and number of samples for compensation features constructed in the Vault basins (under DFO NU-03-0191.4). Year of re-flooding completion est. 2028 (F). 30

Table 6. Summary of monitoring methods, analytical parameters, sampling frequency and number of samples for offsetting features associated with Phaser Lake dewatering. Year of re-flooding completion est. 2025 (F). 32

Table 7. Summary of monitoring methods, analytical parameters, sampling frequency and number of samples for access enhancement compensation features. 34

Table 8. Summary of monitoring methods, analytical parameters, sampling frequency and number of samples for All Weather Private Access Road R02 (bridge 1) habitat compensation features. 35

SECTION 1 • INTRODUCTION

1.1 BACKGROUND

Agnico Eagle Mines Limited (AEM) Meadowbank Division currently operates an open pit gold mine located on Inuit-owned land in the Kivalliq Region of Nunavut. The mine site is approximately 70 km north of the hamlet of Baker Lake. Mining rights for this site were obtained by AEM from Cumberland Resources Ltd. in 2007.

Since mining activities at this site were planned to result in the harmful alteration, disruption and destruction of fish habitat, a series of DFO Fisheries Act Authorizations have been required. In 2006, Cumberland Resources Ltd. developed a No Net Loss Plan (NNLP) in support of the initial application to DFO. This plan has since been updated and quantified losses to fish habitat that were expected to occur, and described the habitat gains that would be achieved through compensation measures or fisheries offsets.

The first DFO Fisheries Act Authorization (NU-03-0190) issued was for the All Weather Access Road, in 2007. This was followed with the issue of a Fisheries Act Authorization for the Portage lakes area (July 30, 2008; NU-03-0191).

As a result of discrepancies between the 2006 NNLP and the issued Portage Lakes Fisheries Act Authorization, as well as changes to construction feasibility and mine site designs, Meadowbank's NNLP was updated in October, 2012. An updated Fisheries Act Authorization for the Portage lakes area was provided in March, 2013 (NU-03-0191.3), and a new Authorization for Vault Lake was provided in May, 2013 (NU-03-0191.4). Following submission of an addendum to Meadowbank's NNLP (Draft Fish Habitat Offsetting Plan: Phaser Lake; February, 2016), Agnico Eagle received a Fisheries Act Authorization for Phaser Lake in July, 2016 (NU-14-1046).

In support of each application for a Fisheries Act Authorization, this Habitat Compensation Monitoring Plan has been developed and maintained for the Meadowbank site. The purpose of this plan is to describe the specific monitoring program that will be implemented to determine the effectiveness of fish habitat compensation or offsetting features. This plan will be updated to reflect associated offsetting plans and related project authorization conditions of future extensions of the Meadowbank mine. Habitat compensation monitoring techniques described in this plan are expected to be transferable to future offsetting measures. A summary of plan revisions is provided in the Document Control section.

Efforts have been made to update terminology used in this Plan to reflect the current Fisheries Act provisions (generally, habitat "offsetting" has replaced language regarding habitat "compensation"). However, to maintain continuity with previous versions and existing Fisheries Act Authorizations, it will continue to be referred to as the Habitat Compensation Monitoring Plan.

1.2 OBJECTIVES

In general, habitat gains at Meadowbank are planned to be achieved through re-flooding of de-watered lake basins and pit areas following construction of features such as dike faces and roads that act as reefs or shoals, access enhancements for isolated fish populations, and land-to-lake conversions. Based on the conditions in the Fisheries Act Authorizations described above, assessment of the structure and successful utilization of these features by fish are the primary goals of the monitoring program.

This work will be carried out as a targeted monitoring plan under the Meadowbank Aquatic Effects Monitoring Program (AEMP).

The objectives of this plan are:

1. To provide an overview of habitat offsetting features at Meadowbank
2. To summarize the habitat monitoring conducted to date
3. To describe the physical and ecological monitoring methods for each feature
4. To describe the quality assurance and control measures to be included in the monitoring program
5. To define the criteria for success
6. To present the monitoring frequency and reporting schedule

SECTION 2 • HABITAT OFFSETTING FEATURES

In the 2006 NNLP, habitat gains for the Meadowbank site were largely to be obtained from re-flooding of dewatered basins and excavated pits. The construction of boulder gardens, reef and shoal features within the dewatered basins were proposed to increase habitat value. In addition, large (19 ha) finger dikes and habitat mounts were planned for in-water construction in Second and Third Portage Lakes (outside the dikes) to provide supplementary habitat gains pre-closure.

Re-flooding of the dewatered areas remains the primary offsetting measure to be implemented at Meadowbank (AEM, 2012b; AEM, 2016a). However, based on the experience of AEM with in-water dike construction, the supplementary dike construction projects proposed previously were found to be technically challenging to construct without possible short-term impacts on the aquatic system. The updated 2012 NNLP therefore includes similar finger dike features, with modifications for improved constructability and reduced potential for impact to the receiving environment. A current schedule of completion for the habitat features is provided in Table 1.

2.1 RE-FLOODING OF DEWATERED BASINS AND PITS

As previously stated the major compensation measure proposed for the Meadowbank site is the re-flooding of dewatered basins and some associated pits following mining activities. In order to provide the greatest gain:loss ratio possible, considerations for improving fish habitat have been incorporated into the basin and pit designs (e.g. boulder gardens, backfilling of deep pits). During consultations prior to submission of the offsetting plan for Phaser Lake, it was determined that new pit areas that are not backfilled (BB Phaser Pit) would no longer be considered to have any habitat value when calculating offsets. However, re-flooding the former Phaser lake bed (non-pit area) and the backfilled Phaser Pit is considered to provide a habitat offset.

2.1.1 Portage Lakes Area

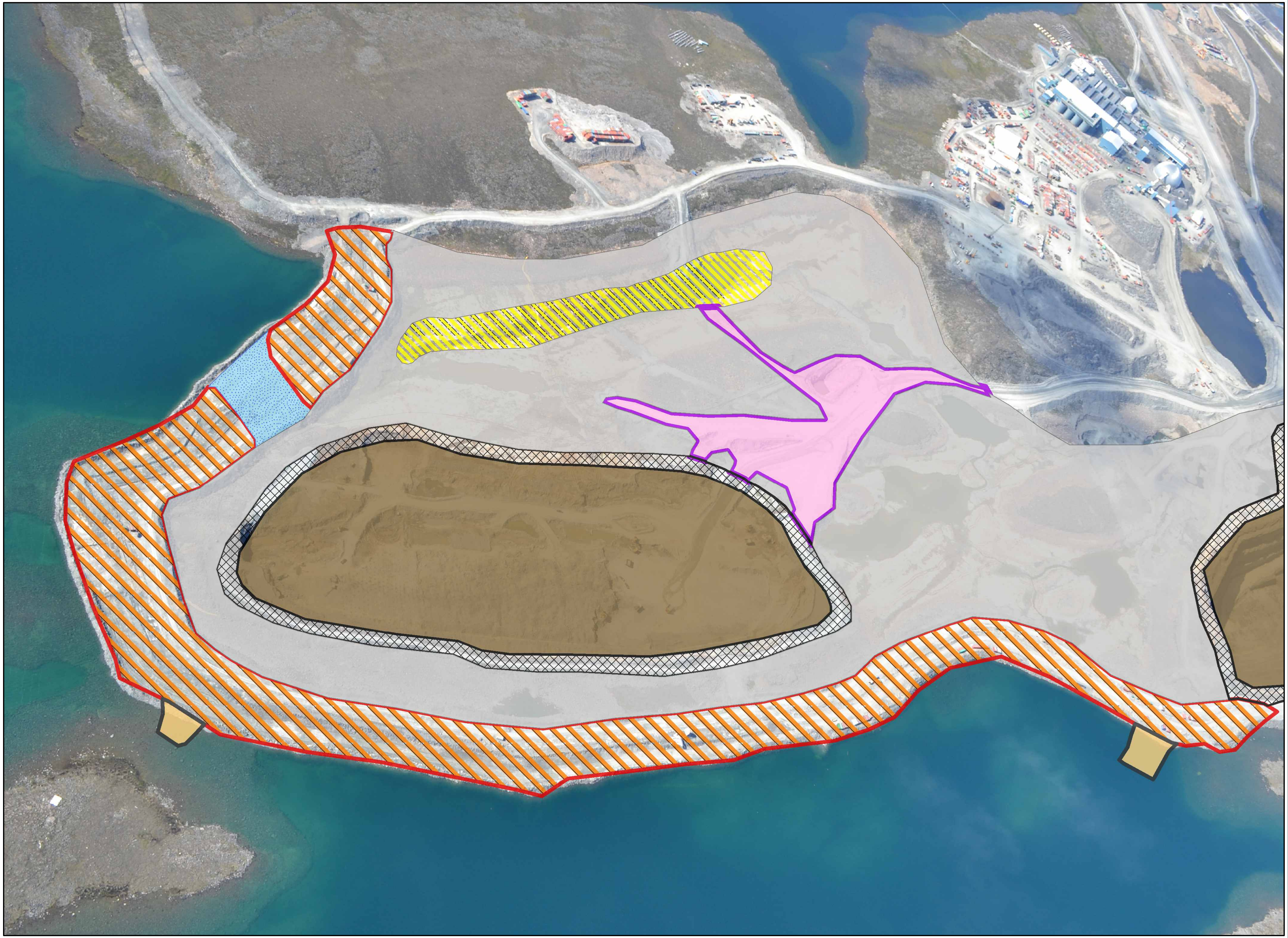
Following completion of mining in the Portage and Goose Island pits, the impounded former lake area will be gradually re-flooded. Post-closure (after water quality criteria are met), the Bay-Goose dike will be breached to allow fish entry and re-gain the temporarily lost habitat. The portion of Second Portage Lake between the East Dike and the Central Dike will become part of Third Portage Lake, due to the land-to-lake conversion resulting from the Portage Pit construction. The East Dike will not be breached in order to maintain the current 1 m difference in elevation between Second Portage and Third Portage Lakes.

Prior to re-flooding, a number of habitat improvement measures will be implemented to increase the productive capacity of this area (Figure 1). Construction of a boulder garden feature along the west side of the soft-sediment Bay-Goose Basin will increase habitat suitability in this area. This feature will consist of at least 2.97 ha of heterogeneous, coarse substrate habitat in the <4 m depth zone, just west of the Goose Island Pit. Further, construction of mine-related features (pit caps, roads and dikes) from coarse rock material throughout the basin will create shoals and reefs after re-flooding. In addition, approximately 30% of the area of Portage Pit will be backfilled to a depth of 4-10 m during the construction phase, reducing the amount of ultra-deep water areas, and increasing habitat suitability in this area.

2.1.2 Vault Lake and Phaser Lake Area

After mining, Phaser Lake will be connected to Vault Lake via the Phaser and Vault Pits, and eventually the Vault Dike will be breached to allow a connection to Wally Lake. Post-closure alterations to Vault and Phaser Lakes will result from construction of pits, pit caps, roads and dikes. Both lakes will be expanded as a result of land-to-lake conversion in the Vault Pit and Phaser Pit (as shown in Figure 2). Partial backfilling of Phaser Pit will reduce the amount of ultra-deep areas. Vault Pit will not be backfilled, but is assumed under the NNLP (AEM, 2012) to provide overwintering habitat, which is limited in these relatively shallow lakes. BB Phaser Pit will not be backfilled, and in accordance with recent DFO consultation, it is not assumed to provide any habitat value. However, future monitoring of the pit areas to determine habitat suitability will be conducted as described herein. Further habitat improvements in Vault and Phaser Lakes will be made through development of shoals due to permanent roadway construction, areas of mixed substrate from temporary haul roads, and the improvement of the connecting channels between Vault and Wally Lakes, and Vault and Phaser Lakes, to allow fish movement. In particular, the connection to Vault Lake will provide access for Arctic char, which were not naturally present in Phaser Lake. Improvement of the connection to Wally Lake will involve deepening the channel inside the Vault Dike to a depth of at least 3 m, while the lake is dewatered, to allow fish passage year-round after removal of the dike.

As per the Fisheries Productivity Investment Policy: A proponent's guide to Offsetting (DFO Nov. 2013), AEM will also work with DFO prior to and during the transfer or stocking of all fish species from adjacent lakes into reflooded areas. This includes transferring Arctic char from Wally Lake into the re-flooded Vault Lake, Vault Pit, Phaser Lake and Phaser Pits. As discussed in the NNLP (2012), it was suspected that the lack of char in Wally and Phaser Lakes is due to historical isolation and the lack of deep-water habitat, which is preferred by this species. Pit development in the Vault Lake area will provide a significant quantity (approximately 45 ha) of this deep-water habitat, which is limited in the Vault Lake Area, but is prevalent in all nearby char-bearing lakes.



Legend

Post-Closure Features

- Capped roadways
- Dike to remain
- Finger dike
- Breach in dike
- Free dump boulder garden
- Mixed substrate basin
- Pit
- Pit capping

Bay Goose Basin Conceptual Drawings

POST-CLOSURE FEATURES

DOUGAN & ASSOCIATES
ECOLOGICAL CONSULTING & DESIGN
77 Wyndham Street South • Guelph ON N1E 5R3
T 519.822.1609 • F 519.822.5389 • www.dougan.ca

PROJECT: DA11-062-02

CLIENT: Agnico-Eagle Mines Ltd., Meadowbank Div.

W
S N
E
UTM Zone 14 NAD83

DATE: OCTOBER 2012

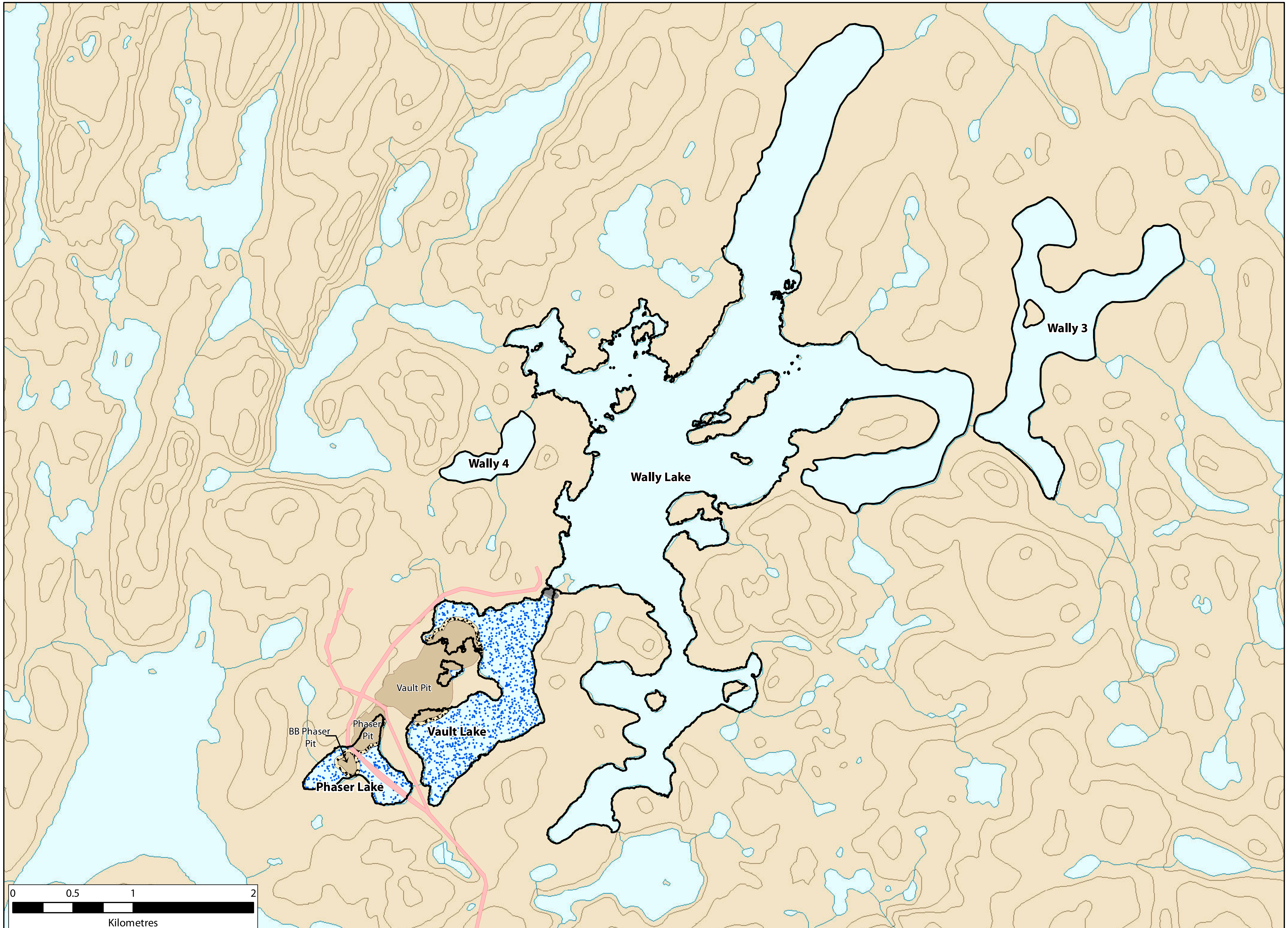
SCALE: NTS

DRAWN BY: MAY

CHECKED BY: RV

FIGURE:

1



Legend

- Study Lakes
- Dike
- Dike Base
- Roads
- Pit
- Pit Cap
- Lake Basin

Features
Vault Lake Area

DOUGAN & ASSOCIATES
ECOLOGICAL CONSULTING & DESIGN
77 Wyndham Street South • Guelph ON N1E 5R3
T 519.822.1609 • F 519.822.5389 • www.dougan.ca

PROJECT: DA11-062-06

CLIENT: Agnico-Eagle Mines Ltd., Meadowbank Div.

N
W E
S
UTM Zone 14 NAD83

DATE: JUNE 2015

SCALE: 1:29,531

DRAWN BY: LC

CHECKED BY:

FIGURE:

2

2.1.3 Dogleg System

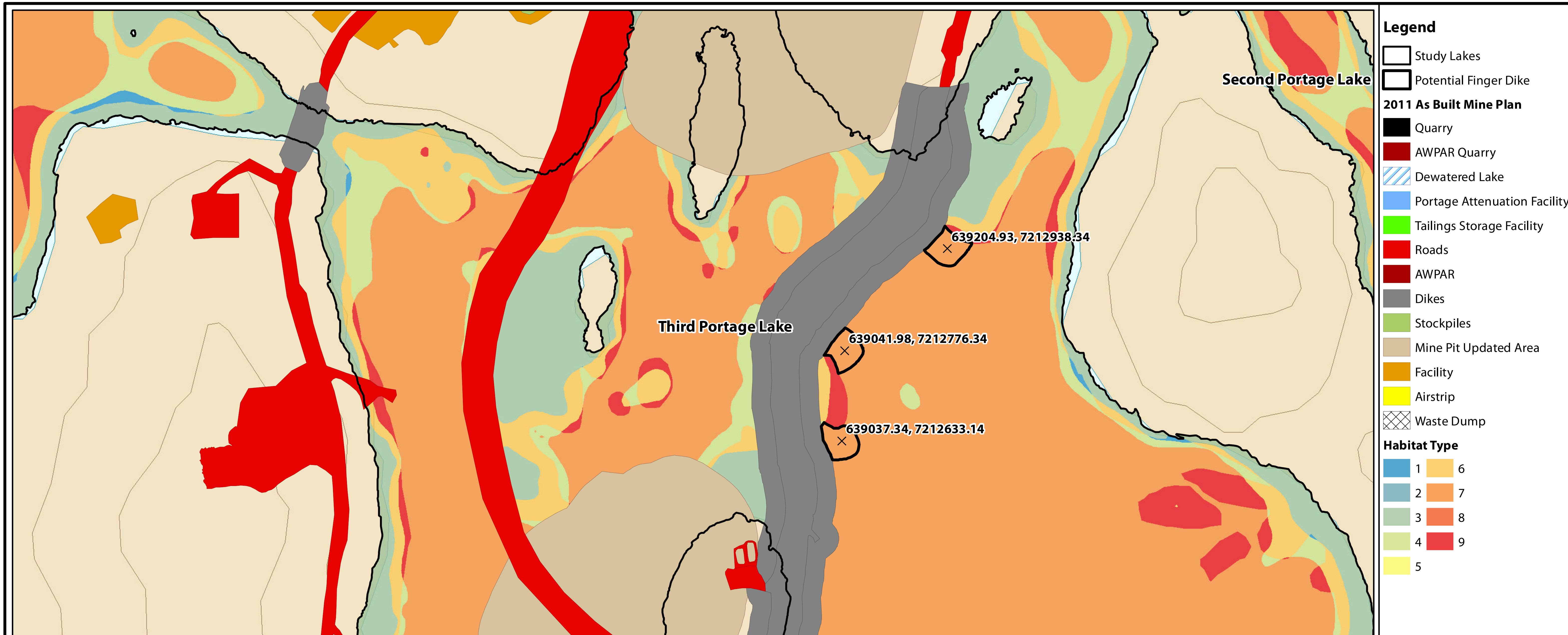
Dogleg Pond and the "North Portage" ponds, Dogleg North Pond (NP-1) and NP-2, are isolated ponds located near the waste rock area, just north of Second Portage Lake. They are shallow ponds, with a maximum depth of 11 m in Dogleg Pond. Dogleg North Pond reaches about 3.8 m in depth, and NP-2 has a small area of about 5 m depth. The project described below was not specifically developed as compensation, but has integrated habitat compensation with water management to result in a small net gain of fish habitat.

NP-2 formerly drained into the TSF area of Second Portage Lake, while Dogleg and Dogleg North drain towards the main body of Second Portage Lake. Since drainage of NP-2 became blocked by the waste rock pile on the northern edge of the TSF, a connecting channel was excavated to direct flow from NP-2 to Dogleg North, effectively increasing the drainage area of Dogleg and Dogleg North Pond. The accompanying increase in wetted area is estimated at 5% for Dogleg Pond, 15% for Dogleg North Pond, and 5% for NP-2.

Through construction of the diversion channel, connectivity between the ponds has been improved, and previously inaccessible habitat in Dogleg North Pond will be available for use by lake trout and round whitefish currently inhabiting Dogleg Pond and NP-2. Eventually these ponds may be seasonally accessible from Second Portage Lake. This connection would theoretically provide access for Arctic char to the Dogleg system, but because it is deemed unlikely due to the shallow, ephemeral nature of the connections, access for char is conservatively excluded from habitat gain calculations.

2.2 FINGER DIKES

In keeping with the original NNLP, a number of finger dikes are proposed to be built, extending from the Bay-Goose Dike into Third Portage Lake. While the original NNLP (2006) proposed 19 ha of finger dikes, AEM has found that the method described for construction to pose safety concerns, as well as potential concerns with elevated TSS during settling of material. Therefore, as described in the 2012 NNLP, the new finger dikes will be 1 ha in total at their base. Potential locations for each finger dike are shown in Figure 3. Specific locations will be chosen prior to construction. These changes will not alter the monitoring techniques described in Section 4 and 5.



Minesite Features
Potential Finger Dike

DOUGAN & ASSOCIATES
ECOLOGICAL CONSULTING & DESIGN
77 Wyndham Street South • Guelph ON N1E 5R3
T 519.822.1609 • F 519.822.5389 • www.dougan.ca

PROJECT: DA11-062-02

CLIENT: Agnico-Eagle Mines Ltd., Meadowbank Div.

DATE: MARCH 2011

SCALE: 1:6,000

DRAWN BY: LW

CHECKED BY:

FIGURE:

3

2.3 WALLY LAKE ACCESS

Wally Lake is a 532 ha lake connected to Vault Lake (see Figure 2) via a seasonally passable channel. Fish movement between these lakes was found to be almost nil and this channel was diked prior to de-watering of Vault Lake. Information in baseline studies (2005) indicated that the only large bodied fish in Wally, Vault and Phaser Lakes were lake trout and round whitefish. In 2012, follow-up studies were completed which confirmed these results. Based on these studies, the 2012 NNLP proposed to provide access for Arctic char to enter Wally, Vault and Phaser Lakes from the isolated Wally 3 Lake (W3), which was found to have a population of char. However, the fish-out of Vault Lake in 2013 found that 5% of the fish population of this lake was in fact comprised of Arctic char, and a number of these were transferred to Wally Lake. As a result, AEM issued a technical memorandum to DFO to recalculate habitat units associated with Vault Lake (AEM, 2016b). Since Arctic char were found to inhabit Vault Lake, and the connection between Vault and Wally Lakes is already planned to be improved, AEM and DFO have discussed the benefits of constructing the channel between W3 and Wally Lake, and determined this project is no longer required (see DFO letter dated June 7, 2016: 2016 DRAFT – Habitat Compensation Monitoring Plan Review by DFO, Comment #2).

2.4 AWAR FISHERIES COMPENSATION

As part of the habitat compensation plan for construction of the roadway between Baker Lake and the mine site, a spawning pad was constructed in 2009 near bridge crossing R02 (Figure 4). This habitat compensation project was constructed according to design specifications that met biological criteria aimed at enhancing Arctic grayling productivity in this stream system. The construction focused on creating high value spawning and nursing habitat to compensate for the loss of the low and medium value habitat affected by bridge abutment construction at the four crossings. An overview of the Meadowbank area post-closure, incorporating all compensation features, is shown in aerial photo below.

Figure 4- Aerial Photo of R02 Habitat Compensation Feature- Taken in September 2009

SECTION 3 • HISTORICAL MONITORING

Until now, monitoring has proceeded according to the 2008 HCMP Version 1 (Azimuth, 2008a) and 2014 HCMP Version 3 (AEM, 2014). Based on construction to date, this includes monitoring of the R02 spawning pads along the AWAR, the East and Bay-Goose Dikes, and Dogleg Pond system. To date, four rounds of monitoring have been conducted.

3.1 AWAR MONITORING

In 2013 and 2015, monitoring of the spawning pads constructed at AWAR crossing R02 was conducted under the HCMP. As described in the schedule of monitoring events, the AWAR study includes a visual assessment of stability, as well biological monitoring to confirm use by Arctic grayling. The major component of the program consists of length and weight measurements and maturity identifications of adult fish captured in hoopnets. Nets are set to capture both upstream and downstream movements as soon as ice conditions allow. Additionally, reproductive success in this reach is assessed using larval drift traps.

To date, the constructed spawning pads have been visually confirmed to be stable as designed. Rates of shifting of material have not exceeded expectations at construction. Generally, condition factors of adult fish, population size distributions and timing of migration have consistent year-over-year, and confirm continued use of this area by Arctic grayling. Larval drift rates of collection continue to exceed those observed prior to construction of the spawning pad, suggesting a positive impact on Arctic grayling reproduction, either through direct use or reduced pressure on upstream spawning areas.

Overall, the constructed spawning pads have not only increased the quantity of high-value habitat, but appear to be effectively increasing production rates in the local population.

3.2 PORTAGE AREA MONITORING

Monitoring in the Portage area under the HCMP has been ongoing since 2009. In 2009, this included analysis of the East Dike face. Monitoring of the both the East Dike and Bay-Goose Dike faces was conducted in 2011, and 2015. Monitoring in 2015 also included an analysis of fish use in the Dogleg Ponds.

3.2.1 Interstitial Water Quality

Water samples are collected from between the rocks of the dike face using a tube sampler and electronic pump, and are analyzed for conventional parameters (hardness, conductivity, pH, and total dissolved and suspended solids), anions (alkalinity, chloride and sulfate), nutrients (ammonia, nitrate, nitrite, total Kjeldahl nitrogen, orthophosphate and total phosphate), organic parameters (chlorophyll-a, dissolved and total organic carbon) and total and dissolved metals at an accredited facility. While TSS was elevated in 2009 and at one station in 2015, this was likely due to sediment re-entrainment during sampling. The dissolved aluminum guideline was exceeded in one sample in 2009 due to marginally low pH, but this trend did not recur with additional sampling. Total phosphorus concentrations exceeded CCME guidelines in 2009 and 2011, but since orthophosphate was at or below detection, no potential ecological concerns were identified and this did not recur in 2015.

3.2.2 Periphyton Community

Density, biomass and composition of the periphyton community are measured in the shallow zone by collecting a sample from the rock face with a specialized scrubber. Underwater video imagery is used to qualitatively examine periphyton growth in the deep zone. Periphyton was found to colonize rocks in shallow areas in the first year after construction of both dikes, and increasing likeness to reference stations (in both density and composition) has been evident year over year.

3.2.3 Fish Use

In 2009, a variety of methods were tested to monitor fish use of the dike face, including hydroacoustic surveys, minnow traps, gill nets and visual observation. Only gill nets were found to be effective, and this method alone was used in 2011. In 2014 the HCMP was amended and in 2015 methods for monitoring fish use focused on the lower-impact techniques of angling and underwater video. Fish use of the dike faces was documented at rates no lower than reference stations in all years.

In 2015, two Arctic char were caught by angling in Dogleg Pond, and two Arctic char and two lake trout were caught in Dogleg North Pond (NP-1). NP-1 was previously determined to be fishless and access to this habitat for lake trout and round whitefish was identified as part of the onsite habitat compensation through construction of a diversion channel from NP-2 Pond, which occurred in 2013 (see Section 2.1.3). These results therefore indicate that the planned compensation has been successful at providing access to habitat in Dogleg North Pond for lake trout, and that Arctic char may be accessing Dogleg Pond from Second Portage Lake.

SECTION 4 • MONITORING COMPONENTS AND METHODS

Habitat gains at Meadowbank are planned to be derived through both physical improvements to existing habitat (e.g. creation of reefs), and the facilitation of access to new habitat (e.g. previously fishless or underutilized areas). As per the original Fisheries Act Authorization, regardless of the type of compensation, both physical and ecological components are included in the monitoring plan, to record whether each feature is constructed and is functioning as intended.

The assessment of habitat features incorporates monitoring methods with specific quantitative criteria for success (physical structure and interstitial water quality), as well as complementary “qualitative” tools (periphyton growth and fish use). All lines of evidence are then integrated in a weight-of-evidence approach to make the final determination regarding habitat feature functionality.

This updated monitoring program maintains the major elements of the original 2008 version (structure, water quality, periphyton and fish use), while modifying timelines and methods based on field experience, as well as to incorporate new offsetting features (AEM, 2012b; AEM, 2016a) and current life-of-mine designs, and to meet the conditions of new Fisheries Act Authorizations. The proposed type and schedule of monitoring is described for each feature in Tables 3 – 8, and details for each monitoring component are provided in Sections 4.1 and 4.2, below.

4.1 PHYSICAL COMPONENTS

Since the habitat evaluation procedure focuses on quantifying losses and gains to habitat, based on physical characteristics (area, depth and type of substrate), physical structure is arguably the most important component to monitor in cases where habitat offsets are derived from constructed features (such as reefs or boulder gardens).

All structures will be assessed post-construction to determine whether they meet the assumptions of their associated no-net-loss or offsetting plan. These include area, depth and substrate characteristics. For each feature, a comparison will be made to the specifications described for these characteristics, to determine whether expected physical habitat gains are achieved in the as-built state (i.e. to confirm features were constructed as planned). This analysis is separate to as-built reports, which are required under NU-03-0191.4, Condition 6.3, but may make use of information provided in those reports. Habitat compensation monitoring reports will, however, include the photographic evidence (pre-, during and post-construction) of compensation features, as described under NU-03-0191.3, Condition 6.4, NU-03-0191.4, Condition 6.2. Photographic evidence for the AWAR compensation feature has previously been included in annual AWAR monitoring reports (e.g. AEM, 2010).

In addition to the analysis of depth, area and substrate in the dry basins, structural integrity will be qualitatively assessed after re-flooding for features in the de-watered basins, to record any movement occurring during this process.

Methods of evaluation will depend on the specific compensation feature, as detailed in Tables 3 - 8. In general, methods will include:

On-the-ground photos – photos will be taken of the compensation feature pre-, during and post-construction and included in HCMP reports.

Aerial photos or PhotoSat Imagery – will be taken of dry basins just prior to re-flooding, to compare areal extents of compensation features with NNLP predictions. Differences will be estimated visually or by GIS.

Visual observation – conducted to ground-truth substrate types for confirmation in air photos.

Field survey – conducted in the dry to determine depth-below-surface of compensation features.

Bathymetric survey – conducted to determine the final depth contours of compensation features that are constructed in-water (i.e. finger dikes).

Underwater video – conducted post-flooding to qualitatively examine structural integrity of constructed features.

Results will be recorded for each feature and compared to the associated NNL or offsetting plan estimate in an HCMP report, making use of the example provided in Table 2.

Analysis of the physical components will occur in the dry for features constructed in de-watered basins, in order to facilitate ground-truthing of substrate and total area. This analysis will occur just prior to re-flooding, such that features are in their final condition. As-built reports will first be consulted to determine if the required information is available. For features constructed in-water (finger dikes, access enhancements), analysis of the physical components will be conducted in the years after construction.

4.2 ECOLOGICAL COMPONENTS

Ecological monitoring elements include interstitial water quality, open basin water quality, periphyton community biomass and fish use.

No changes are proposed here to ecological monitoring methods for habitat features discussed in previous versions of the HCMP (monitoring for features associated with Fisheries Act Authorizations NU-03-0190, NU-03-0190.3, and NU-03-0190.4). The basic monitoring methods for these habitat features are maintained from the 2008 HCMP, with some modifications in 2014 based on field experience. Monitoring for these features focuses on identifying any ecological constraints to habitat function, and the weight-of-evidence evaluation of functionality is primarily based on capability to support fish, rather than on actual use (although fish use in comparison to reference sites is monitored). This approach was initially described in the 2008 HCMP, which formed the basis of monitoring for Fisheries Act Authorizations issued in 2007, 2008, and 2013. However, according to the requirements of DFO's "Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting" (November, 2013), monitoring for offsets developed after that time (Phaser Lake) will further aim to determine whether the system has reached full ecological functionality (i.e. supports fish reproduction, growth, and survival).

Further details of methods for each monitoring component are described below, and in Tables 3 – 8.

4.2.1 Interstitial Water Quality

Modeling during the EIA process indicated that metals leaching from quarried rock would not significantly impact the aquatic environment. Nevertheless, interstitial water quality of constructed habitat compensation features will be assessed through the HCMP to verify these predictions.

In order to collect a representative sample from the bioactive zone between the rocks, an electric diaphragm pump with food-grade silicon tubing is used. Samples will be taken at depths between 1 and 4 m, and analyzed in an accredited laboratory for total suspended solids, and total and dissolved metals. Results will be compared to background concentrations and CCME guidelines where available. Locations and schedules for interstitial water quality sampling are described in Table 3.

4.2.2 Open Basin Water Quality

Modeling during the EIA process indicated that water quality in re-flooded pits and basins would support healthy fish populations. Because the re-flooded areas form part of Meadowbank's habitat compensation, water quality will be monitored as part of the HCMP, in conjunction with Type A Water License requirements, and eventually, the Core Receiving Environmental Monitoring Program (CREMP), in order to determine when breaching of the dike to allow fish access is appropriate. Sampling will be based on procedures and parameters analyzed in the CREMP (Azimuth, 2015) and as identified in Type A Water License 2AM-MEA1525. During operations and closure, analyses will generally be conducted monthly during open water or bi-annually in each pit basin (Goose Island, Portage, Vault, Phaser, and BB Phaser pits), with specific locations determined by experienced field technicians and in accordance with NWB Water License requirements. Analyses will include vertical depth profiles of temperature, DO and conductivity to a representative depth. Secchi depth and surface pH will also be determined at each sampling location. Water samples will be collected from approximately 3 m depth by pumping lake water using weighted flexible (food-grade silicone) tubing, and a diaphragm pump connected to a 12 volt battery. A depth of 3 m is chosen for consistency across all basins and seasons (i.e., sampling at 3 m is still possible in the winter under ice). The lakes are never thermally stratified and are well mixed; given the uncertainty in the end pit water quality, varying depths of samples will be taken. An inline filter is connected to the end of the outflow tube when filling bottles for dissolved metals and dissolved organic carbon analyses.

Water samples will be analyzed by an accredited facility for conventional parameters (hardness, conductivity, pH, turbidity, and total dissolved and suspended solids), anions (alkalinity, bromide, chloride, fluoride, silicate and sulfate), nutrients (ammonia, nitrate, nitrite, total Kjeldahl nitrogen, orthophosphate and total phosphate), organic parameters (chlorophyll-α, dissolved and total organic carbon) and total and dissolved metals. Results will be compared to background concentrations, CREMP trigger or threshold levels and CCME guidelines where available. Locations and schedules for open basin water quality sampling are described in Tables 4 - 6.

4.2.3 Periphyton Community

The periphyton community consists of a collection of microorganisms, including algae, that grow attached to or in very close proximity to submerged substrate. Colonization of the community occurs over time, with rates depending on nutrient and light availability. Periphyton is an important food source for benthic invertebrates, so colonization will be monitored to ensure that quarried rock substrate provides habitat that is as suitable at this level of the food chain as natural substrate.

Periphyton sampling for habitat assessments will be carried out in the same manner as described in the CREMP (Azimuth, 2015). Briefly, a specialized scrubber will be used to collect periphyton samples from a prescribed area of rock face, in order to calculate cell density, biomass (μg/cm^2), and species composition. Underwater video may also be used in deeper areas to make qualitative assessments of periphyton growth. Results will be compared to reference sites, baseline data, and/or historical monitoring programs. Locations and schedules for periphyton sampling are described in Table 3.

4.2.4 Fish Use

4.2.4.1 Portage Lakes, Dogleg Ponds, Vault Lake

The ultimate goal of NNL planning according to AEM's 2012 NNLP is to provide suitable habitat for fish populations. As described previously, fish data for the Portage Lakes, Dogleg Ponds, and Vault Lake will be used as a complementary qualitative tool to support the assessment of habitat feature functionality.

Since the use of gill nets has historically been found to result in elevated incidences of mortality, angling and underwater motion camera techniques were proposed in 2014, implemented in 2015 and will continue to be used to establish fish presence around the constructed habitat features and in open basins. Catch per unit effort and physical characteristics (species, length, weight, maturity, sex) will be recorded and compared to reference areas and/or historical results, as the dataset allows. If these techniques are not successful, a DFO representative will be contacted and the use of gill nets may need to be included. Hoopnets or trap nets may be used at dike breaches to assess fish movement into the re-flooded basins. Locations and schedules for monitoring of fish use are provided in Tables 3 – 8.

4.2.4.2 Phaser Lake Monitoring

In accordance with DFO's "Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting" (November, 2013), monitoring of fish use in Phaser Lake will aim to demonstrate that the system has reached full ecological functionality (i.e. supports fish reproduction, growth, and survival). This status will be assessed through year-over-year analysis of length-frequency distributions and abundance data, and potentially through the proposed research program described below. Planned methods to monitor fish populations in the re-flooded Phaser Lake will generally be the same as those described in Section 4.2.4.1, including angling and underwater camera use. It is estimated to be more likely that use of gill nets may be required to demonstrate that criteria for success have been met (see Section 5.3.5) in the case of Phaser Lake. However, DFO will be contacted regarding the need to utilize gill nets prior to their implementation.

In addition to angling, underwater camera monitoring, and potential gill netting, AEM is proposing to work with researchers as a complementary offsetting measure (described in the Phaser Lake Offsetting Plan; AEM, 2016a). This research may focus on a fish tagging program to assess movements, survivorship, and habitat use of fish introduced to the re-flooded Phaser Lake. While not specifically planned as a component of the HCMP, if successful, this program would complement the standard monitoring data.

4.2.4.3 AWR R02 Compensation Monitoring

Monitoring fish use of the compensation structure at R02 will continue as previously. This monitoring program consists of sampling adult fish populations using hoopnets, and assessing reproductive activity using larval drift traps.

As described above, hoopnets consisting of either a 4 ft (1.22 m) or 3 ft (0.9 m) diameter front hoop will be used to target Arctic grayling. The captured fish are gently removed by field technicians from the nets using dip nets, placed in large tubs filled on location with stream water for biological processing and then placed in a recovery tub. The fish are released up or downstream of the hoopnets (depending on the fish's migration direction) following handling. Biological processing includes measurement of fork length, weight and maturity.

Hoopnets are placed adjacent to the habitat compensation area, in a riffle/ side channel area upstream of the bridge and downstream of the compensation area, and immediately upstream of the culverts. Nets are set with the goal of capturing the maximum number of fish moving beyond the R02 bridge crossing, but also to assist in determining effectiveness of the R02 habitat compensation area. Larval drift traps were placed in representative, high to moderate flow sections of the stream, both upstream and downstream of the habitat compensation feature. These traps consist of a square sided cone with a ridged frame that funnels into a 0.5 mm nitex mesh bag. Attached at the back of the nitex bag was a Nalgene®-type container where the drift is collected. The frame is submerged at least halfway under water and secured by poles on each side. Drift traps will be checked at least every other day. Larval drift will be identified in the field and preserved in vials of diluted formalin.

4.3 FREQUENCY

The sampling schedule and general locations are described in Tables 3 - 8. Specific sampling locations will be determined in the field by a qualified environment technician or biologist.

SECTION 5 • QA/QC AND CRITERIA FOR SUCCESS

5.1 LABORATORY QA/QC

Water Quality – Data Quality Objectives (DQOs) are numerically definable measures of analytical precision and completeness. Analytical precision is a measurement of the variability associated with duplicate analyses of the same sample in the laboratory. Completeness for this study is defined as the percentage of valid analytical results. Duplicate results will be assessed using the relative percent difference (RPD) between measurements.

The laboratory DQOs for this project are:

Analytical Precision = 25% RPD or less for concentrations that exceed 10x the method detection limit (MDL).

Completeness = 95% valid data obtained.

Periphyton Community – Laboratory analyses for periphyton samples will be conducted by experienced scientists following a standardized procedure (i.e., quality assurance), internal quality control samples (e.g., duplicate counts) will be included to document analytical variability.

5.2 FIELD QA/QC

Water Sampling – Field QA/QC standards during water sampling will be maintained for every sample. The standard QA/QC procedures include thoroughly flushing the flexible tubing and pump to prevent cross-contamination between stations and thoroughly rinsing the sample containers with site water prior to sample collection. Trip blanks and field duplicates will be collected (approximately 1 per 10 samples). Field duplicates assess sample variability and sample homogeneity; a RPD of 50% or less for concentrations that exceed 10x the MDL is considered acceptable.

Periphyton Community – Standard procedures will be used to collect biota samples. All sampling gear will be thoroughly rinsed between sampling stations to ensure that there was no inadvertent introduction of biota from one station to another. A field duplicate will be collected for phytoplankton at one sampling station per sampling event to assess sampling variability and sample homogeneity. Due to large natural variability and the qualitative nature of this component, no specific RPD acceptability criterion is recommended for density and biomass.

Fish Use – These study components will be conducted in accordance to the general practices listed previously. All relevant spatial and depth information will be recorded. Fish biological data will be recorded as will reference spatial information. Field notebooks or field sheets will be used to compile notes and observations relevant to the studies. Fishing will be carried out by experienced technicians or biologists who are very familiar with this kind of work. Video/photo survey data will be conducted carefully to provide representative images of target communities. All relevant spatial and depth information will be recorded and identified by the time stamp (or photo number) and tape number (or memory card number).

5.3 CRITERIA FOR SUCCESS

As described in AEM's 2008 HCMP, a weight-of-evidence approach will continue to be used to determine whether habitat offsetting features are functioning as intended. Specific, quantitative criteria for success have been established for physical structure and water quality components of the monitoring program, whereas monitoring of periphyton growth and fish use are considered qualitative tools without specific success criteria. Results of these assessments will not be used on their own for decision-making, but will be considered along with results of structure and water chemistry monitoring to evaluate whether habitat features are functioning as intended.

The following specific success criteria will be used prior to integrating data in a weight-of-evidence evaluation of habitat compensation and offsetting projects:

5.3.1 Physical Structure

In order to provide the required habitat gains, constructed features should meet the specifications described for area, depth and substrate in the NNLP. Where specifications are not met, the total habitat units afforded by the feature in its as-built state should be calculated. If there is a deficiency in habitat units site-wide, DFO will be consulted.

5.3.2 Interstitial Water Quality

Water chemistry results will be compared to reference locations, and CCME water quality guidelines. Since analysis of large in-water features (dikes) to date has not indicated any significant adverse effects on water quality, success criteria are expected to be met in the future. However, if necessary, follow-up sampling will be conducted as soon as practical (next ice-free season). If water quality criteria do not meet background or CCME guidelines after two monitoring events, risk-based toxicity reference values will be compared, and additional testing, such as laboratory toxicity tests will be considered. Because onsite experience and HCMP dike face monitoring results to date indicate that adverse effects are unlikely, any additional testing would be determined in consultation with DFO in the unlikely situation that it is required.

5.3.3 Open Basin

Long-term water quality predictions made during the initial planning phase of the project (Cumberland, 2005) indicated that although some water quality parameters in the Vault and Portage Pit lakes may exceed CCME criteria in year 10 post-closure, they would be within the same order of magnitude, which was recognized as the sensitivity limit of the modelling exercise. In particular, CCME exceedances were predicted for cadmium, zinc and arsenic in the Bay-Goose/Portage area, and for aluminum, arsenic, cadmium, copper, fluoride, mercury, and unionized ammonia (NH_3) in the Vault area. In addition, a temporary chemocline was predicted to occur 100 m below water surface in the Portage pit. Since pit backfilling is now prescribed for that area, this may not be a factor.

Since the pits are to be flooded with water from adjacent lakes, chemistry is expected to be similar. During HCMP monitoring of the re-flooded basins, water chemistry results will be compared to reference locations, CREMP trigger/ threshold levels, and CCME guidelines where available. The dike will be breached to allow mixing with adjacent lakes and fish entry once water quality meets these criteria during three sequential sampling events.

5.3.4 Periphyton Community

Since lakes in the Meadowbank region are ultra-oligotrophic and ice-covered for the majority of the year, periphyton development is expected to be slow and no specific criteria are provided for this monitoring component. Further, periphyton growth in the project lakes area has been shown to be highly variable in the past (Azimuth, 2008b). However, based on experience to date, the periphyton community on constructed habitat features is slowly developing and has been visible on new substrate within the first year of construction.

5.3.5 Fish Use

5.3.5.1 Portage area, Dogleg Ponds and Vault Lake

When Meadowbank's Fisheries Act Authorizations for the Portage Lakes and Vault Lake (NU-03-0191.3; NU-03-0191.4) were provided in March and May, 2013, the premise of NNL planning was that habitat compensation will increase the productive capacity of water bodies. Since it was recognized that factors other than habitat quantity or quality may limit fish population growth, no specific criteria for success were prescribed for this metric. Fish monitoring results will continue to be used as a complementary tool in the weight-of-evidence approach to verify the intended functionality of the habitat features. Observations of the East and Bay-Goose Dikes have indicated fish presence around these features is no lower than in reference areas, so this trend is expected to continue. This approach will apply moving forward for the Portage area, Dogleg Ponds and Vault Lake.

5.3.5.2 *Phaser Lake Monitoring*

According to DFO's "Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting" (November, 2013), monitoring of offsetting measures must be designed to confirm that serious harm to fish has been effectively counterbalanced. As a result, criteria for success for Phaser Lake are aimed at demonstrating presence, survivorship and full ecological functionality of the system (i.e. reproduction, growth, survival). For Phaser Lake, this status will be determined through year-over-year analysis of length-frequency distributions and abundance data.

5.3.5.3 *AWR R02 Compensation Monitoring*

No specific criteria are established for determining success of the spawning pads constructed at R02 based on fish use metrics (hoopnet catch, larval drift). Based on results to date, however, the number of successful spawning events has increased in this reach relative to pre-construction.

SECTION 6 • REPORTING AND PLAN REVIEW

Annual reports describing activities conducted under this Habitat Compensation Monitoring Plan will be submitted with AEM's Annual Report to the NIRB by March 31 of the following year.

The HCMP will be reviewed as required by the Meadowbank Environment Superintendent, and updated as necessary based on changes to mine site designs. All changes will be provided to DFO for approval.

SECTION 7 • REFERENCES

Azimuth, 2008a. Habitat Compensation Monitoring Plan, Meadowbank Gold Project. Prepared by Azimuth Consulting Group Inc. for Agnico-Eagle Mines Ltd. May, 2008.

Azimuth. 2008b. Aquatic Effects Management Program Monitoring – Meadowbank Gold Project, 2007. Report prepared by Azimuth Consulting Group Inc., Vancouver, BC for Agnico-Eagle Mines Ltd., Vancouver, BC. March 2008.

Azimuth. 2010a. Aquatic Effects Monitoring Program – Habitat Compensation Monitoring 2009, Meadowbank Gold Project. Report prepared by Azimuth Consulting Group Inc. for Agnico-Eagle Mines Ltd. January 2010.

Azimuth, 2015. Core Receiving Environment Plan Monitoring Program. 2015 Plan Update. Prepared for Agnico-Eagle Mines Ltd. November 2015

AEM, 2010. 2009 All Weather Private Access Road Fisheries Report. Agnico-Eagle Mines Ltd. January 2010.

AEM. 2012a. Aquatic Effects Monitoring Program – Habitat Compensation Monitoring 2011, Meadowbank Gold Project. Report prepared by Azimuth Consulting Group Inc. for Agnico-Eagle Mines Ltd.

AEM, 2012b. No Net Loss Plan. Agnico-Eagle Mines – Meadowbank Division. October 15, 2012.

AEM, 2016a. Fish Habitat Offsetting Plan: Phaser Lake. Agnico-Eagle Mines: Meadowbank Division. February, 2016.

AEM, 2016b. Technical Memorandum – Re: Review of Offsetting Calculations Pursuant to Fisheries Act Authorization 03-HCAA-CA7-00191 (NU-03-0191.4) Vault Lake. To Julie Dahl, Fisheries Protection Program, Fisheries and Oceans Canada. From Ryan Vanengen (AEM), Stephane Robert (AEM) and Leilan Baxter (Consultant to AEM). February 22, 2016.

Cumberland, 2005. Meadowbank Gold Project - Water Quality Predictions. October, 2005.

TABLES

Table 1. Estimated timeline for the construction of fish habitat structures.

Lake	Feature Name	Date of Completion
Second and Third Portage Lakes	In-basin habitat improvements	Ongoing until re-flooding
	Re-flooded basins and pits	2029
	Finger dikes	2017
Vault Lake	In-basin habitat improvements	2014 until re-flooding
	Re-flooded basins and pit	2029
Phaser Lake	In-basin habitat improvements	2016 until re-flooding
	Re-flooded basin and pits	2027
	Access to Vault Lake	2027
Dogleg System	NP-2 channel	2013 (completed)
	NP-2 (increase in area)	2013- closure
	Dogleg North Pond (increase in area and access)	2013- closure
	Dogleg Pond (increase in area)	2015- closure
Wally Lake	Improved access from Vault Lake to Wally Lake	2029

Table 2. Example comparison of NNLP designs and as-built physical properties of habitat compensation features.

Feature	Assessment Metric*	Method	Design	As-Built
Boulder garden	Area	Air photo	2.97 ha	3.5 ha
	Substrate	Visual observation	Coarse	Coarse (indicate actual grain size)
	Depth	Field survey	> 4 m	> 4 m
	Stability	Underwater video	-	Minor movement

*Area, depth, substrate type or stability

Table 3. Summary of monitoring methods, analytical parameters, sampling frequency and number of samples for dike faces and finger dikes (under MMER Schedule II TSF and DFO NU-03-0191.3). *Dike as-built designs were incorporated into the 2012 NNLP. Active flooding (F) is estimated to be completed in 2024), and the dike breached in 2029 (B).

Feature	Component	Reason	Method	Parameters	Completed Sampling	Number of Samples	Sampling Schedule
East Dike	Interstitial water	Possible metals leaching	Tube sampler	TSS Total and dissolved metals	2009 2011 2015	2 locations (exterior) and 2 locations (interior, post-flooding)	Exterior: Odd-numbered years until 2021 Interior: Every two years between F and B, B+1, B+3, B+5.
	Periphyton	Base of food chain	Periphyton sampler	Biomass	2009 2011	2 locations (exterior) and	Exterior: Odd-numbered years until 2021

Feature	Component	Reason	Method	Parameters	Completed Sampling	Number of Samples	Sampling Schedule
					2015	2 locations (interior, post-flooding) Plus reference station	Interior: B+1, B+3, B+5.
	Fish use	Confirm use by fish	Angling Underwater motion camera	CPUE, physical characteristics	2009 2011 2015	2 locations (exterior) and 2 locations (interior, post dike breach) Plus reference station	Exterior: Odd-numbered years until 2021 Interior: B+1, B+3, B+5
	Structure	Design intent met	As-built designs	Area, substrate, depth zone	2012*	-	Complete
		Stability	Underwater camera	Qualitative observations	2009 2011	Vertical transects at 5 locations	Complete
Bay Goose Dike	Interstitial water	Possible metals leaching	Tube sampler	TSS Total and dissolved metals	2011 2015	3 locations (exterior) and 3 locations (interior, post flooding)	Exterior: Odd-numbered years until 2021 Interior: Every two years between F and B, B+1, B+3, B+5
	Periphyton	Base of food	Periphyton	Biomass	2011	3 locations	Exterior: Odd-

Feature	Component	Reason	Method	Parameters	Completed Sampling	Number of Samples	Sampling Schedule
		chain	sampler		2015	(exterior) and 3 locations (interior, post flooding) Plus reference station	numbered years until 2021 Interior: B+1, B+3, B+5
	Fish use	Confirm use by fish	Angling Underwater motion camera	CPUE Physical characteristics	2011 2015	3 locations (exterior) and 3 locations (interior, post flooding) Plus reference station	Exterior: Odd-numbered years until 2021 Interior: B+1, B+3, B+5
	Structure	Design intent met	As-built designs	Area, substrate, depth zone	2012*	-	Complete
		Stability	Underwater camera	Qualitative observations	2011	Vertical transects at 10 locations	Complete
Finger Dikes	Interstitial water	Possible metals leaching	Tube sampler	TSS Total and dissolved metals	-	2 locations	Odd-numbered years after construction (est. 2017) until 2021 One time between 2024 – 2026 (to coincide with

Feature	Component	Reason	Method	Parameters	Completed Sampling	Number of Samples	Sampling Schedule
							dewatering dike monitoring if feasible)
	Structure	Design intent met	Photos Field survey	Area, substrate, depth zone	-	-	Upon construction
		Stability	Underwater camera	Qualitative observations	-	One vertical transect of each dike	Upon construction
	Periphyton	Base of food chain	Periphyton sampler	Biomass	-	One location per finger dike (reference stations same as for Bay-Goose/East Dike)	Odd-numbered years after construction (est. 2017) until 2021 One time between 2024 – 2026 (to coincide with dewatering dike monitoring if feasible)
	Fish use	Confirm use by fish	Angling Underwater motion camera	CPUE Physical characteristics	-	One location per finger dike (reference stations same as for Bay-Goose/East Dike)	Odd-numbered years after construction (est. 2017) until 2021 One time between 2024 – 2026 (to coincide with dewatering dike monitoring if feasible)

Feature	Component	Reason	Method	Parameters	Completed Sampling	Number of Samples	Sampling Schedule
Central Dike	Interstitial water	Possible metals leaching	Tube sampler	TSS Total and dissolved metals	-	2 locations	Every two years between F and B, B+1, B+3, B+5
	Periphyton	Base of food chain	Periphyton sampler	Biomass	-	2 locations (reference stations same as for Bay-Goose/East Dike)	B+1, B+3, B+5
	Fish use	Confirm use by fish	Angling Underwater motion camera	CPUE Physical characteristics	-	2 locations (reference stations same as for Bay-Goose/East Dike)	B+1, B+3, B+5
	Structure	Design intent met	As-built designs	Area, substrate, depth zone	-	-	Prior to flooding
		Stability	Underwater camera	Qualitative observations	-	Vertical transects at 5 locations	F+2

Table 4. Summary of monitoring methods, analytical parameters, sampling frequency and number of samples for compensation features constructed in the Portage basin (Under MMER Schedule II and DFO NU-03-0191.3). Active flooding (F) is estimated to be completed in 2024, and the dike breached in 2029 (B).

Feature	Component	Reason	Method	Parameters	Number of Samples	Sampling Schedule
Basin	Structure	Design intent met	Air photos Field survey	Area, substrate, depth zone	-	Prior to flooding
	Open basin water quality*	Possible metals leaching, anoxia	Tube sampler Grab samples Depth profiles	According to Type A Water License requirements	1 per pit area	According to Type A Water License requirements (monthly – bi-annually during operation/closure; annual throughout post-closure period)
	Fish use	To confirm the successful transfer or stocking and subsequent presence of fish; confirm survivorship. (re-flooded basin and at dike breach)	Angling Underwater motion camera Gill nets if necessary Hoopnets or trap nets or electrofishing (dike breach)	CPUE Physical characteristics Length-weight; meristics data on incidental mortalities	TBD by field staff	B+1, B+3, B+5
Roads	Structure	Design intent met	Air photos Field survey	Area, substrate, depth zone	-	Prior to flooding
		Stability	Underwater camera	Qualitative observations	Representative transects TBD by field staff	F+2

Feature	Component	Reason	Method	Parameters	Number of Samples	Sampling Schedule
Pits	Structure	Design intent met	Air photos Field survey	Area, substrate, depth zone	-	Prior to flooding
50 x 7 m rock shoal	Structure	Design intent met	Air photos Field survey	Area, substrate, depth zone	-	Prior to flooding
		Stability	Underwater camera	Qualitative observations	Representative transects TBD by field staff	F+2
	Interstitial water quality	Possible metals leaching	Tube sampler	TSS Total and dissolved metals	-	Every two years between F and B, B+1, B+3, B+5
	Periphyton	Base of food chain	Underwater camera	Qualitative observations	Representative transect TBD by field staff	B+1, B+3, B+5
	Fish use	To confirm use by fish	Angling^{++}	CPUE Physical characteristics	One location TBD by field staff	B+1, B+3, B+5
Boulder garden	Structure	Design intent met	Air photos Field survey	Area, substrate, depth zone	-	Prior to flooding
		Stability	Underwater camera	Qualitative observations	Representative transects TBD by field staff	F+2

*Monitoring and sampling protocols will be developed and conducted in-line with CREMP sampling and will be conducted throughout the post-closure period; this duration will be determined in the final Reclamation and Closure Plan, to be submitted to NWB 1 year prior to closure.

Table 5. Summary of monitoring methods, analytical parameters, sampling frequency and number of samples for compensation features constructed in the Vault basins (under DFO NU-03-0191.4). Active flooding (F) is estimated to be completed in 2025, and the dike breached in 2029 (B)

Feature	Component	Reason	Method	Parameters	Number of Samples	Sampling Schedule
Basin	Structure	Design intent met	Air photos Field survey	Area, substrate, depth zone	-	Prior to flooding
	Open basin water quality*	Possible metals leaching, anoxia	Tube sampler Grab samples Depth profiles	According to Type A Water License requirements	1 per basin	According to Type A Water License requirements (monthly – bi-annually during operation/closure; annual throughout post-closure period)
	Fish use	To confirm the successful transfer or stocking and subsequent presence of fish; confirm survivorship. (re-flooded basin and at dike breach)	Angling Underwater motion camera Gill nets if necessary (DFO to be contacted prior) Hoopnets or trap nets or electrofishing (dike breach)	CPUE Physical characteristics Length-weight; meristics data on incidental mortalities	TBD by field staff	B+1, B+3, B+5
Roads	Structure	Design intent met	Air photos Field survey	Area, substrate, depth zone	-	Prior to flooding
		Stability	Underwater	Qualitative	Representative	F+2

Feature	Component	Reason	Method	Parameters	Number of Samples	Sampling Schedule
			camera	observations	transect TBD by field staff	
Pits	Structure	Design intent met	Air photos Field survey	Area, substrate, depth zone	-	Prior to flooding

*Monitoring and sampling protocols will be developed and conducted in-line with CREMP sampling and will be conducted throughout the post-closure period; this duration will be determined in the final Reclamation and Closure Plan, to be submitted to NWB 1 year prior to closure.

Table 6. Summary of monitoring methods, analytical parameters, sampling frequency and number of samples for offsetting features associated with Phaser Lake dewatering. Flooding (F) is estimated to be complete in 2027 and the dike breached in 2029 (B).

Feature	Component	Reason	Method	Parameters	Number of Samples	Sampling Schedule
Basin	Structure	Design intent met	Air photos Field survey	Area, substrate, depth zone	-	Prior to flooding
	Open basin water quality*	Possible metals leaching, anoxia	Tube sampler Grab samples Depth profiles	According to Type A Water License requirements	1 per basin	According to Type A Water License requirements (monthly – bi-annually during operation/closure; annual throughout post-closure period)
	Fish use	To confirm the successful transfer or stocking and subsequent presence of fish; confirm survivorship, growth, reproduction.	Angling Underwater motion camera Gill nets as necessary	CPUE Physical characteristics Length-weight; meristics data on incidental mortalities	TBD by field staff	B+1, B+3, B+5, or until presence, survivorship, growth, and reproduction are demonstrated
Roads	Structure	Design intent met	Air photos Field survey	Area, substrate, depth zone	-	Prior to flooding
		Stability	Underwater camera	Qualitative observations	Representative transect TBD by field staff	F+2

Feature	Component	Reason	Method	Parameters	Number of Samples	Sampling Schedule
	Periphyton	Base of food chain	Underwater camera	Qualitative observations	Representative transect TBD by field staff	B+1, B+3, B+5, or until fish presence, survivorship, growth, and reproduction are demonstrated
Pits	Structure	Design intent met	Air photos Field survey	Area, substrate, depth zone	-	Prior to flooding

*Monitoring and sampling protocols will be developed and conducted in-line with CREMP sampling and will be conducted throughout the post-closure period; this duration will be determined in the final Reclamation and Closure Plan, to be submitted to NWB 1 year prior to closure.

Table 7. Summary of monitoring methods, analytical parameters, sampling frequency and number of samples for access enhancement compensation features.

Feature	Component	Reason	Method	Parameters	Number of Samples	Sampling Schedule
Dogleg Ponds	Structure	Design intent met (monitor water levels, especially access to Dogleg North)	Bathymetric survey	Area of ponds, depth of access channels	All three ponds and connecting channels	2015, 2017, 2019, 2021 (Odd-numbered years); 2025
	Fish use	Confirm use by fish	Angling Underwater motion camera	CPUE Physical characteristics	TBD by field staff	Odd-numbered years until 2021; 2025

Table 8. Summary of monitoring methods, analytical parameters, sampling frequency and number of samples for All Weather Private Access Road R02 (bridge 1) habitat compensation features.

Feature	Component	Reason	Method	Parameters	Completed Sampling	Sampling Schedule
Spawning pads	Structure	Design intent met	As-built report	Area, substrate	2009	-
		Stability	Visual observation	Qualitative observations	2010 2011 2013 2015	Every-other year (Odd-numbered years) until 1 year after the road is decommissioned (last monitoring estimated in 2031)
	Fish use	Confirm use by Arctic grayling	Hoopnets set downstream and upstream Larvae traps	CPUE Physical characteristics	2009 2010 2011 2013 2015	As above

MEADOWBANK GOLD PROJECT

Emergency Response Plan

Prepared by:
Agnico-Eagle Mines Limited – Meadowbank Division

Version 11
January 2017

EXECUTIVE SUMMARY

The Emergency Response Plan (ERP) is activated when an operations-related emergency, accident or malfunction occurs, or if such an incident is foreseeable. The ERP outlines potential emergency scenarios, initial actions for emergencies and the internal and external resources available including personnel, emergency response equipment and communication systems.

The ERP will be reviewed and updated as required, but on a minimum basis of at least once per year or following its implementation should a cyanide release occur.

IMPLEMENTATION SCHEDULE

This Plan will be immediately implemented**.**

DISTRIBUTION LIST

AEM – Linked to Intelex Documents on AEM Intranet system for following authorized users:

AEM – General Mine Manager / Designate

AEM – Assistant General Mine Manager

AEM – Health and Safety Superintendent / Designate

AEM – Human Resources Superintendent / Designate

AEM – Engineering Superintendent / Designate

AEM – Geology Superintendent / Designate

AEM – Environment Superintendent / Designate

AEM – Process Plant Superintendent / Designate

AEM – Energy & Infrastructure Superintendent / Designate

AEM – Mine Superintendent / Designate

AEM – Maintenance Superintendent / designate

AEM – Emergency Response Counselors

AEM – OHSC Co-chairs

AEM – Security

AEM – General Supervisor Inventory

Updated Hard copies distribution list:

AEM -- Meadowbank Emergency Response Centers

DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
1	08/10/31	Appendix A		Revision to include East Dike design modifications
2	09/11/16	All Sections		Confirmation of specific details and procedures Account for as-built designs and emergency preparedness for dike failure scenarios
3	12/01/31	All Sections		Review of all the documents
4	12/07/27	All Sections		Review of all documents
5	13/05/21	All Sections		Review of all documents – logo change – Duty cards
6	13/08/09	All Sections		Added appendixes at back
7	13/09/05	All Sections		Updated information on Dykes, Storm Water
8	14/07-23	All Sections		Revised procedure for calling a Code 1 using radios
9	14/11-10	All sections		General Revision and compliance with International Cyanide Management Code
10	16-08-24	All sections		General Revision and compliance with RMMS
11	17-01-05	All sections		General Revision in accordance with Intelex nomenclature and its new links Emergency Telecom plan link added. (Section 3) Vessel Contingency Plan link added. (4.8.1)

Prepared By: Norm Ladouceur

Norman Ladouceur.
Health and Safety Superintendent

Approved By:

Bertin Paradis
Meadowbank General Manager

TABLE OF CONTENTS

EXECUTIVE SUMMARY……………………………………………………………………..II
DISTRIBUTION LIST ……………………………………………………………………..III
DOCUMENT CONTROL …………………………………………………………………….IV

SECTION 1 INTRODUCTION 8
1.1 Purpose and Scope of the Emergency Response Plan ……………………....8
1.2 AEM's Policy Statement ……………………………………………………….8
1.3 Policy With Respect to Contractors and Visitors……………………………....9
1.4 Environmental Policy……………………………………………………………9

SECTION 2 ORGANIZATION AND JOB RESPONSIBILITIES ………………….10
2.1 General Manager………………………………………………………………..10
2.2 Emergency Control Group……………………………………………………….10
2.2.1 Official In-Charge……………………………………………………...11
2.2.2 Incident Commander…………………………………………………….12
2.2.3 Emergency Log Recorder…………………………………………….13
2.2.4 Muster Station Coordinator…………………………………………...14
2.2.5 Emergency Response Team (ERT) ………………………………......14
2.2.6 Mine Superintendent…………………………………………………..15
2.2.7 Mill Superintendent……………………………………………………14
2.2.8 Environmental Superintendent……………………………………….15
2.2.9 Health and Safety Superintendent…………………………………...15
2.2.10 Energy & Infrastructure Superintendent..……………………………..15
2.2.11 Maintenance Superintendent………………………………………....16
2.2.12 Human Resources Superintendent…………………………………..16
2.2.13 Health Care Professionals…………………………………………….16
2.2.14 Security Department…………………………………………………...16
2.2.15 Procurement/Warehousing General Supervisor………………………16

2.2.16 Department's Duty cards / Roles and Responsibilities…………..**18**
Manager on Duty……………………………………………...18
Health and Safety……………………………………………..20
Dept. Head where incident occurred…………………………..22
Logistic (General Services Superintendent)………………….23
Warehouse……………………………………………………..24
Human Resources…………………………………………….25
ERT Captain……………………………………………….….26
Environment…………………………………………………...28
Maintenance…………………………………………………...29
Mine…………………………………………………………….30
Engineering……………………………………………………31
Geology………………………………………………………...32

Energy & Infrastructure……………………………………….....33
Mill………………………………………………………………35
Camp / Housekeeping……………………………………….36
Incident Commander…………………………………………37
Scribe…………………………………………………………..38

2.3 Occupational Health and Safety Committee………………………………….....39
2.4 All Employees ………………………………………………………………39
2.5 Supervisor……………………………………………………………………..39
2.6 Other Personnel……………………………………………………………….39
2.7 Emergency Response Contact Information **(Contacts listing)**……………....40
2.8 Emergency Coordination Centre………………………………………………44
2.9 Training…………………………………………………………………………45
2.10 Emergency Response Equipment……………………………………………..45

SECTION 3 **COMMUNICATION SYSTEMS………………………………………46**

SECTION 4 **EMERGENCY MEASURE………………………………………………..47**
General Emergency Response Flowchart……………………………………………48
4.1 Fire……………………………………………………………………………49
4.1.1 Muster Point……………………………………………………………………49
4.2 Medical Emergencies…………………………………………………………51
4.2.1 Medical Evacuation Plan………………………………………………………52
4.3 Aircraft Crash Disaster………………………………………………………..53
4.4 Pipeline Breakage……………………………………………………………...55
4.5 Toxic Gas Releases……………………………………………………………..55
4.6 Dike Failure……………………………………………………………………...56
4.7 Emulsion Plant…………………………………………………………………..56
4.8 Baker Lake Marshalling Facility………………………………………………56
4.8.1 Vessel Contingency Plan………………………………………………………57
4.9 Emergencies dealing with reagents…………………………………………57
4.10 Fatality occurring on site……………………………………………………58
4.11 Missing Person………………………………………………………………....59
4.12 Mass Casualty ………………………………………………………………59

SECTION 5 **REFERENCES………………………………………………………………60**

SECTION 6 **LIST OF ACRONYMS…………………………………………………..61**

LIST OF TABLES

Table 2.1: Emergency Response Contact Information ……………………………...40
Table 2.2: External Emergency Phone Numbers ……………………………………42

LIST OF APPENDICES

Appendix A: Emergency Telecom Plan

Appendix B: Emergencies Involving Reagents
B.1 Cyanide (Sodium Cyanide)
B.1.1 General Cyanide Spill/Release Guidelines
B.1.2 Cyanide Transportation Accidents
B.1.3 Cyanide involved in fires
B.1.4 Important release of HCN from storage
B.1.5.1 Process Plant: Important release of HCN
B.1.5.2 Process Plant: Release during Mixing / Unloading
B.1.5.3 Process Plant: Pipe, Valve breakage.
B.1.5.4 Process Plant: Major Breakage on tailing lines, cyanide treatment pumps or Tank rupture.
B.1.6: Failure or overtopping of tailings impoundments

Appendix C: Emergency Response Plan for DYNO Nobel Emulsion Plant

Appendix D: Oil Pollution Emergency Response Plan

Appendix E: Nolinor ERP Plan (Note: accessible only on Intelex under Plans – Emergency Response

Appendix F: Baker Lake Facilities O M Manual Appendix

Appendix G: Desgagnes Vessel Contingency Plan

Appendix H: Baker Lake Bulk Fuel Storage Facility Enviro. Perfo. Monitoring Plan Ver. 2

Appendix I: Meadowbank Transportation Management Plan AWPAR

Appendix J: Appendix J is left blank

Appendix K: Emergency Response Guideline Handbook – ERG 2012

Appendix L: Site maps

Appendix M: Spill Contingency Plan

Appendix N: Meadowbank Crisis Management Plan

SECTION 1 • INTRODUCTION

1.1 PURPOSE AND SCOPE OF THE EMERGENCY RESPONSE PLAN

The purpose of this Emergency Response Plan (ERP) is to provide a consolidated source of information for employees, contractors, and site visitors to respond quickly and efficiently to any foreseeable emergency that would likely occur at the Meadowbank project site. This ERP forms a component of the Environmental Management System (EMS) for the Project. As such, it is a working document that will be reviewed and updated on a regular basis as mine development, construction and operations proceed.

This ERP addresses gold mining, processing, transportation and related activities at the Meadowbank site as well as possible emergency scenarios that may occur off-site along the All Weather Private Access Road or at the Baker Lake Marshalling Facility. Guiding the development of this document has been the principle that an effective ERP must provide:

- A clear chain of command for safety and health activities;
- Well-defined corporate expectations regarding safety and health;
- Comprehensive hazard prevention and control methods; and
- Record-keeping requirements to track program progress.

AEM will ensure that all employees, contractors and site visitors fully understand and comply with all legislated safety standards, and the policies and procedures outlined in the ERP.

This ERP will be reviewed annually, or more frequently as required, to ensure compliance with applicable legislation, to evaluate its effectiveness and to continually improve the procedures. All employees, contractors and site visitors are encouraged to offer suggestions for ways to eliminate potential hazards and improve work procedures.

1.2 AEM'S POLICY STATEMENT

AEM is committed to protecting the health and safety of all its workers and the environment, and to adhering to all legislated safety standards. The necessary resources will be available to respond quickly and efficiently to all emergencies to prevent injury to, or degradation of, the health of individuals or the environment. In implementing this emergency response policy, AEM will set preparedness targets and report its progress on a regular basis.

To this end:

All relevant safety and emergency response laws and regulations will be incorporated into the ERP as minimum standards.

Senior management is responsible for making funds and other resources available, including hiring and training qualified personnel, to ensure the successful implementation of the ERP in the event of an emergency.

All supervisors are responsible for ensuring that their employees are aware of, and trained in, the proper emergency response procedures and that procedures and contact information are posted in all work areas. Supervisors are also responsible for ensuring that all employees follow safe work methods and all related regulations to prevent emergencies from occurring, and that they are provided with the proper tools to do so, including Personal Protective Equipment (PPE).

An emergency response team and coordination centre is establishes at the Meadowbank site.

The ERP will be tested on a periodic basis to ensure its effectiveness.

1.3 POLICY WITH RESPECT TO CONTRACTORS AND VISITORS

Every person working at or visiting the Meadowbank site receives an orientation upon arrival and as such is apprised of, and required to follow the ERP policies and procedures set forth in this manual. For a list of responsibilities, see Section 2.

Major contractors, such as those for mining and hauling, are required to have their own H&S services. This is verified by AEM management prior to engagement of the contractor.

1.4 ENVIRONMENTAL POLICY

AEM is committed to achieving a high standard of environmental care in conducting its mineral exploration activities. AEM's Environmental Policy includes:

- Compliance with all applicable legislation including laws, regulations, and standards. Where laws do not exist, appropriate standards will be applied to minimize environmental impacts resulting from exploration activities.
- Open communication with government, the community, and employees on environmental issues.
- Development and adherence to management systems that adequately identify, monitor, and control environmental risks associated with AEM's exploration activities.
- Assurance that the employees are aware of their responsibilities and comply with AEM's Environmental Policy and field guide.

It is the policy of AEM to protect the environment, public health and safety, and natural resources by conducting operations in an environmentally sound manner while pursuing continuous improvement of our environmental performance.

SECTION 2 • ORGANIZATIONAL RESPONSIBILITIES

This section details the roles and responsibilities of all parties involved in emergency response planning and implementation at the Meadowbank mine site.

2.1 GENERAL MANAGER

The General Manager is responsible for implementing and maintaining the ERP. In addition, the General Manager's responsibilities are to:

- Act as a spokesperson on behalf of AEM with the public, media, and government agencies, as required;
- Prepare and submit any formal reports (within the required time frame) to regulators and AEM management detailing the occurrence of an emergency; this includes submitting an incident reporting form;
- Ensure that the Health & Safety and Environment Superintendents have the means (financial and otherwise) to ensure that all required resources are made available, or provided from off-site if required;
- Work with the H&S, Human Resources and Environment Superintendent to evaluate what training is required by all staff, ensure that all staff are given appropriate training, and ensure that all staff are retrained as needed;
- Ensure that the Human Resources Superintendent has the means (financial and otherwise) to ensure that all employees' training requirements are current;
- Ensure that inspections of emergency response training practices and emergency response equipment are carried out;
- Ensure that emergency response exercises are conducted annually,
- Ensure that the results of the regular inspections are used to improve emergency response practices, and improve relevant plans accordingly;
- Complete an annual detailed review of the ERP with the management team and the Join Health and Safety Committee with particular emphasis on the objectives and methods of the plan, and the job descriptions of all positions named within;
- Ensure that updates to new emergency communications information (new phone numbers, changes in reporting structure, etc.) are distributed as soon as the new information becomes available;

2.2 EMERGENCY CONTROL GROUP – ***ON SITE MANAGEMENT TEAM***

No single department can handle an emergency situation alone. Everyone must work together to manage the emergency and coordinate the effective use of all available resources.

Therefore at the time of any emergency, all the management team and/or their designate must report to the 3rd floor Emergency Response Control room #1 or to the Emergency Response

Control Room #2, at the Training room or to the Emergency Response Control Room #3 at the Meadowbank gatehouse.

The Emergency Control Team structure lends support, fosters efficiency and provides additional knowledge during an emergency response situation.

The Official In-Charge, (General Mine Manager or Designate) maintains the overall coordination and direction of the Emergency and ensures the continued safety of all employees and the public.

However, the Superintendent or designate of the Area affected by the emergency, will assist with the development of the overall emergency response plan.

The remainder of the Emergency Control Team will be given specific tasks to perform that will assist with the management and coordination of the emergency response plan.

Roles & Responsibilities of the Emergency Control Group (See Duty Cards)

2.2.1 Official In-Charge

The Official In-Charge (General Manager or designate) will take charge for overseeing and approving the overall emergency strategy.

Immediate duties of the Official In-Charge include:

- Consult with the Incident Commander the status of emergency.
- Appoint an Emergency Log Recorder to maintain a written record of the time and events, including all discussions, instructions and decisions made by the Emergency Control Team;
- Appoint a Muster Station Coordinator, who will ensure that proper head counts are conducted at three (3) designated Muster Stations.
- Issues specific tasks to the members of the Management as they arrive at the Control Room, as per this guideline;
- Brief the Emergency Control Team;
- Ensure that the safety of personnel is maintained, throughout the operation.
- Ensure procedures are in place for prompt dispatch of requested personnel, materials and equipment to the emergency area.
- Arrange for all reports to be presented at specific intervals to the Emergency Control Team
- Finalize the recommendations of the Incident Commander for rescue and recovery operations.

- The Official In-Charge is the only person authorized to release information to Government Agencies, Corporate Office or the Local Communities. He may delegate this activity to other members of the Emergency Control Team.

    - Verify all information you release;
    - Keep a record of all inquiries (media and non-media);
    - Do not speculate on causes;
    - Do not speculate on resumption of normal operations or when the problem will be solved;
    - Advise that further updates will be forth coming.

- Notify the corporate management, if the following appear probable:
    - fatalities;
    - injuries that could probably become items of local, regional or national media interest;
    - there is a public health or environmental risk;
    - an incident involving chemicals where there is a large volume or the potential for over reaction (e.g., cyanide);
    - a spill of effluent or contaminated water or chemical substance to an area that lies outside the area of drainage control of the mine site (i.e., an external spill);
    - mine operations may be stopped for more than two (2) days;
    - Government authorities will become involved.

- Ensure all response teams, regulatory agencies and any other agency on emergency alert notice are advised when the emergency has ended.
- **At all time, the mine acting manager will decide to take over external communications from site accordingly with the Meadowbank Crisis Management Plan.**

- Ensure all documentation (i.e., notes, log sheets, written instructions, etc.) is gathered for the creation of the final report.

- Participate in debriefing.

2.2.2 Incident Commander – Usually a Trained Staff Member (ERT Coordinators or Supt. / GF.)

The responsibilities of the Incident Commander include;

- Ensure Security has been notified of emergency;

- Ensure the evacuation procedures have been activated, if required;

- Ensure that there are sufficient ERT members available to respond to the emergency;

- Ensure that the ERT has back-up support, a standby Team;

- Ensure that ERT Team has refreshments and nourishment (if the emergency requires several hours to resolve);

- Assess the size and severity of the emergency and the likely consequences. Establish response priorities;

- Maintain communication with the ERT Captains.

- Advise the Official In-Charge of the ERT Team's activities, regarding the rescue and recovery operations.

- Appoint sufficient personnel, equipment and outside services are available. Utilize the members of the Emergency Control Team to organize these resources.

- Advise Official In-Charge when the emergency situation is under control and give the "All Clear".

- Participate in emergency investigation.

- Coordinate an orderly return to normal operating conditions.

- Arrange for a debriefing session, and utilize the services of all involved in resolving the emergency.

- Assist to write the final report.

2.2.3 Emergency Coordination Center Log Recorder :

- "*Keep a systematic record of the emergency events" and get an accurate "Head Count during Emergencies***"**

- These persons can be the Engineering Supt/Designate/ General Supt. (whoever is available to perform these duties).

- The log is intended to be a systematic record of the events from the start of the emergency through all phases to termination, and will be used in the preparation of the final report. It is important that the log be legible and that all information is recorded.

- Date and time the incident was reported, who reported the event;
- Every person entering or exiting the ''Emergency Control Room'' must report to Log Recorder.
- Record all subsequent developments as they occur;
- Record all phone calls all discussions and decisions made;
- Record any other information that needs to be captured for the final report;
- Keep all the sheets of paper used to record information numbered, for the final report;
- All the pages will be initialed by the recorder and official in-charge;
- The official document will stay with the Health & Safety Department upon completion of the emergency.

2.2.4 Meadowbank Site / Muster Stations Coordinator*:*

"Provide a Head Count during Emergencies".

- As soon as Management begins to assemble in the Emergency Control Room , the Person In Charge (the manager/designate) needs to assign a member of the Management Team *to be responsible for ensuring that the Muster Stations are contacted.*
- These persons can be the Geology Supt/Designate/ General Supt. (whoever is available to perform these duties).
- The Muster Stations Coordinator is required to contact the three Muster Stations by radio on channel **''Muster Station''** to ensure that there is a Supervisor or designate in charge of that specific muster station and give him/her 20 minutes to achieve the head count.
- The Muster Stations Coordinator will need to record the time the muster station was called, who is in-charge of the muster station, and any other instructions that have been given.
- The Muster Stations Coordinator needs to open the Flo on his/her laptop in order to cross reference the names, once they receive the lists from the Muster Stations. (Additional persons may need to be assigned to assist with the cross reference, in order to complete the head count in a timely manner).

2.2.5 Emergency Response Team (ERT Team) Duties:

- The ERT Team Members must report to the Fire Hall, when paged for a "code One" emergency;
- ERT Team Members will be given instructions on the emergency by the Incident Commander;
- ERT Team Members will follow instructions from the Incident Commander and will not put the Team at risk;
- The ERT Team Captain will maintain radio contact with the Incident Commander throughout the emergency:

2.2.6 Mine Superintendent/Designate Duties;

- Ensure that all employees working, are accounted for;
- Ensure that the ERT Members of his crew have responded to the "code One" emergency;
- If the "Emergency" is in the Mining area, then assist the Official-in-Charge with the action plan to deal with the emergency:
- Assist as required by supplying equipment and/or manpower;

- Assist with restoring of the Operations back to normal operating standards:

2.2.7 Mill Superintendent/Designate Duties;

- Ensure all employees working, at this time, are accounted for;
- Ensure that the ERT Members on his crew, have responded to the “ Code One” emergency;
- If the “ Emergency” is in the Mill facilities, assist the Official-in-Charge with the action plan to deal with the emergency:
- Assist as required by supplying equipment and/or manpower;
- Assist with restoring of the Operations back to normal operating standards:

2.2.8 Environmental Superintendent/Designate Duties:

- Provide technical advice on probable environmental effects resulting from a spill and how to minimize them;
- Ensure that the ERT Members of his crew have responded to the “code One” emergency;
- Provide advice to the Official-in-Charge for appropriate spill response procedures;
- Ensure that Environmental Staff are available to direct the spill response action plan;
- Assist with restoring of the Operations back to normal operating standards:

2.2.9 Health and Safety Superintendent/Designate Duties:

- Ensure that an Incident Commander is in place to oversee the ERT Teams;
- Ensure that all Management respond to the emergency and meet in the emergency control room;
- He will oversee all activities that require Security or Nursing. He will arrange for Medevac transport, if required;
- Will assist with getting a “head count” for the Official in-charge;
- Assist with obtaining outside help if required:

2.2.11 Energy & Infrastructure Superintendent / Designate Duties:

- Ensure that all his employees are accounted for
- Ensure that all ERT Member on his Crew, respond to the “ code One” emergency;
- If the “ Emergency” involves the Site facilities, assist the Official-in-Charge with the action plan to deal with the emergency:
- Assist as required by supplying equipment and/or manpower;

- Assist with restoring of the Operations back to normal operating standards:

2.2.12 Maintenance Superintendent/Designate:

- Ensure that all of his employees are accounted for;
- Ensure that all ERT Members of his crew respond to the "Code One" emergency;
- If the "Emergency" is in the Maintenance Shops, then assist the Official-in-Charge with the action plan to deal with the emergency;
- Assist as required by supplying equipment and/or manpower;
- Assist with restoring of the Operations back to normal operating standards:

2.2.13 Human Resources Superintendent/Designate Duties:

- Ensure that all HR employees are accounted for;
- Provide assistance to the Official-in-Charge if there are employees issues, such as injuries, transportation requirements, etc.:

2.2.14 Health Care Professional (Nurse/Medic):

The on-site health professionals are responsible for the following:

- Providing on-site first aid and other medical support;
- Establish a triage location if there are multiple casualties;
- Arrange for medevac transportation, if required;
- Ensuring that the first aid room is maintained at all times, by using First Responders as support:

2.2.15 Security Department:

The on-Site Security Supervisor is responsible for the following:

- Ensure that access points to the emergency are properly guarded.
- Notify the Baker Lake Gatehouse if the emergency involves the All-weather private Road (AWPR).
- Assist with other duties as requested by the Emergency Control Group.

2.2.16 Procurement and Logistic / Warehouse Department:

The on-Site Procurement or Warehouse General Supervisor / Designate will be responsible for:

- Ensure that all his employees are accounted for
- Ensure that all ERT Member on his Crew, respond to the " code One" emergency;

- Assist as required by supplying equipment and/or manpower;
- Assist with restoring of the Operations back to normal operating standards:

2.2.17 Duty Cards for each Department/Roles and Responsibilities

Each individual roles and responsibilities are defined on the following pages:

Name: ___________________________

Date: ____________________________

Time assumed Role: _______________

Manager On Duty - Duty Card	**Completed**	**Time**
1. Notified of an emergency – Make decision to have the whole Management Paged – control group		
2. Brief Management Team on the emergency		
3. Appoint a Scribe – Engineering department		
4. Decide if communications are to be cut – Notify IT		
5. Ensure that the emergency remains confidential – limit what is said to employees		
6. Conduct a head count – (Muster Stations) Assign duty to Geology Department		
7. Ensure unaffected Departments are put on Standby – E.g.: mine dept. – may need equipment		
8. Ensure all Service Departments are put on Standby – as required by ERT – Camp / Mine / Site Services / Maintenance / Manpower / Equipment / Tools / Equipment		
9. Ensure Power House is on standby		
10. Ensure that Protocol is on standby – flights to and from site for our workers / Mutual Aid teams		
11. Ensure Warehouse is on standby:		

Note: list of materials taken will be kept and accounted for after the emergency is over		
12. Do we need radios, ERP, Site Drawings out for incident command team		
13. Security / Close Roads		
Once Emergency is over:		
1. Initiate the "Emergency Stand Down" when required		
2. Follow up with HR Designate on any victim or surviving members concerns		
3. Hold a de-briefing with Personnel prior to them exiting the site		
4. Gather any information for Corporate HQ and Regulatory Agencies (Mines Inspector)		
5. Prepare and facilitate a Debriefing Session		
6. **General Manager will liaise with media with ALL information going out from site.**		
*** Write notes on reverse side and return this Card to Scribe after the Incident Debriefing for compilation purposes**		
No information will be relayed to Corporate or Media without the expressed confirmation of the Manager on Duty.		

Name: _______________________

Date: _________________________

Time assumed role: _____________

Health & Safety Department or Designate Duty Card	**Completed**	**Time**
Print Name:		
1. Report to Command Centre		
2. Offer support to all Incident Command Group Management Team Members		
3. Account for all persons in Health and Safety Dept.		
4. Liaison between Emergency Response Teams and Incident Command Group Management Team Members		
5. Review remaining Emergency Response Capabilities: manning, equipment, resources		
Questions to ask: a) Do we need to stop operations? (Ex: SCBA use – if SCBA's are required for emergency, and we have other confined space work occurring, do we cancel? b) Do we need to reduce or have rescuers stand down during an emergency to ensure that we have adequate numbers available for continuation of normal operations? c) (Ex: mine rescue team called out to an emergency, 12 people show up, only 6 is required for emergency, and then 6 can stand down and go back to work and be available if another emergency occurs at same time. d) If people and equipment are available to meet		

Regulation requirements, then normal operations can continue. If not – consider putting alternate plans in place.		
6. Respond to any field requests		
7. Maintain notes of all decisions made with times as required.		
8. Organize and manage any site security requirements		
9. Liaison with any other emergency resource provider		
10. Provide information updates to the Incident Command Group		
11. Maintain Health and Safety Standards at the Mine Site during any incident		
12. Assist with any trauma management situations and Post Incident Debriefing sessions as required		
13. Participate in the incident debriefing session		
14. Liaison with the Department Head where incident occurred and help with incident investigation process		
15. Advise on corrective action initiatives		
16. Communicate with Mines Inspector – Serious Injury / Dangerous Occurrence – only after approval of Manager on duty		
***Write notes on reverse side and return this Card to scribe after the Incident Debriefing**		

Name: ___________________________

Date: ____________________________

Time assumed role: ________________

Department Head where incident occurred Duty Card	**Completed**	
Print Name:		
1. Report to Command Centre		
2. Gather all available information and share with Incident Command Group Team Members		
3. Account for all persons under area of responsibility – (Need to determine who is missing and where they may be)		
4. Confirm effective Communications with Responders and Relative Supervisors		
5. Confirm Incident losses and status of the incident		
6. Designate an Assistant if required		
7. Assess current resources and determine if additional resources are required		
8. Manage Personnel duty hours, needs, food and other		
9. Visit the incident scene if required – and Safe to do so		
10. Assemble any information required for a report		
11. Attend the Incident Debriefing		
***Write notes on reverse side and return this Card to Scribe after the Incident Debriefing**		

Name: ___________________________

Date: ____________________________

Time assumed role: ________________

Logistic Duty Card **(Designated by Acting Manager)**	**Completed**	**Time**
Print Name:		
1. Report to Command Centre		
2. Account for all persons under area of responsibility		
3. Ensure that flights are arranged for outgoing and incoming purposes when required		
4. Ensure IT is available upon request – (cut communications) fix radios etc.		
5. Arrange transportation of all personnel as required		
6. Arrange for provision of food, water, temporary shelter, radios, PPE, etc. when required		
7. Assemble any information required for a report		
8. Participate in the Incident Debriefing		
***Write notes on reverse side and return this Card to scribe after the Incident Debriefing**		

Name: ___________________________

Date: ____________________________

Time assumed role: ________________

Warehouse or Designate Duty Card	**Completed**	**Time**
Print Name:		
1. Report to Command Centre		
2. Account for all persons under area of responsibility		
3. Assemble lists for inventory of possible equipment or supply needs		
4. Source any supplies and equipment that is requested by the Manager on Duty		
5. Source any requests for external services or supplies		
6. Designate an Assistant if Required		
7. Schedule Support Staff Personnel if required		
8. Ensure that someone is available at all times during the entire emergency to supply equipment materials as necessary		
9. Assemble any information required for a report		
10. Participate in the Incident Debriefing		
***Write notes on reverse side and return this Card to scribe after the Incident Debriefing**		

Name: ____________________________

Date: _____________________________

Time assumed role: _________________

Human Resources/Designate Duty Card	**Completed**	**Time**
Print Name:		
1. Report to Command Centre		
2. Account for all persons under area of responsibility		
3. Set up a format for any media communications		
4. Confirm information accuracy if required		
5. Designate an Assistant if required		
6. Ensure proper notification systems are followed (RCMP are responsible for initial notification of family in fatal events)		
7. Coordinate any follow up visits to family of victims		
8. Confirm that Employee Assistance Program, Critical Incident Stress or Victim Services is available to injured or survivors or Post Traumatic Stress sufferings of any personnel		
9. Assemble any information required for a report		
10. Help Manager on Duty prepare communication to advise workforce		
11. Participate in the Incident Debriefing		
12. **All communication to media will be done through the Manager on Duty**		
***Write notes on reverse side and return this Card to scribe after the Incident Debriefing**		

Name: ______________________________

Date: _______________________________

Time assumed role: __________________

Emergency Response Team Captain Duty Card	**Completed**	**Time**
Print Name:		
1. Respond to the scene or requested area with all available and applicable equipment		
2. Confirm communication with the Incident Commander at Base Station		
3. Contact Department Head of affected area for any request or directions through Incident Commander		
4. Direct emergency activities with your Team		
5. Maintain Safe Working Standards with you team		
6. Offer periodic Status Reports to Incident Commander at Base Station		
7. Secure the incident scene – as per Regs. 16.03/16.04		
8. Liaison with any other external emergency personnel		
9. Ensure area clearances with Helicopter Pilots – if required		
10. Respond accordingly within you and your team's capabilities		
11. Request any additional resources through your Incident Commander at Base Station		
12. Assemble any information required for a report		

13. Attend the Incident Debriefing		
14. Take Cell Phone with them when going off site – phone number is 867-793-1330		
***Write notes on reverse side and return this Card to scribe during the Incident Debriefing**		

Note: Captain must have a report that will be submitted at completion of emergency which includes all of the above.

Name: ________________________________

Date: _________________________________

Time assumed role: _____________________

Environmental Department Duty Card	**Completed**	**Time**
Print Name:		
1. Report to Command Centre		
2. Account for all persons in area of responsibility		
3. Be available as a resource to Incident Command Group		
4. Maintain a log of events, calls, requests, external personnel and contact lists if requested		
5. Liaison with all field operations on the incident when involving spills/chemicals		
6. Liaise with Government Regulators as necessary for reporting spills/chemicals etc. upon approval of Manager on Duty.		
7. Designate an Assistant if required to help out in the field		
8. Direct external Emergency Spill Response Personnel to proper location(s) if required		
9. Assemble any information required for a report		
10. Attend the Incident Debriefing		
***Write notes on reverse side and return this Card to scribe during the Incident Debriefing**		

Name: ________________________________

Date: _________________________________

Time assumed role: _____________________

Maintenance Department Duty Card	**Completed**	**Time**
Print Name:		
1. Report to Command Centre		
2. Account for all persons in area of responsibility		
3. Be available as a resource to Incident Command Group		
4. Maintain a log of events, calls, requests, external personnel and contact lists		
5. Liaison with all field operations on the incident when involving equipment, machinery		
6. Have personnel available to deal with broken down machinery etc.		
7. Designate an Assistant if required to help out in the field		
8. Make equipment and manpower available if required by Emergency Response Team		
9. Assemble any information required for a report		
10. Attend the Incident Debriefing		
***Write notes on reverse side and return this Card to scribe during the Incident Debriefing**		

Name: ________________________________

Date: _________________________________

Time assumed role: _____________________

Mine Department Duty Card	**Completed**	**Time**
Print Name:		
1. Report to Command Centre		
2. Account for all persons in area of responsibility		
3. Be available as a resource to Incident Command Group		
4. Maintain a log of events, calls, requests, external personnel and contact lists		
5. Liaison with all field operations on the incident when involving incidents in the pit		
6. Ensure that contractors in area of responsibility are notified and accounted for		
7. Designate an Assistant if required to help out in the field		
8. Make equipment and manpower available as necessary to help Emergency Response Teams		
9. Assemble any information required for a report		
10. Attend the Incident Debriefing		
***Write notes on reverse side and return this Card to scribe during the Incident Debriefing**		

Name: ________________________________

Date: _________________________________

Time assumed role: _____________________

Engineering Department Duty Card	**Completed**	**Time**
Print Name:		
1. Report to Command Centre		
2. Account for all persons in area of responsibility		
3. Be available as a resource to Incident Command Group		
4. Maintain a log of events, calls, requests, external personnel and contact lists (SCRIBE) for the incident		
5. Liaison with all field operations on the incident when involving incidents where engineering is required		
6. Designate an Assistant if required to help out in the field		
7. Make equipment and manpower available as necessary to help Emergency Response Teams		
8. Assemble any information required for a report		
9. Attend the Incident Debriefing		
***Write notes on reverse side and return this Card to scribe during the Incident Debriefing**		

Name: ________________________________

Date: ________________________________

Time assumed role: _____________________

Geology Department Duty Card	**Completed**	**Time**
Print Name:		
1. Report to Command Centre		
2. Account for all persons in area of responsibility		
3. Be available as a resource to Incident Command Group		
4. Conduct a proper head count of all persons assembled in the Muster Stations (Procedure can be found in Emergency Response Plan)		
5. Maintain a log of events, calls, requests, external personnel and contact lists		
6. Designate an Assistant if required to help out in the field		
7. Make equipment and manpower available as necessary to help Emergency Response Teams		
8. Assemble any information required for a report		
9. Attend the Incident Debriefing		
***Write notes on reverse side and return this Card to scribe during the Incident Debriefing**		

Name: ________________________________

Date: _________________________________

Time assumed role: _____________________

Energy & Infrastructure Department Duty Card	Completed	Time
Print Name:		
1. Report to Command Centre		
2. Account for all persons in area of responsibility		
3. Be available as a resource to Incident Command Group		
4. Ensure that manpower, equipment is available for the proper function and maintenance of fire sprinkler systems		
5. Ensure that manpower, equipment is available to maintain an open road (AWPR) to Baker Lake		
6. Ensure that manpower is available as airport marshal and for moving material arriving in aircraft, fuel, etc.		
7. Ensure that manpower, equipment is available for transportation of men/gear to help Emergency Response Teams		
8. Ensure that personnel and equipment is available to maintain the required electrical power supply		
9. Maintain a log of events, calls, requests, external personnel and contact lists		
10. Designate an Assistant if required to help out in the field		
11. Make equipment and manpower available as necessary to help Emergency Response Teams		
12. Assemble any information required for a report		

13. Attend the Incident Debriefing		
***Write notes on reverse side and return this Card to scribe during the Incident Debriefing**		

Name: ________________________________

Date: _________________________________

Time assumed role: _____________________

Process Plant Department Duty Card	**Completed**	**Time**
Print Name:		
1. Report to Command Centre		
2. Account for all persons in area of responsibility		
3. Be available as a resource to Incident Command Group		
4. Conduct a proper head count of all persons assembled in the Arctic Corridor Muster Station		
5. Maintain a log of events, calls, requests, external personnel and contact lists		
6. Designate an Assistant if required to help out in the field		
7. Make equipment and manpower available as necessary to help Emergency Response Teams		
8. Assemble any information required for a report		
9. Attend the Incident Debriefing		
***Write notes on reverse side and return this Card to scribe during the Incident Debriefing**		

Name: ________________________________

Date: _________________________________

Time assumed role: _____________________

Camp/Housekeeping Department Duty Card	Completed	Time
Print Name:		
1. Report to Command Centre through HR		
2. Account for all persons in area of responsibility		
3. Be available as a resource to Incident Command Group		
4. Ensure an adequate supply of food when requested		
5. Ensure that an adequate supply of blankets, washers/dryers are available when requested		
6. Maintain a log of events, calls, requests, external personnel and contact lists		
7. Designate an Assistant if required to help out in the field		
8. Make equipment and manpower available as necessary to help Emergency Response Teams		
9. Assemble any information required for a report		
10. Ensure that HR has all available information		
***Write notes on reverse side and return this Card to scribe during the Incident Debriefing**		

Name: ______________________________

Date: _______________________________

Time Assumed Role: _________________

To be filled out by Incident Commander:

Incident Commander Duty Card	**Completed**	**Time**
Print Name:		
1. Initiate an emergency response as required		
2. Ensure communications with Emergency Response Team Captain and be there to request assistance or resources		
3. Ensure incident scene is secured as required		
4. Liaise between Emergency Response Team and Incident Command Group		
5. Ensure that all gear, equipment, supplies required by Emergency Response Team is made available to them		
6. Have the gear, equipment, supplies brought to Emergency Response Teams when required		
7. Assemble any information required for a report		
8. Request any additional resources at any time required		
9. Attend the Incident Debriefing if requested		
***Write notes on reverse side and return this Card to ICS during the Incident Debriefing**		

Name: ______________________________

Date: _______________________________

Time assumed role: __________________

Scribe Duty Card	**Completed**	**Time**
Print Name:		
1. Report to Command Centre		
2. Scribe all accounts of activity in chronological order		
3. Scribe information as requested by the Incident Command Group – Manager on Duty		
4. Provide a detailed report at end of incident		
5. Assemble any information required for a report		
***Write notes on reverse side and return this Card to ICS during the Incident Debriefing**		

2.3 OCCUPATIONAL HEALTH AND SAFETY COMMITTEE:

The Occupational Health and Safety Committee are responsible for:

- Review the emergency response plan on an annual basis.
- Assist with any investigation resulting from the emergency.

2.4 ALL EMPLOYEES:

All employees are responsible for:

- Reporting to the nearest Muster Station when an fire alarm is sounded;;
- Employees reporting to the Muster Station need to assemble at the placard that has their department name.
- Employee's must be quiet and await the "head count**".**
- Reporting any emergency by either using a two-way radio on your regular "working channel" (Note: Working zone channel 9 (AEM Surface should initiate a Code 1 on channel 3 (Mill Repeater) or by using the telephone to call 6911, to describe the type, the location, and nature the emergency, including possible injuries, trapped personnel, and the presence of any chemical or explosive hazards.

2.5 SUPERVISOR:

The Supervisor is responsible for:

- Ensuring the "Code One" call in, is accurate and that all the pertinent information is available for the official-in-Charge. (providing details regarding the type, the location, and the nature of the emergency, including possible hazardous materials involved and health and safety concerns);
- Ensure all workers on his shift are accounted for.

2.6 OTHER PERSONNEL:

Depending on the nature of the emergency (medical, electrical, mechanical, fire, etc.) other site personnel, including the Site Electrician, Site Mechanic, and others, may be called upon to play key roles.

2.7 EMERGENCY RESPONSE CONTACT INFORMATION – INTERNAL & EXTERNAL

AEM internal emergency response personnel, their duties, and phone numbers has been compiled in Table 2.1, Important external contacts such as regulatory agencies, health organizations and transportation companies providing evacuation support are listed in Table 2.2.

Table.1: Internal Emergency Response Contact Information Chart

NOTE: Pagers are activated by dialing **6930** and listen for instructions

GENERAL MANAGER or Acting Manager	**Pager: 404**
Bertin Paradis	**Ext: 6725**
	Cell: 819-355-9348
Assistant-General MANAGER	**Pager: 215**
Luc Chouinard	**Ext: 6767**
	Cell: 819-856-8160
INCIDENT COMMANDER	**Pager: 402 Ext: 6809**
Andre Rouleau	**Cell: 819-355-2191**
Philippe Beaudoin	**Cell: 450-847-4214**
Health & Safety	**Pager: 213**
Information Technology	**Pager: 282**
Security	**Pager: 468**
Engineering	**Pager: 230**
Geology	**Pager: 218**
Mining Dept.	**Pager: 234**
Environment	**Pager: 232**
Process Plant	**Pager: 214**
Energy and Infrastructure	**Pager: 219**

Human Resources	**Pager: 217**
Maintenance	**Pager: 231**
Logistic and Warehouses	**Pager: 216**

In order to reach the whole management team with one call: PAGER 6930 - 408

Every department has the obligation to designate a representative that is wearing the departmental pager and is also knowing and understanding basic principles of the Emergency Response Plan.

All pagers can be activated by dialing 6930 on MBK's regular phone network

Table 2.2: External Emergency Phone Numbers

Organization / Authority	Telephone Number	Fax Number
NT-NU 24-HOUR SPILL REPORT LINE	867.920.8130	867.873.6924
Nunavut Water Board	867.360.6338	867.360.6369
Environnent Canada, Environemental Protection Branch	867.669.4700	867.873.8185
Environment Canada: 24-hour emergency pager monitored by Emergency and Enforcement	867-920-8130	Same as NT-NU 24-hours spill
Manager Pollution Control & Air Quality Environmental Protection, Government of Nunavut	867.975.7748	867.975.5981
General Inquiry Department of Environment, Government of Nunavut	867.975.7700	
Indian and Northern Affairs Canada (INAC) – Water Resources Manager, Nunavut Regional Office	867.975.4550	867.975.4585
Indian and Northern Affairs Canada (INAC) – Manager, Land Administration, Nunavut Regional Office	867.975.4280	867.975.4286
Kivalliq Inuit Association – Reporting Line	867.645.2810 or 867.645.2800	
Department of Fisheries and Oceans (DFO) – Nunavut Regional Office	867.979.8000	867.979.8039
Workers Safety and Compensation Commission **WSCC Emergency** Mine Inspector: Martin Van Rooy Chief Inspector of mines – Fred Bailey	800.661.0792 **877-661.0792** 867.979.8527 867.669.4430	
Health Services – Baker Lake	867.793.2816 867.793.2817	
Keewatin Air Ambulance (Medevac) 24h/7 – Rankin Inlet dispatch	867.645.4455	
Baffin Regional Hospital (Iqaluit)	867.979.7300	

Baker Lake RCMP Baker Lake RCMP – emergency number Cambridge Bay RCMP	867.793.0123 867.793.1111 867.983.1111	
Baker Lake Hamlet Office	867.793.2874	
Baker Lake Fire Emergency	867.793.2900	
Baker Lake Radio Station	867.793.2962	
Baker Lake Airport	867.793.2564	
Poison & Drug information service (PADIS)	866-727-1110	
Search and rescue – Artic Armed Forces Rescue Coordination Centre Trenton	800.267.7270 613.965.3870	
NAVCAN (Flight Information Center North Bay)	866.541.4109	
CANUTEC (Spill Support Information)	613.996.6666	
Charter Aircraft (for Evacuation)		
Keewatin Air Ambulance (Medevac) 24h/7 – Rankin Inlet dispatch	867.645.4455	
Calm Air	204.677.0513 204.677.0519	
Nolinor	450.476.0018 888.505.7025	
First Air	867.669.6694 867.444.2002	
Helicopter Transport Services (HELI transport)	613.839.5868	
Nunavut Emergency Management – Rankin Inlet	1-867-645-6803	
Nunavut Emergency Management – Iqaluit	1-867-979-6262	

2.8 EMERGENCY COORDINATION CENTRE

Emergency operations will be directed out of the Emergency Control Centre (ECC). The ECC is located in the 3rd Floor of the Service Building Conference Room, or in the Training room on the main floor, or in the Airport Controller Building by Air Strip from where the following will take place:

- Key decisions will be made and operations will be managed;
- Technical information to direct emergency activities will be provided;
- A communications centre will be established for emergency operations and to communicate with other organizations;
- Resource procurement will be provided and resource use will be directed;
- Any damage will be assessed and long-range objectives and plans will be developed; and
- Information on the emergency will be stored and disseminated to all necessary internal and external parties.

The following information is available at the centre:

- Shutdown procedures for operations;
- Locations of hazardous material storage areas;
- Locations of emergency and safety equipment;
- Locations of first aid stations and muster areas;
- Maps of communities and environmental maps;
- Information on location of other communications equipment, including portable sets;
- Information on emergency power;
- Contacts for other utilities;
- Operating manuals;
- Materials Safety Data Sheets (MSDS);
- List of personnel with alternate skills for use in emergencies;
- Type and location of alarm systems;
- Accident report forms;
- Accident status board and log book;
- Notification lists, staff lists, contact lists, with regular and emergency telephone/pages numbers, etc.

The ICC will be located at a safe and secure place near the site of the emergency. All responses and mitigation efforts developed at the ECC will be implemented through the ICC.

In the event of an emergency, security personnel may be required to establish and maintain a security perimeter to prevent or minimize injury to personnel, to preserve evidence for investigation, or to prevent unauthorized access to the scene.

2.9 TRAINING

The HR Superintendent is responsible for documenting, tracking, and updating all training activities. Record of training requirements and training attendance will be kept, tracked and updated for all employees by the HR Superintendent to ensure that retraining occurs as required.

For mine operations, AEM will ensure a sufficient number of trained ERT team members are on site at all times. All members of the ERT will be trained and familiar with emergency procedures. Emergency training will be conducted annually to ensure that a sufficient number of team members are available and that their training is up-to-date. The following will be included in the training:

2.10 EMERGENCY RESPONSE EQUIPMENT

The Emergency Measures Counsellor will ensure that site drawings and equipment lists are posted conspicuously in key locations throughout the site so that important information is always readily available. This will include the following:

- Location and isolation points of energy sources;
- Location of emergency equipment (e.g., fire water pumps, fire extinguishers, monitors, self-contained breathing apparatus);
- Emergency procedures outlines, such as specialist firefighting, chemical neutralization;
- Availability of internal and external emergency medical support (e.g., hospitals, clinics, ambulances, medical supplies, personnel with medical or first aid training);
- Location of toxicity testing facilities (e.g., gas and water);
- Location of wind direction / speed indicators;
- Location of personal protective equipment and directions on its proper use; and
- Location of first aid stations and muster areas.

The Incident Commander, EMC, and Health and Safety Superintendent will know where, throughout the project site, all of this information is posted and where emergency equipment is stored. These individuals will also be trained in the proper use of emergency equipment.

SECTION 3 • COMMUNICATION SYSTEMS

The primary basis for communication will be the phone system; back-up communication will be available via satellite phone. For on-site communication, hand-held radios will be mandatory for all employees working or travelling in remote areas from the main camp. Cell phones can be used as an additional means of communication. Back-up power sources and replacement batteries for communications equipment will be available to provide continuous, uninterrupted operation either at fixed facilities or at emergency sites.

Key site personnel will be accessible at all times by either portable radios, radios in vehicles, or office radios. The Health Care Professional will carry a hand-held radio and will be available at all times. Security personnel will monitor the emergency channel twenty-four hours per day. Senior management personnel will rotate as “On-Call Managers” for after-hour emergencies. An accommodations list that highlights key personnel will be posted and updated as required.

Lists of employees trained in first aid, mine rescue, and Emergency Response will also be posted. Employees and contractors who will be on site for extended periods will be trained initially and then retrained annually. This training will include the locations and use of emergency equipment, terminology used, and who needs to be contacted immediately in the event of an emergency.

There is a document listing all telecommunications systems supported by the Department of Information Technology during an emergency and their location. It also uses procedures for certain equipment and procedure in the case of a request for closure of all telecommunications services with the outside.

This document can be found under APPENDIX ‘’A’’

SECTION 4 • EMERGENCY MEASURES

In the event of an emergency, the employee will have to follow our emergency procedure:

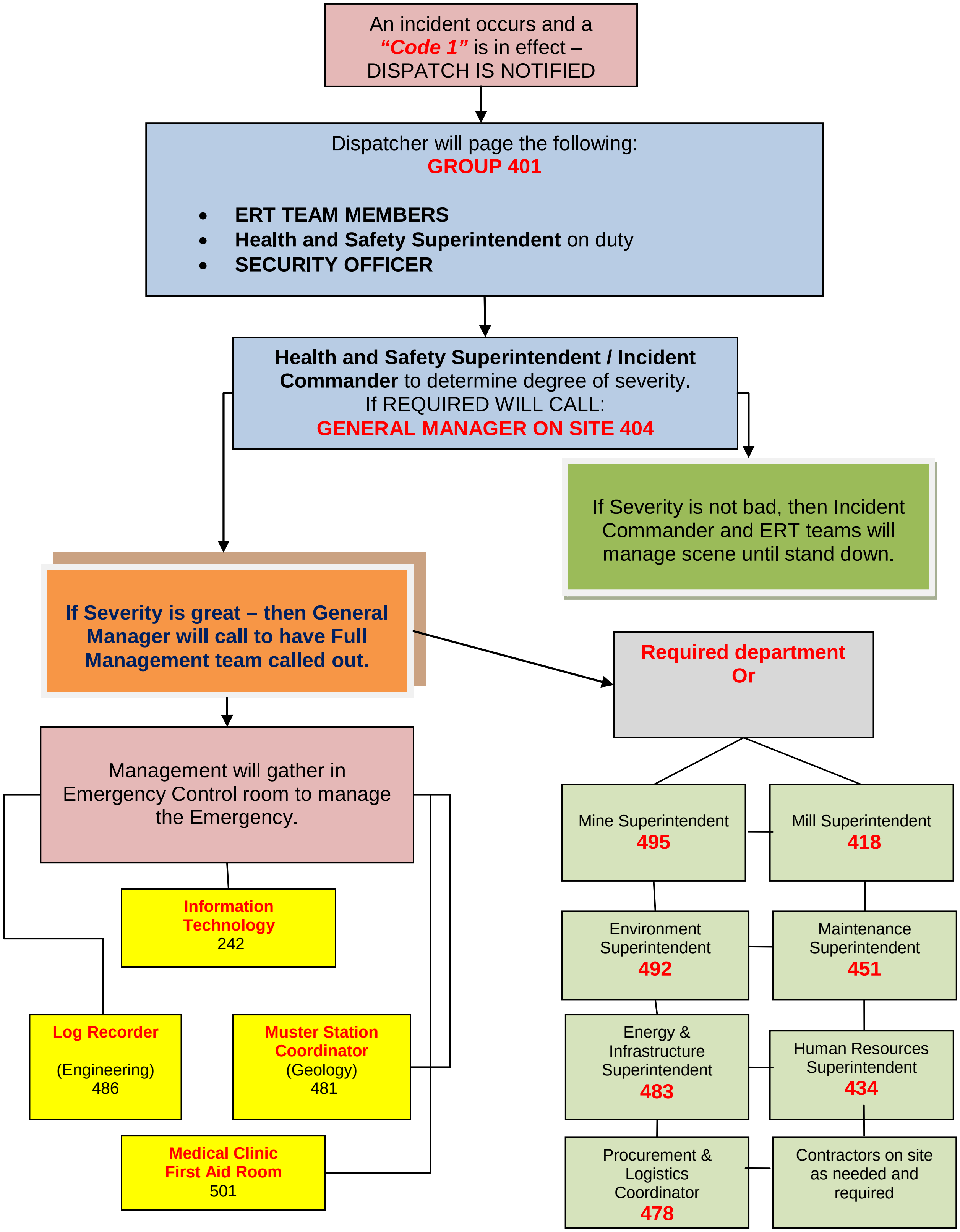
A Code 1 can be called by any person on site as long as they have a two-way radio to report an accident, serious incident or fire which requires the response of the ERT (Emergency Response Team). All ***Code 1*** should be called on your regular "working channel" (Note: Working zone channel 9 (AEM Surface should initiate a Code 1 on channel 3 (Mill Repeater)

or ***6911*** on phone.

The procedure steps:

- Call ***Code One*** over the two-way radio "working channel" ***three (3) times*** and identify the type of accident, serious incident or fire.
- Give your name, location and the nature of the accident, serious incident or nature of the fire to the person on the other end of phone or two-way radio (dispatch).
- Upon notification of the ***Code 1,*** the "dispatch" is the only person who will communicate with the person who initiated the Code One.
- The "dispatch" will contact ERT via pagers to notify them of the ***Code 1*** Emergency.
- The ERT will immediately respond to the ERT staging area (ERT garage).
- The Incident Commander or ERT Team Captain (First Captain on scene) will evaluate the call and announce if deemed necessary the cessation of work and activities in the affected area. This will be done on the appropriate work area channel (example "Zone 1, channel "3").
- **EXAMPLE: all work in ZONE 1 must cease until further notice, this includes all active pit areas.**
- The Incident Commander or ERT Team Captain will dispatch the Emergency Response Team to the incident site, with the appropriate equipment for the situation.

Once the ***Code 1*** is called, all work in the affected ZONE will be stopped and equipment will be secured so as not to interfere with the response by the ERT. Radio Silence on "working channel" that initiated ***Code 1*** must be observed until advised otherwise by the Incident Commander or ERT Team Captain.


An incident occurs and a "Code 1" is in effect – DISPATCH IS NOTIFIED
Dispatcher will page the following:
GROUP 401
ERT TEAM MEMBERS
Health and Safety Superintendent on duty
SECURITY OFFICER
Health and Safety Superintendent / Incident Commander to determine degree of severity.
If REQUIRED WILL CALL:
GENERAL MANAGER ON SITE 404
If Severity is not bad, then Incident Commander and ERT teams will manage scene until stand down.
If Severity is great – then General Manager will call to have Full Management team called out.
Required department Or
Management will gather in Emergency Control room to manage the Emergency.
Information Technology 242
Log Recorder (Engineering) 486
Muster Station Coordinator (Geology) 481
Medical Clinic First Aid Room 501
Mine Superintendent 495
Mill Superintendent 418
Environment Superintendent 492
Maintenance Superintendent 451
Energy & Infrastructure Superintendent 483
Human Resources Superintendent 434
Procurement & Logistics Coordinator 478
Contractors on site as needed and required

4.1 FIRE

The Camp Complex and Process Plant is equipped with a fire detection and audible fire warning system. All site operating personnel receive basic training in the use of fire extinguishers. This training is tracked by the HR Superintendent.

For any situation involving fires, the first action will be to extinguish the fire if it is safe to do so and then report the incident. If the person cannot safely put out the fire, it must be reported as quickly as possible. In the event of a fire alarm, all employees not directly involved with fighting the fire will report to the designated muster location (section 5.2). Employees will remain in this area until assigned other duties by the ERT or until given clearance that the emergency is over.

When an alarm occurs, the incident commander will:

- Locate the source of fire.
- Dispatch the evacuation at the safest muster point.
- Assign a captain and his team.
- Ensure the security of all the ERT's members or any other required service persons (medics, security guard, electricians, etc…).
- Inform Acting Mine Manager of the situation.
- If the intervention of the mine inspector is necessary for a special investigation, he will ask to the security department to ensure the integrity of the scene.
- Call the end of the emergency operations and invites everyone evacuated to reintegrates their original locations.

General Manager or designate can decide to use any available machinery to separate all or part of a building to protect people or minimize losses.

Incident Reports are to be filed detailing the causes of the fires and responses undertaken. This information will be used by the EMC in subsequent fire prevention activities.

4.1.1 Muster Point

In the event that an evacuation is necessary, it is important that all affected personnel leave the emergency area and congregate at a pre-determined area or *Muster point* so that a head count can be taken to determine if there are any missing persons. Employees must remain at the muster point until the supervisor of the emergency area gives permission to return to work.

Upon hearing a fire alarm, smoke alarm, or evacuation alarm you shall ….

- ***Do Not Panic*** – Always ensure that you are prepared for the weather conditions – Dress appropriately – (Winter clothing during winter months).
- *DO NOT* delay and *DO NOT* stay and finish work before taking the proper steps to evacuate.
- Always **close** windows/doors as you leave your room or office etc.
- *Always* head to the *closest* **EXIT** door and follow **EXIT** signs to the closest muster station.
- If there is smoke between your location and the nearest muster, follow **EXIT** signs to the closest Outside door.
- Once outside head to the *closest* "*Muster Station*".
- Once in "*Muster Station*" – Stay put until relieved or instructed otherwise by the **Muster Station Leader.**

- The **Muster Station Leader** will designate a specific guard for every door of the muster in order to avoid people already registered to leave the Muster Station.
- The **Muster Station Leader** will *conduct a tally* (head count) of everyone in his/her department. Ensure that you get your name on the tally form.
- Note: on nightshift, the highest level of Management may be a front line Supervisor.
- *DO NOT* enter a building when the alarm is sounding. Head straight to a “Muster Station”.
- *Never* go through a building to get to a “Muster Station”. Once you are outside, the first door you open should be the one to the “Muster Station”.
- *Never* disregard an evacuation alarm. We understand that the system goes off without incident on occasion, but to disregard an *alarm is to endanger your life and the lives of others.*
- *Stay in* “Muster Station” until you are instructed to “Stand Down” by the **Incident Commander** or the **Muster Station Leader**.
- *Do Not* leave “Muster Station” to go outside for a smoke. It is important for your Supervisor to know where you are at all times – especially during an “Emergency”.
- The only person authorized to initiate a “Stand Down” is the **Incident Commander/ERT Captain or the General Manager or designate**.
- Failure to follow proper Evacuation Procedures will result in Discipline.
- The following areas are considered “**<u>Muster Stations</u>**” (see Figure)

4.2 MEDICAL EMERGENCIES

- Emergency is initiated - by calling **6911** on desk type phones, or calling on Two-way radio on **"Working Channel" – Code 1 – Code 1 – Code 1.**
- All communication stops except for those involved with the Emergency – I.e.:ERT, Dispatcher, Medical personnel at the clinic, as required.
- All work stops in affected area or (depending on seriousness of Emergency) the whole site.
- Dispatcher will answer the phone and/or radio call.
- **Responder –** will ask where the medic is required, what is the nature of the emergency? Etc…
- **Caller –** will give a brief description of the Emergency – name, location and what is wrong and/or required.
- **Responder –** will confirm location and details of incident and activate the **ERT** team. A page call will be sent out to **medical personnel (pager 501)** or to the **First responder team (pager 403)** or, if required, all **ERT** team members(pager 401) on site.
- The person at the casualty(s) will administer First Aid if trained to do so.
- Incident Commander will be immobilized as to ensure that communications, transportation, and effective deployment of **ERT** resources are conducted. Depending on the gravity of the situation, It is possible that the Official In-Charge be notified immediately.
- Transportation will be arranged to meet at the **ERT** hall by the two large doors for medical gear and **ERT** team members.
- The **ERT** team (minimum of 6 team members) will assemble as quickly as possible. (Expectation – when the page goes off – all **ERT** team members will make their way expediently to the **ERT hall).**
- As soon as steps have been implemented to properly attend to the casualties, the Incident Commander will notify the appropriate authorities of the accident by telephone, providing as much information as possible. A complete accident description and investigation form is required to be submitted as soon as possible. The accident description and investigation form will be completed and submitted by the General Mine Manager. Unless some action is required to remove an immediate hazard, the site of any serious accident will be cordoned off and remain unchanged until clearance is received from the appropriate authorities.

4.2.1 MEDICAL EVACUATION (MEDEVAC) PLAN

In the event of serious injury, it may be necessary to remove the individual from the source of the danger and to administer emergency first aid. The Health Professional will be notified immediately in order to take charge of the situation and ensure the safe removal of the injured person to the first aid room if possible.

- The **ERT** team will respond with (Nurse / Medic) and assist as necessary with equipment, treatment etc.
- The (Nurse / Medic) and as many **ERT** team members as required will respond to the incident site. When the (Nurse / Medic) arrives at the scene, they will notify the First Aid Treatment Room.
- First Aid will be administered to casualty(s); the casualty(s) will be secured and transported to the First Aid Room. Vehicles transporting casualty(s) will have priority over any other vehicle on site.
- Once the "Mechanisms of Injury" and the patient's condition have been assessed, a decision will be made by the (Nurse / Medic) whether a Medevac is required and decide on ground or air transportation. There are guidelines to follow to make this determination.

  First thing: Dr. Lee (AEM – MBK) Medical Director - will be notified.

  Then, Baker Lake Health Centre will be contacted to obtain a warrant number.

If a **MEDEVAC** is required, the Health Care Provider will call the following airline:

- Keewatin Air: (**867)-645-4455 or (877)-879-8477**

The following **INFORMATION** will be relayed to **Medical Facility** that you have reached and to **MEDEVAC** dispatcher:

- Give Patient's Name, Age, Mechanism of Injury, Nature of Injuries, and Medical Condition. Give all tests, treatment which you have done as well as ALL of the medication that has been administered to patient including the patient's past medical history and medications that he/she is taking.
- The TRANSFER sheet should be included and if possible FAX: to the Health Care Facility who will be receiving the **MEDEVAC and patient.**

If the **MEDEVAC** comes to site with a **Medical crew:**

- The **MEDEVAC** team will call ahead to notify their ETA.
- The patient will STAY in First Aid Room until his/her **Condition is stabilized**
  - Unnecessary delays will be avoided in transportation of Patient to Receiving Health Care Provider.

- ❖ The Manager on Duty or designate will ensure that a vehicle is sent to the airstrip at the ETA.
- ❖ The **Medical crew** with their equipment will be brought to the First Aid Room.
- ❖ Once the **MEDEVAC** equipment is in place, the **ERT** team will assist the **MEDEVAC Medical crew,** and (Nurse / Medic) with the transfer of the patient to the ambulance, and into the aircraft.

If the accident requiring a MEDEVAC is work related, the incident scene, materials, machinery, medical equipment etc. will remain undisturbed until the investigating team has conducted the investigation. This type of incident is considered a "Reportable Incident" therefore the Mines Inspector shall be notified (without delay). The Official In-Charge will be responsible for ensure that this occurs. Under no circumstances shall any person move, or otherwise interfere with any wreckage or equipment at the scene of a "reportable incident" until an inspector has conducted an investigation of the incident and has given permission to do so.

The Official In-Charge will make all necessary calls to the outside for notification purposes: I.e.: Corporate Office notification, Mines Inspector, RCMP, etc.

If the incident is of a fatality, it is CLEAR that the Coroner or in his/her absence, the RCMP are in total control of the incident scene. The scene is to remain undisturbed until orders have been issued by either of these two authorities. *Refer to Section 4.10 (Fatality on site) of this Emergency Response Plan.*

The scene will then be released to the local authorities such as the Mines Inspector for their portion of the investigation.

Upon arrival of the aircraft to the airport of the Receiving Medical Facility (other than Baker Lake), the receiving team will be notified and a designated person will call the Incident Command (control center) and update them on their arrival and the next steps to be taken. I.e.: transportation to Receiving Medical Facility.

Control + Click here to link to procedure MKK-HSS-CLI Medical Evacuation Communication Pathway

4.3 AIRPLANE CRASH DISASTER

Emergency Response begins as soon as an air crash is identified or reported.

- o When the Meadowbank Air Traffic Controller or Meadowbank Dispatcher is notified that an approaching aircraft is having difficulty, they will immediately notify the Incident Commander and General Manager or Designate.
- o In the event of reported air crash off-site the Meadowbank Air Traffic Controller or Meadowbank Dispatcher will notify the General Manager or Designate.
- o Emergency Response procedure will be initiated if required for response by ERT
- o The ERT Team on scene will make a preliminary assessment and notify the Nursing Clinic.
- o The Nurse or Medic, with the ERT Team, shall establish triage, treatment, transportation, communication, and staging.

- The ERT Incident Commander will direct all emergency response actions, and assess the need for additional resources keeping the Command Post updated as to all actions

- The RCMP will establish access and traffic control and assist the Coroner in body recovery and identification, if necessary.

- The Incident Commander will instruct emergency response personnel to not move debris associated with the wreckage, ie. cargo, plane remnants, passenger belongings, unless there is imminent danger of items being destroyed, or unless they inhibit access to passenger rescue.

- The Coroner/RCMP is responsible for the identification, movement and/or removal of the fatality. Unauthorized personnel are not to move the dead without express approval of the Coroner/RCMP, except when there is a question of whether the person is deceased or if the body is in danger of being destroyed. In all cases involving the movement of a body, personnel moving the body shall make careful note of the location and condition of the body for the Coroner/RCMP.

- Upon notification of an air disaster, NAV Canada will be responsible for air traffic in proximity to the scene, with immediate regulatory control of airspace around the area.

- They will keep the airspace clear of intrusive air traffic, to the limits of the regulations.

- **Recovery:**

- Recovery immediately follows emergency response. It involves direction from the General Manager or Designate.
- Maintaining access control to the scene.
- Providing emergency social services (critical stress debriefing), for employees and rescue workers.
- Investigating the accident.
- Clean-up of the crash site.

4.4

PIPELINE BREAKAGE

- Pipelines will be used to transport tailings solids, reclaim water, freshwater, and domestic sewage on site. Pipeline breakage could lead to localized, short-term smothering of vegetation, the release of poor-quality water, and potentially exposure of mine personnel to infectious or toxic substances. In the event of a pipeline breakage, the following actions will be taken as required and when it is safe to do so:
- Shut off the feed to the pipeline;
- Call dispatch in order to have Incident Commander notified of the breakage.
- Physically contain the spill through the construction of dikes, berms, sumps and collection ditches;
- Pump collected water to the tailings reclaim pond or sewage treatment plant;
- Collect and remove solids for disposal in the tailings facility, incineration, or off-site disposal at a licensed disposal facility; and
- Monitor for residual contaminants on land and in surface water.
- A general response procedure for the handling of spilled domestic sewage (infectious substances) is provided in the Spill Contingency Plan (Appendix M).
- A specific response procedure for cyanide involved systems is provided in Appendix B of the Meadowbank Site Emergency Response Plan.

0 **4.5**

TOXIC GAS RELEASES

- In the event of a toxic gas release, the following actions will be taken:
- Immediately evacuate the area/building and notify the incident commander;
- If possible and safety permits, turn off the source of the gas and ventilate (i.e., open windows/doors to outdoors) the area;
- Call dispatch in order to have Incident Commander notified of the release.
- Isolate the area and restrict access to ERT personnel only; and
- Implement air quality monitoring
- For the mill, refer to the specific procedure: **MBK-MIL-PRO *General Alarm Evacuation Procedure*.**

Control + click here to link to this procedure

- A general response procedure for the release of compressed gases is provided in the Spill Contingency Plan.

❖ **IN THE EVENT THAT CYANIDE HYDROGEN (HCN) IS INVOLVED, REFER TO APPENDIX B OF THIS DOCUMENT.**

o **4.6**

DIKE FAILURE

- In the event of a dike failure, the following actions will be taken:
- Immediately evacuate the area and pit where failure could affect and notify the incident commander;
- Isolate the area and restrict access to ERT personnel only
- Use any material, heavy equipment and tools to make temporary or permanent repairs. All work to be conducted under ECC's supervision.

A detailed Emergency Preparedness Plan (EPP) was developed to address the consequences of failure of any of the dikes on site. The procedure was developed by the Geotechnical Engineering team with the assistance of the dike designer (Golder Associates provided the first version of the dike OMS and EPP, which was then elaborated upon by AEM) and the review of the EMC and the Satety Superintendent. The EPP for the dewatering dikes and Tailings Storage Facility are available in the Operation, Maintenance and Surveillance Manual (OMS manual) for the Tailing Storage Facilities and the Dewatering Dikes. Background information and potential failure scenarios of the dewatering dikes and Tailings Storage Facility are provided in Appendix A.

In the event that the failure involves Tailings installations, refer to Appendix B.1.6

4.7

EMULSION PLANT

- A detailed Emergency Response Plan (ERP) was prepared by Dyno Nobel and addresses incidents and potential incidents involving the manufacturing, handling and storage of explosives and related products in Dyno Nobel Canada Inc.' magazines, emulsion plants and worksites at Meadowbank.
- **The ERP for Dyno Nobel emulsion plant is provided in Appendix C.**

4.8

BAKER LAKE MARSHALLING FACILITY

- The Baker Lake Marshaling facilities is located 2 Km., east of the Hamlet of Baker Lake and is used for the interim storage of supplies, including hazardous materials, prior to being transported to the mine site. The fuel farm at the Facility is used for bulk storage of:

  60,000,000 liters of fuel

  1,900,000 liters of Jet ''A'' fuel.

Spill emergencies occurring at the Marshaling Facility will be handled according to the:

Spill Contingency Plan (Appendix M).

In case of any other major disaster, the primary Emergency procedures will fall under the Hamlet of Baker Lake authorities' responsibility.

By-Law no 212 (Emergency Response Plan) has already been adopted by local authorities.

4.8.1 VESSEL CONTINGENCY PLAN

At any time emergency situations can occur and without warning aboard vessels dock siding in Baker Lake. Crewmembers might require mutual assistance from Emergency Response crews in Baker Lake or Meadowbank. Refer to **Appendix ''G''** for procedures to be followed in order to respond effectively.

4.9

EMERGENCIES DEALING WITH REAGENTS

At Meadowbank mine site, we carry the following reagents:

- Cyanide (Sodium Cyanide)
- Copper Sulphite
- Lime (Calcium Oxide) (Quick Lime)
- Sodium Metabisulphite
- Caustic Soda (Sodium Hydroxide)
- Sulphur (Prill form)
- Nitric Acid
- Calcium Chloride (Dust Suppression)
- Flocculants
- Lead Nitrate
- Milsperse (Antiscalant)

Emergency Procedures for dealing with <u>some of these reagents</u> are found in **Appendix B of this Emergency Response Plan.**

4.10 FATALITY OCCURING ON SITE

- **INCIDENT SITE**:
- **<u>Work related fatality:</u>**
    - Incident site must be kept barricaded off and guarded and undisturbed except for the purpose of preventing injury or relieve suffering, until appropriate personnel (RCMP), (Coroner), (Mines Inspector) have conducted their investigations and have released the scene.
    - Only the coroner or the medical director is eligible to declare that a person is officially dead. Medical staff at MBK should be the first to be put in contact with medical authorities for this purpose.
    - At all time RCMP shall be notified of a fatality on site and all facilities should be supplied to their representatives in order to assist them for required investigation.
    - RCMP is the only communication channel that will be issued toward victim's relatives. They will make all arrangements in order to make sure that the relatives are aware of the situation.
    - All communications going out from MBK will be under the acting manager's control as long as needed in order to avoid misunderstandings or confusion for every concerned.
    - If involving chemical, biological, radiological or nuclear agent, consult with the Incident Commander regarding the agent dispersed, dissemination method, level of PPE required, location, geographic complications (if any), and the number of person(s) involved.
    - Ensure that all person(s) involved have the proper level of PPE protection, training and knowledge to deal with the situation.
    - Notification of a work related fatality (or ''reportable incident'') shall be made to WSCC according to Mine Act and Regs 16:02

    <u>At all time, the mine acting manager will decide to take over external communications from site accordingly with the Meadowbank Crisis Management Plan.</u>

- **RECOVERY AND ON-SITE MORGUE**:
        - Gather all necessary information and document all findings.
    - Wear PPE until all bodies(s) are deemed free of contamination if necessary.
    - Establish a preliminary (holding) morgue. The remaining's should be kept at cool temperature and away from freezing. Vault WTP is actually designated as temporary morgue.
    - Depending on the situation, it might be possible that RCMP will require the remaining's to be sent to their facilities for extensive investigation.
    - Gather all necessary information and document all findings.
    - According to the situation the site manager will take all actions in order to respectfully evacuate the remaining to the required destination.
    - If suspecting contamination, see the Decontamination section for decontamination procedures.
    - If needed, decontaminate affected bodies before they are removed from the incident site.

4.11

MISSING PERSON

- As soon as a worker is missing from his regular work (at beginning of shift or during the day) the supervisor will ensure that the worker's room, workplace, and public areas have been searched, in addition to checking with the Medical Clinic personnel.
- After this primary search, if the worker is still missing, the Meadowbank Security Officer (SO) must be advised. If the Security office is closed, the Front desk Officer will be advised.
- If nobody can be reached at the Camp front entrance offices, then, the Medical Clinic personnel should be notified. The nurse will take charge and follow up with the searches by getting in touch with the Security Officer and/or the ERT Incident Commander (IC).

The procedure: **MBK-HSS-EMR-PRO Missing person** will be initiated.
Control + Click here to link to the document

4.12

MASS CASUALTY EMERGENCIES

- By definition a Mass (Multiple) Casualty Incident (MCI) is any incident in which Emergency Service Resources, such as personnel and equipment, are overwhelmed by the Number and Severity of Casualties.
- In the make-up of our MCI Plan there should be Two (2) sections. Both sections would generally be happening simultaneously. These sections are giving more details and can be found through the: **MBK-HSS-EMR-PLN Mass Casualty Management** plan:

  Control + Click here to link to the document

SECTION 5 • REFERENCES

AMEC. December 2003. Meadowbank Gold Project Baseline Hydrology Report

Canadian Dam Association (CDA) 1999. Dam Safety Guidelines.

Canadian Standards Association. 1995. Emergency planning for industry: A national standard for Canada (CAN/CSA-Z731-95). Toronto: Canadian Standards Association.

Echo Bay Mines Ltd. 2001. Lupin Winter Road Spill Contingency Plan.

Echo Bay Mines Ltd. 2000. Winter Road Rules and Regulations.

Emergency Response Guidebook. (2008) Transport Canada

Environment Canada's Guidelines for Preparing or Reviewing an Emergency Response Plan for a Canadian Pulp and Paper Mill.

Environment Canada's Implementing Guidelines for *Canadian Environmental Protection Act*, 1999 Section 199 - authorities for requiring environmental emergency plans; the Government of the Northwest Territories' Spill Contingency Planning and Reporting Regulations; and, the Government of the Northwest Territories' Mine Health and Safety Regulations.

Environment Canada. 1994. Guidelines for preparing or reviewing an emergency response plan for a Canadian pulp and paper mill. Environmental protection series report EPS 1/PF/2. Renewable Resources Division, Industrial Sectors Branch, Environment Canada.

Environment Canada. 2001. Implementation guidelines for *Canadian Environmental Protection Act*, 1999, Section 199 – authorities for requiring environmental emergency plans. Environmental Emergencies Program, Environment Canada.

GNWT Consolidation of Mine Health and Safety Regulations R-125-95. GNWT Spill Contingency Planning and Reporting Regulations R-068-93.

Golder Associates Ltd. November 2006. Report on Bathymetric Surveys, Meadowbank Project, Nunavut.

Golder Associated Ltd. October 2008. Draft Report on East Dike Design, Meadowbank Gold Project,

Golder Associated Ltd. March 2007b. Final Report Detailed Design of Central Dike, Meadowbank Gold Project, Volumes 1 to 3.

ICOLD. 1995. Dam failures statistical analysis – International Commission on Large Dams, Paris, Bulletin 99.

NWT Water Board. January 1987. Guidelines for Contingency Planning. Government of the Northwest Territories.

SECTION 6 • LIST OF ACRONYMS

AEM	Agnico-Eagle Mines Limited – Meadowbank Division
AWPAR	All Weather Private Access Road
CDA	Canadian Dam Association
DFO	Fisheries and Oceans Canada
ECC	Emergency Coordination Centre
EIA	Environmental Impact Assessment
EMS	Environmental Management System
EPP	Emergency Preparedness Plan
ERG	Emergency Response Guidebook
ERP	Emergency Response Plan
ERT	Emergency Response Team
FoS	Factors-of-Safety
GN	Government of Nunavut
HAZCOM	Hazard Communication
HMMP	Hazardous Materials Management Plan
HR	Human Resources
HSC	Occupational Health & Safety Committee
IATA	International Air Transport Association
IC	Incident Commander
ICC	Incident Command Centre
INAC	Indian and Northern Affairs Canada
KIA	Kivalliq Inuit Association
MMER	Metal Mining Effluent Regulations

MSDS	Materials Safety Data Sheets
MSHA	Mine Safety and Health Administration
NWB	Nunavut Water Board
OHSA	Occupational Health and Safety Administration
OHSP	Occupational Health & Safety Plan
PPE	Personal Protective Equipment
SCP	Spill Contingency Plan
SO	Security Officer
TDG	Transportation of Dangerous Goods
TSF	Tailings Storage Facility
WCB	Worker's Compensation Board
WHMIS	Workplace Hazardous Materials Information System

APPENDIX A

MBK-IT-PLN Emergency Telecom Plan at Meadowbank

Control + Click here to link to this plan

APPENDIX B

Emergencies involving Reagents.

- **Immediate Actions**

For all spills and releases of any hazardous material, the following steps should always be taken:

- Stop the flow of material and/or contain it, if possible, using proper safety equipment and precautions. **Do not endanger yourself!**
- Administer first aid if required. If anyone comes in direct contact with cyanide solution decontaminate them immediately, monitor them closely and give oxygen if there is any indication of symptoms of poisoning.
- Contact your supervisor. Call for help.
- Secure the area.
- Prevent unnecessary exposure.
- Perform remedial action for cleanup.

Emergencies involving reagents might be addressed by first responders, by using **EMERGENCY RESPONSE GUIDEBOOK**

ERG2012.pdf

In an emergency, CANUTEC may be called collect at
613-996-6666 (24 hours)
***666 cellular (Press star 666, Canada only)**

B.1: Cyanide (Sodium Cyanide)

UN #: 1689 (Guide 157 of the Emergency Response Guidebook)

Environmental remediation of a spill of cyanide will be managed under the: MBK Spill Contingency Plan

Control + Click here to link to Environment Spill Contingency Plan

B 1.1 General Cyanide Spill/Release Guidelines

Immediate Actions

For all spills and releases of cyanide, the following steps should always be taken:

- Prevent unnecessary exposure.
- Stop the flow of material and/or contain it, if possible, using proper safety equipment and precautions. Do not endanger yourself.
- Administer first aid if required. If anyone comes in direct contact with cyanide solution decontaminate them immediately, monitor them closely and give oxygen if there is any indication of symptoms of poisoning.
- Contact your supervisor, call for help.
- Secure the area.
- Monitor for HCN Gas with MX-6 Gas Monitor.

Supervisor's Immediate Action

- Eliminate or reduce immediate health and safety hazards and administer first aid if required, Call for help by dialing 6911 or calling a Code 1 on the radio.
- Arrange for removal and transportation of injured out of the dangerous zone, if safe to do so.
- Begin containment if needed. Protect yourself and others.
    - Remove all unnecessary personnel and restrict entry to the area.
    - If the problem is in the mill, make sure the Mill Evacuation procedure is complete.
    - Ensure safe procedures are followed and proper safety equipment is used.
    - Eliminate the source.
- Assess the incident.
    - Determine the source, quantity, and type of material that was spilled/released.
    - Quantify health and environmental hazards, toxic vapors, ground/surface water contamination if and when required by I.C. or Environment Supervisor.
- Perform remedial action for cleanup.
- Clean up the incident area when asked by I.C.

All spills and remedial actions taken must be reported immediately to the area Supervisor.

- Protect yourself. Don't become a casualty. Wear the necessary personal protective equipment needed for containment. Use the "buddy" system. The following equipment along with containers of household bleach are located in the warehouse.
    - Rubber Gloves
    - Chemical Protective Suit (TYCHEM QC)
    - Rubber Boots
    - Chemical Goggles
    - Respirator (Handling Dry Cyanide Only)

Caution: Respirator is for protection from solid cyanide and solids containing cyanide i.e. dust, mud, etc. A respirator will not protect you from deadly HCN gas.

Perform lifesaving rescues and first aid. If needed, administration of cyanide antidote will be done by medical clinic personnel by applying the following procedure:

Control + Click here to link to the Medical Protocol Cyanide poisoning Management

SODIUM and/or Calcium CYANIDE (SOLID and/or FLAKED) (ID#1689, ERG #157)
If the release occurs in a wet area (i.e. rain storm) personnel shall obtain and wear self-contained breathing apparatus and full protective clothing/gear. The area should be monitored for HCN gas. The release should be controlled with earthen berms. Adding chemicals to reduce risk of HCN vapor emission will be done only under Incident Commander or Environmental Supervisor's authority.. Pump or excavate cyanide back into the nearest containment facility as directed by the Incident Commander or Environmental Supervisor. If a release occurs in a dry area personnel shall wear the appropriate respirator with cyanide dust cartridge and work coveralls. Using a shovel, carefully place material into a dry container for transport to an approved process component. Deposit the material in an area designated by the Incident Commander or Environmental Supervisor. Flush the spill area with water (use water spray to reduce vapors). **Do not use water if it will cause the spill to flow off of the containment.** The spilled cyanide can be reused and does not create a waste to be disposed of.

SODIUM CYANIDE - DILUTE PROCESS SOLUTIONS (ID# 1689 ERG #157)
This process is for diluted weak cyanide solutions. The process solutions may be high pH and may cause injury to exposed skin. Control flow by shutting down pumps and valves. Personnel shall wear full personal protective equipment, including clothing (TYCHEM Qc). Control area of spill with earthen berms. In case of questionable or unknown pH, monitor the area with an HCN monitor. Adding chemicals to reduce risk of HCN vapor emission will be done only under Incident Commander or Environmental Supervisor's authority. Pump any solution back into the nearest containment facility. Excavate all wet soil and haul it to an approved containment facility. Solution samples should be taken and analyzed under Incident Commander or Environmental Supervisor's authority.

NOTE: Should the process plant need to be evacuated; the procedure MBK-MIL-PRO General Emergency Evacuation will apply

Control + Click here to link to this procedure

B 1.2 Cyanide Transportation Accidents

Although there is a procedure for Transportation of dangerous goods on the Meadowbank AWAR, **(MBK-ENV-PRO AWAR_TDG)**
Control + Click here to link to this procedure

the following actions are to be taken in the event of an accident on the AWAR or at the barge unloading facilities **involving cyanide transport** vehicle.

- Call Dispatch and report the location and nature of the accident and indicate the type of assistance required (medical help, environmental clean-up, fire and/or mechanical help);
- AEM personnel working in this area will evacuate and secure the 2 access roads leading to the unloading/storage area.
- Meadowbank's Incident Commander on duty will take command of any action required by the situation at this moment.
- Local resources (Baker Lake Fire dept. or R.C.M.P.) will not be involved in this process.

IF THERE IS A VICTIM and IF SAFE TO DO SO: Remove the victim from spoiled area

- As the very first minutes are critical for the victim, administration of oxygen must be the first action to be done on scene (IF THERE IS EVIDENCE THAT THE VICTIM IS CONTAMINATED WITH CYANIDE, THE DECONTAMINATION PROCEDURE MUST BE APPLIED PRIOR OF ANY ACTION).

- Cross contamination may be fatal to rescuers if they are not correctly protected against inhalation, skin absorption or ingestion of Cyanide or by-products. Proper PPE must include TYCHEM Qc suit, proper face mask, gloves, rubber boots etc…

WARNING: EVALUATE THE LIKELY HARM WITHOUT INTERVENTION

Before decontaminating the victim with water, all clothing should be removed.
Flush body immediately with water until medical help arrives or before transporting victim.
Dust half masks **do not protect** against HCN gas

IF THERE IS NO VICTIM:

- Secure the accident site so that the vehicles or spilled chemical not continue to present a hazard to others. This may involve blocking off the road back from the site in both directions in the event of a more serious accident.

- **If safe to do so** secure the site to prevent continued spill or leakage of contaminants into the surrounding environment.

- Upon receiving the accident call, Dispatch will initiate the mine's Emergency Response Team passing along the information to the Emergency Incident Commander (I.C.). The I.C. will then call out the required Emergency Response Personnel to assist at the accident site. He will also make sure to inform the Acting Manager of the situation.

- Accident site decontamination will then be initiated as per the **Meadowbank Site Spill Contingency Plan.**

  Control + Click here to link to this plan

- Once the accident site is secured, all people requiring assistance have been removed to medical care and cyanide spill controlled, the Emergency Incident Commander will turn the scene over to the mine's safety personnel so that an appropriate accident investigation can be initiated.

B 1.3 Cyanide involved in Fires.

- Sodium cyanide (NaCN) is non-combustible.
- The agent itself does not burn.
- Sodium cyanide releases highly flammable and toxic hydrogen cyanide gas (HCN) on contact with acids or water.
- Fire will produce irritating, corrosive, and/or toxic gases.
- Stay upwind.
- Note: Most foam will react with the agent and release corrosive/toxic gases.
- For small fires, **do not use carbon dioxide**; use dry chemical, dry sand, or alcohol-resistant foam. **NOTE:** At Meadowbank, we are using non-Alcohol-resistant foam.
- For large fires, use water spray, fog, or alcohol-resistant foam. Move containers from the fire area if it is possible to do so without risk to personnel. Use water spray or fog; do not use straight streams. Dike fire control water for later disposal; do not scatter the material.
- For fire involving tanks or car/trailer loads, fight the fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after the fire is out. Withdraw

immediately in case of rising sound from venting safety devices or discoloration of tanks. Always stay away from tanks engulfed in fire. **NOTE:** At Meadowbank, most of the cyanide product is under its solid state.

- Run-off from fire control or dilution water may be corrosive and/or toxic, and it may cause pollution.
- If the situation allows, control and properly dispose of run-off (effluent).

Control + Click here to link to Environment Spill Contingency Plan

B 1.4 Important release of HCN from storage

- Large quantities of sodium cyanide are used at the Meadowbank Gold Project to optimize gold recovery from the ore. Due to transportation restrictions, normally a full year's supply of sodium cyanide will be transported and stored on site. This product will be stored on secured and separate laydown known as ''Overpad'' storage area, The product will also be handled, transferred and used in compliance with appropriate legislation and applicable Best Management Practices.

- Procurement and Logistics Department's workers are ruled by Procedure ''MBK-PRL-PRO Cyanide Storage Procedure'' for Cyanide Storage.

- **Control + Click here to link to this procedure**

- In the event of a major release of HCN from the storage area it will be critical that any worker in the immediate area of the release evacuate upwind and call for help by following the **Code 1 procedure.**

- Upon receiving the HCN release call, Dispatch will initiate the mine's Emergency Response Team passing along the information to the Emergency I.C. The Emergency I.C. will then call out the required Emergency Response Personnel to assist at the release site. He will also make sure to inform the Acting Manager of the situation.
- Emergency Response Team will make sure evacuation is completed in Red and Yellow zones as determined in the **Emergency Response Guidebook 2012** and then will monitor the area by using MX-6 gas monitors. Following monitoring, and analyzing wind direction, air dampness and any other significant input, the decision will be then taken to evacuate a larger perimeter if needed to do so.

- Depending of wind direction, the following buildings/area may be used as ''MUSTER STATIONS'' in case of a catastrophic situation requiring a major evacuation of the premises:
  - *FGL/SANA buildings*
  - *VAULT pit Refuge*

- *DYNO-NOBEL Emulsion plant*

- After re-assessing the situation, Emergency I.C. and Acting Manager will decide if a complete Meadowbank site evacuation or if any other Emergency or remediation measure is required.

B 1.5.1 PROCESS PLANT Important release of HCN

- The cyanide transferred from the Storage laydown to the process plant is stored outdoor on a specific laydown, in front of door ''C'' of the Process Plant
- A maximum of 24 tons (24 bags) are stored in the mill at the same time.
- In case of a release of HCN, the monitoring system of the process plant will be activated automatically and the Emergency Evacuation of the mill will take place, accordingly to Procedure MBK-MIL-PRO- General Emergency Evacuation.
  Control + Click here to link to this procedure
- Upon receiving the HCN release call, Dispatch will initiate the mine's Emergency Response Team passing along the information to the Emergency I.C. The Emergency I.C. will then call out the required Emergency Response Personnel to assist at the release site. He will also make sure to inform the Acting Manager of the situation.
- Emergency Response Team will make sure evacuation is completed in Red and Yellow zones as determined in the **Emergency Response Guidebook 2012** and then will monitor the area by using MX-6 gas monitors. Following monitoring, and analyzing wind direction, air dampness and any other significant input, the decision will be then taken to evacuate a larger perimeter if needed to do so.

- Depending of wind direction, the following buildings/area may be used as ''MUSTER STATIONS'' in case of a catastrophic situation requiring a major evacuation of the premises:

  - *FGL/SANA buildings*
  - *VAULT pit Refuge*
  - *DYNO-NOBEL Emulsion plant*

- After re-assessing the situation, Emergency I.C. and Acting Manager will decide if a complete Meadowbank site evacuation or if any other Emergency or remediation measure is required.

B 1.5.2 PROCESS PLANT: Release during mixing / unloading

- Every Process Plant worker is required to be trained on ''Chemical Awareness'' and ''Mill Induction'' trainings. These mandatory trainings are scheduled on regular basis by training department for every new worker at Process Plant. Moreover, Oxygen administration training is given to every Reagent Operators, Supervisors or Relief Operators working at Process Plant.

- There is an Oxygen administration First Aid Kit nearby the Mixing area. This kit includes: Oxygen administration portable system, and an Automated External Defibrillation kit. As the ''buddy'' system is always used, an affected (splashed) worker will be first removed from spoiled area, given oxygen, undressed and taken under the Emergency shower.
- In case of a release of HCN, the monitoring system of the process plant will be activated automatically and the Emergency Evacuation of the mill will take place, accordingly to **MBK-MIL-PRO General Emergency Evacuation**

  Control + Click here to link to this procedure.
- According to this procedure, after head count at Muster, if workers are missing, the Code 1 Procedure will be applied.

B 1.5.3 PROCESS PLANT: Pipe, Valve breakage.

- In case of a small visible leak on the cyanide network (pipe, valve, etc…), a red ribbon and required warning tags will immediately be installed in order to protect the affected area. Supervisor will take all necessary measures to stop the leak and repair the broken part. The primary measure will be to communicate with the Process Plant Operator and have the broken section isolated and/or de-activated by control room operator.

  Control + Click here to link to related procedure.

- In case of a major and/or catastrophic leak that could endanger workers, then there will be an immediate evacuation of mill as per the General Emergency Evacuation procedure.

B 1.5.4 PROCESS PLANT: Major breakage on tailing lines, cyanide treatment pumps or tank rupture.

- If a sudden major breakage is happening on any vital cyanide destruction and/or tailing lines, complete stopping of the Process Plant will immediately be required.
- Complete stopping will be done by following procedure **MBK-MIL-OP-PRO Process Plant Shutdown V7**

  Control+ Click here to link to this procedure

Also, the Process Plant Reagent operator will immediately close the manual valve at the feed of the CIP to prevent the leach tank from emptying inside the mill and then, overflowing. Also the valve at the exit of leach tank #9 towards the CIP will be closed as additional safety measure. This will prevent any major spill inside the mill that could result in slurry going out of the mill.

- Shouls the breakage involving tailing lines only, then procedure:

  MBK-MIL-OP-PRO Process Plant Loss of Tailings will be applied.

  Control + Click here to link to this procedure

B 1.6 Failure or overtopping of tailings impoundments.

Should a major problem occurring to tailing impoundments, all emergency measures as recommended by engineering department are depicted into two manuals:

- **Control + Click here to link to the ''Dewatering Dikes OMS Manual''**
- **Control + Click here to link to the ''TSF OSM Manual''**
- These manuals should be consulted as containing primary emergency measures for tailing impoundments failure and more likely Section 8 and 9 as below:

- ***Extract from OMS Manual:***

- ***SECTION 8 • EMERGENCY PREPAREDNESS PLAN 8-1***

8.1 Emergency Procedures 8-1
8.1.1 Operation 8-1
8.2 Emergency Details 8-2
8.2.1 Access to the Project Site 8-2
8.2.2 Emergency Assessment 8-2
8.2.3 Emergency Communication and Actions 8-2
8.2.4 Site Emergency Procedure 8-3
8.2.5 Communication Equipment Location 8-3
8.3 Medical and First Aid Services 8-4
8.4 On Site Equipment and material 8-4
8.4.1 Pumping Equipment 8-4
8.4.2 Mobile Equipment 8-4
8.4.3 Earthwork Material and Equipment..8-1

- ***SECTION 9 • EMERGENCY RESPONSE REFERENCE DOCUMENTS 9-1***

GENERAL INFORMATION ABOUT CYANIDE

Common Names:

- Sodium salt of hydrocyanic acid

Agent Characteristics

- **APPEARANCE**: White crystalline or granular powder.
- **DESCRIPTION**: Sodium cyanide releases hydrogen cyanide gas, a highly toxic chemical asphyxiant that interferes with the body's ability to use oxygen. Exposure to sodium cyanide can be rapidly fatal. It has whole-body (systemic) effects, particularly affecting those organ systems most sensitive to low oxygen levels: the central nervous system (brain), the cardiovascular system (heart and blood vessels), and the pulmonary system (lungs). Sodium cyanide is used commercially for fumigation, electroplating, extracting gold and silver from ores, and chemical manufacturing. Hydrogen cyanide gas released by sodium cyanide has a distinctive bitter almond odor (others describe a musty "old sneakers smell"), but a large proportion of people cannot detect it; the odor does not provide adequate warning of hazardous concentrations. Sodium cyanide is odorless when dry. Sodium cyanide is shipped as pellets or briquettes. It absorbs water from air (is hygroscopic or deliquescent).
- **METHODS OF DISSEMINATION**:
  - Indoor Air: Sodium cyanide can be released into indoor air as fine droplets, liquid spray (aerosol), or fine particles.
  - Water: Sodium cyanide can be used to contaminate water.
  - Food: Sodium cyanide can be used to contaminate food.
  - Outdoor Air: Sodium cyanide can be released into outdoor air as fine droplets, liquid spray (aerosol), or fine particles.
  - Agricultural: If sodium cyanide is released as fine droplets, liquid spray (aerosol), or fine particles, it has the potential to contaminate agricultural products.
- **ROUTES OF EXPOSURE**: Sodium cyanide can affect the body through ingestion, inhalation, skin contact, or eye contact.

Personal Protective Equipment

- **GENERAL INFORMATION**: First Responders should use a NIOSH-certified Chemical, Biological, Radiological, Nuclear (CBRN) Self Contained Breathing Apparatus (SCBA) with a Level A protective suit when entering an area with an unknown contaminant or when entering an area where the concentration of the contaminant is unknown. Level A protection should be used until monitoring results confirm the contaminant and the concentration of the contaminant.

  NOTE: Safe use of protective clothing and equipment requires specific skills developed through training and experience.

Emergency Response

- **CHEMICAL DANGERS**:
  - Sodium cyanide is water-reactive.
  - Sodium cyanide decomposes on contact with acids, acid salts, water, moisture, and carbon dioxide, producing highly toxic, flammable hydrogen cyanide gas.
  - Sodium cyanide solution in water is a strong base; it reacts violently with acid and is corrosive.
  - Sodium cyanide is incompatible with strong oxidants.
  - Carbon dioxide from the air is sufficiently acidic to liberate toxic hydrogen cyanide gas on contact with sodium cyanide.

- **EXPLOSION HAZARDS**:
  - Sodium cyanide reacts violently with strong oxidants such as nitrates, chlorates, nitric acid, and peroxides, causing an explosion hazard.
  - Upper and lower explosive (flammable) limits in air are not available for sodium cyanide.
  - Containers may explode when heated or if they are contaminated with water.

- **FIRE FIGHTING INFORMATION**:
  - Sodium cyanide is non-combustible.
  - The agent itself does not burn.
  - Sodium cyanide releases highly flammable and toxic hydrogen cyanide gas on contact with acids or water.
  - Fire will produce irritating, corrosive, and/or toxic gases.
  - Note: Most foam will react with the agent and release corrosive/toxic gases.
  - For small fires, do not use carbon dioxide; **use dry chemical**, dry sand, or alcohol-resistant foam.
  - For large fires, use water spray, fog, or alcohol-resistant foam. Move containers from the fire area if it is possible to do so without risk to personnel. Use water spray or fog; do not use straight streams. Dike fire control water for later disposal; do not scatter the material.
  - For fire involving tanks or car/trailer loads, fight the fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after the fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tanks. Always stay away from tanks engulfed in fire.
  - Run-off from fire control or dilution water may be corrosive and/or toxic, and it may cause pollution.
  - If the situation allows, control and properly dispose of run-off (effluent).

- **INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES**:
  - If a tank, rail car, or tank truck is involved in a fire, isolate it for 0.5 mi (800 m) in all directions; also consider initial evacuation for 0.5 mi (800 m) in all directions.
  - Small spills (when spilled in water)
    - First isolate in all directions: 200 ft (60 m).
    - Then protect persons downwind during the day: 0.1 mi (0.2 km).
    - Then protect persons downwind during the night: 0.4 mi (0.7 km).
  - Large spills (when spilled in water)
    - First isolate in all directions: 1300 ft (390 m).
    - Then protect persons downwind during the day: 0.8 mi (1.3 km).
    - Then protect persons downwind during the night: 3.0 mi (4.9 km).

- **PHYSICAL DANGERS**:
  - Vapors may collect and stay in confined areas (e.g., sewers, basements, and tanks).
  - Hazardous concentrations may develop quickly in enclosed, poorly-ventilated, or low-lying areas. Keep out of these areas. Stay upwind.
  - Hydrogen cyanide gas produced from sodium cyanide mixes well with air; explosive mixtures are easily formed.

Signs/Symptoms

- **TIME COURSE**: Effects occur rapidly following exposure to sodium cyanide. Inhalation exposure to hydrogen cyanide gas released from sodium cyanide produces symptoms within seconds to minutes; death may occur within minutes.

- **EFFECTS OF SHORT-TERM (LESS THAN 8-HOURS) EXPOSURE**: Early symptoms of cyanide poisoning include lightheadedness, giddiness, rapid breathing, nausea, vomiting (emesis), feeling of neck constriction and suffocation, confusion, restlessness, and anxiety. Accumulation of fluid in the lungs (pulmonary edema) may complicate severe intoxications. Rapid breathing is soon followed by respiratory depression/respiratory arrest (cessation of breathing). Severe cyanide poisonings progress to stupor, coma, muscle spasms (in which head, neck, and spine are arched backwards), convulsions (seizures), fixed and dilated pupils, and death. The CNS is the most sensitive target organ of cyanide poisoning. Cardiovascular effects require higher cyanide doses than those necessary for CNS effects. In serious poisonings, the skin is cold, clammy, and diaphoretic. Blue discoloration of the skin may be a late finding. Severe signs of oxygen deprivation in the absence of blue discoloration of the skin suggest cyanide poisoning.

- **EYE EXPOSURE**:
  - Redness, pain, and severe deep burns.

- Contact with the eyes can contribute to whole-body (systemic) toxicity. See Inhalation Exposure.

- **INGESTION EXPOSURE**:
  - Nausea, vomiting (emesis), abdominal pain, and irritation or corrosion of the lining of the esophagus and stomach.
  - Whole-body (systemic) toxicity can occur. See Inhalation Exposure.

- **INHALATION EXPOSURE**:
  - Mild to moderate: Central Nervous System (CNS) effects: headache, confusion, anxiety, dizziness, weakness (malaise), and loss of consciousness. Cardiovascular effects: palpitations. Respiratory effects: respiratory tract irritation, difficulty breathing or shortness of breath (dyspnea), and transient increase in rate and depth of breathing (hyperpnoea). Gastro Intestinal effects: nausea and vomiting (emesis).
  - Severe: CNS effects: coma, seizures, and dilated pupils (mydriasis). Cardiovascular effects: shock, abnormal or disordered heart rhythms (dysrhythmias), critically low blood pressure, and cardiac arrest. Respiratory effects: abnormally rapid, followed by abnormally slow respirations; accumulation of fluid in the lungs (pulmonary edema); and respiratory arrest. Eye effects: dilated pupils, inflammation of the surface of the eye, and temporary blindness.

- **SKIN EXPOSURE**:
  - Irritation, tissue damage (ulceration), burning sensation, and pain
  - Absorption through the skin can contribute to whole-body (systemic) toxicity. See Inhalation Exposure.

Decontamination

- **INTRODUCTION**: The purpose of decontamination is to make an individual and/or their equipment safe by physically removing toxic substances quickly and effectively. Care should be taken during decontamination, because absorbed agent can be released from clothing and skin as a gas. Your Incident Commander will provide you with decontaminants specific for the agent released or the agent believed to have been released.

- **DECONTAMINATION CORRIDOR**: The following are recommendations to protect the first responders from the release area:
  - Position the decontamination corridor upwind and uphill of the hot zone. The warm zone should include two decontamination corridors. One decontamination corridor is used to enter the warm zone and the other for exiting the warm zone into the cold zone. The decontamination zone for exiting should be upwind and uphill from the zone used to enter.
  - Decontamination area workers should wear appropriate PPE. See the PPE section of this card for detailed information.

- A solution of detergent and water (which should have a pH value of at least 8 but should not exceed a pH value of 10.5) should be available for use in decontamination procedures. Soft brushes should be available to remove contamination from the PPE. Labeled, durable 6-mil polyethylene bags should be available for disposal of contaminated PPE.

- **INDIVIDUAL DECONTAMINATION**: The following methods can be used to decontaminate an individual:
  - Decontamination of First Responder:
    - Begin washing PPE of the first responder using soap and water solution and a soft brush. Always move in a downward motion (from head to toe). Make sure to get into all areas, especially folds in the clothing. Wash and rinse (using cold or warm water) until the contaminant is thoroughly removed.
    - Remove PPE by rolling downward (from head to toe) and avoid pulling PPE off over the head. Remove the SCBA after other PPE has been removed.
    - Place all PPE in labeled durable 6-mil polyethylene bags.
  - Decontamination of Patient/Victim:
    - Remove the patient/victim from the contaminated area and into the decontamination corridor.
    - Remove all clothing (at least down to their undergarments) and place the clothing in a labeled durable 6-mil polyethylene bag.
    - Thoroughly wash and rinse (using cold or warm water) the contaminated skin of the patient/victim using a soap and water solution. Be careful not to break the patient/victim's skin during the decontamination process, and cover all open wounds.
    - Cover the patient/victim to prevent shock and loss of body heat.
    - Move the patient/victim to an area where emergency medical treatment can be provided.

First Aid

- **GENERAL INFORMATION**: Careful observation, supplemental oxygen, and supportive care may be sufficient therapy for the patient/victim who does not exhibit physical findings of cyanide toxicity. For the patient/victim exhibiting physical findings of cyanide toxicity, initial treatment consists of administration of antidotes under a physician's direction, respiratory and circulatory support (oxygen and IV fluids), correction of chemical imbalances in the blood, and seizure control**. Speed is critical.** Avoid mouth-to-mouth resuscitation regardless of route of exposure. Avoid contact with vomitus, which may off-gas hydrogen cyanide.
- **Seek for medical attention by bringing the victim to the clinic after decontamination**
- **If Antidote is needed, it must be administrated by our medical clinic's personnel, under the** :

  MBK-HSS-CLI Medical Protocol Cyanide Poisoning Management procedure

  Control + Click here to link to this procedure

- **EYE CONTACT**:
  - Immediately remove the patient/victim from the source of exposure.
  - Immediately wash eyes with large amounts of tepid water for at least 15 minutes.
  - Monitor the victim for signs of whole-body (systemic) effects.
  - If signs of whole-body (systemic) poisoning appear, see the Inhalation section for treatment recommendations.
  - Seek medical attention immediately.

- **INGESTION**:
  - Immediately remove the victim from the source of exposure.
  - Establish secure large-bore IV access.
  - Ensure that the patient/victim has an unobstructed airway.
  - Do not induce vomiting (emesis).
  - Immediately administer 100% oxygen.
  - Prepare a cyanide antidote kit, for use under a physician's direction, for symptomatic patient/victims. See the Antidote section for antidote administration procedures.
  - Treat seizures with benzodiazepines.
  - Seek medical attention immediately.

- **INHALATION**:
  - Immediately remove the patient/victim from the source of exposure.
  - Evaluate respiratory function and pulse.
  - Ensure that the patient/victim has an unobstructed airway.
  - Immediately administer 100% oxygen.
  - Assist ventilation as required.
  - If breathing has ceased (apnea), provide artificial respiration.
  - The nursing staff will:
    - Establish secure large-bore intravenous (IV) access.
    - Prepare a cyanide antidote kit, for use under a physician's direction, for symptomatic patient/victims. See the Antidote section for antidote administration procedures.
  - Monitor for respiratory distress.
  - Seek medical attention immediately.

- **SKIN**:
  - Immediately remove the patient/victim from the source of exposure.
  - See the Decontamination section for patient/victim decontamination procedures.
  - Monitor the patient/victim for signs of whole-body (systemic) effects.
  - If signs of whole-body (systemic) poisoning appear, see the Inhalation section for treatment recommendations.
  - Seek medical attention immediately.

APPENDIX C

MBK-HSS-EMR-PLN-Dyno Emergency Response Plan

Control + Click here to link to this Specific Emergency Response Plan

APPENDIX D

***MBK-ENV-PLN* Oil Pollution Emergency Plan**

Control + Click here to link to this specific Emergency Response Plan

APPENDIX E

***MBK-HSS-PLN-EMR** Nolinor Emergency Response Plan*

Nolinor ERP Plan (Note: accessible only on Intelex under H&S Plans – Emergency Response

APPENDIX F

MBK-HSS-PLN Baker Lake Facilities O M Manual- Drawings Appendix

Control + click here to link to the document

APPENDIX G

MBK-HSS-EMR-PLN Desgagnes Vessel Contingency Plan

Control + Click here to link to the plan

APPENDIX H

***MBK-ENV-PLN-BL** Baker Lake Bulk Fuel Storage Facility Environmental Performance Monitoring Plan Ver. 2*

Control + Click here to link to this specific Plan

APPENDIX I

MBK-ENV Meadowbank Transportation Management Plan AWPAR

Control + Click here to link to this specific plan

APPENDIX J

Appendix J is left Blank

APPENDIX K

***MBK-HSS-EMR-PLN* Emergency Response Guideline Handbook – ERG 2012**

ERG2012.pdf

Double click on the Icon to open the document

APPENDIX L

<u>Site Maps Quick Link</u>

SITE MAPS ARE ELECTRONICALLY AVAILABLE AT THE EMERGENCY CRISIS RESPONSE ROOM

APPENDIX M

SPILL Contingency Plan (Environment)

Control + Click here to link to this plan

APPENDIX N

MBK-HSS-EMR-PLN MEADOWBANK CRISIS MANAGEMENT PLAN

CONTROL + CLICK HERE TO LINK TO THIS PLAN

MEADOWBANK GOLD PROJECT

Landfill Design and Management Plan

In Accordance with Water License 2AM-MEA1525

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

Version 3
March 2017

EXECUTIVE SUMMARY

This Landfill Design and Management Plan outline the design of the current operational and a conceptual closure industrial waste landfill as part of Agnico Eagle Mines Limited's Meadowbank Mine in Nunavut.

The current landfill (Landfill #1) is required for the disposal of non-salvageable, non-hazardous solid wastes from mining activities that cannot be incinerated. It is located on the Portage Rock Storage Facility and will consist of several sub landfills that evolve with the placement of waste rock. All of the sub-landfills will be identified and mapped.

The leachate from the landfill is very weak (diluted) or simply no existent due to the controls on materials placed in the landfill, and therefore specific leachate management is not considered. Any leachate is naturally drained into the Tailing Storage Facility.

At the end of mine life, the landfill waste will be covered by 0.3 to 1 m thickness of rock fill, with an additional 4 m of coarse NPAG waste rock material. The final landfill slopes will be up to 50%. Drainage water will be managed under the current Water Management plan.

To meet NWB guidelines, an environmental overview effects assessment was conducted to characterize environmental resources and determine the anticipated environmental effects of the landfills. The primary potential environmental effects from landfill activities included leachate generation, windblown debris and habitat (vegetation) loss. Operation of the landfill has not shown any such environmental effects.

A conceptual closure industrial waste landfill will be located near the top of the Portage RSF and would serve the mine for the last two years of the mine closure. Demolition waste from the plant site removal / reclamation will be disposed of in Landfill #2.

IMPLEMENTATION SCHEDULE

This plan will be immediately implemented (March 2017) and is subject to any modifications proposed by the NWB as a result of the review and approval process**.**

DISTRIBUTION LIST

Agnico Eagle – General Mine Manager

Agnico Eagle – Environment Superintendent

Agnico Eagle – Environmental Senior Coordinator

Agnico Eagle – Engineering Superintendent

Agnico Eagle – Mine Superintendent

Agnico Eagle – Energy and Infrastructure Superintendent

DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
1	08/10/08			Amalgamation of original report and supplementary documents (Golder Associates, Doc 562 – *Landfill Design and Management Supplementary Information* and AEM document – *Meadowbank Type A Water License – Response to Pre-Hearing Commitments*, Appendix I)
		4	11	Addition of testing protocol and incinerator criteria; Incorporation of Government of Nunavut Environmental Guidelines
		5	14	Addition of protocols for material placement in the landfills; Confirmation that there are no planned design changes as of October 2008 to Landfill #1 or Landfill #2
2	12/12/18	ALL	ALL	Comprehensive update of entire plan
3	17/03/31	ALL	ALL	Comprehensive update of entire plan

Prepared By: Environmental Department

Approved by: ______________________
Erika Voyer
General Supervisor Environment

Table of Contents

1 INTRODUCTION 7
1.1 PROJECT OVERVIEW 7
1.2 LANDFILL SITING 8
2 REGULATORY SETTING 9
3 PLAN FOR THE ON-SITE DISPOSAL OF SOLID WASTE 10
3.1 APPROACH 10
3.2 ACCEPTABLE WASTE FOR LANDFILLING 11
3.2.1 Acceptable waste 11
3.2.2 Asbestos 11
3.3 UNACCEPTABLE WASTE FOR LANDFILLING 11
3.3.1 Fluorescent Lamp Tubes 12
3.3.2 Ozone Depleting Substances 12
3.4 TOTAL VOLUME OF WASTE 12
3.5 INCINERATOR ASH TESTING PROTOCOL 12
4 LANDFILL LOCATION AND CONSTRUCTION 13
4.1 LANDFILL #1 13
4.1.1 Landfill #1 Protocol for Placement of Material 13
4.2 LANDFILL #2 13
4.2.1 Landfill #2 Protocol For Placement of Material 14
4.3 LEACHATE MANAGEMENT 14
4.4 LANDFILL ENCAPSULATION WITHIN THE PORTAGE RSF 14
5 LANDFILL OPERATION 15
5.1 CONCEPTUAL OPERATIONS PLAN 15
5.2 CONCEPTUAL CLOSURE PLAN 16
6 POTENTIAL ENVIRONMENTAL EFFECTS 22
6.1 EFFECTS SUMMARY 23
7 PLAN REVIEW AND CONTINUAL IMPROVEMENT 24
8 REFERENCES 25

LIST OF FIGURES

Figure 1: Meadowbank Mine Site Facility Layout 27
Figure 2: Landfill #1 Location 28
Figure 3: Approximate location of the Landfill #2 on top of Portage RSF 29
Figure 4: Landfill #2 Conceptual Cross Section 30

LIST OF APPENDICES

Appendix A MBK-HSS-IH-PRO Asbestos Waste Management Procedure

1 INTRODUCTION

1.1 PROJECT OVERVIEW

This Landfill Design and Management Plan (Plan) outlines the design, operation and closure for two solid waste landfills as part of the Agnico Eagle Mines Limited Meadowbank Mine.

The objectives of this Plan are summarized as follows:

1. To define the location, design and operating procedures to be used in the landfill disposal of non-hazardous solid waste generated at the Meadowbank Mine;
2. To define acceptable/non-acceptable types of solid waste to be placed in the Meadowbank landfill; and
3. To define operating and monitoring requirements for the landfill.

This updated version of the Landfill Design and Management Plan was developed in March 2017 in concordance with the water license requirement. This document will supersede all of the previous Landfill Design and Management Plans created by Agnico Eagle.

The Meadowbank Project operates under Water License 2AM-MEA1525 issued by the Nunavut Water Board on July 23rd 2015 and signed into effect by the Minister of Indian and Northern Affairs Canada. The landfills are required for the disposal of non-salvageable, non-hazardous industrial wastes from standard mining activities that cannot be incinerated.

Hazardous wastes will not be placed in the landfills. Management procedures for hazardous wastes are provided under a separate management plan – Hazardous Materials Management Plan (Ver.3, October 2013). All other materials considered unsuitable for landfill deposition are packaged for shipment and disposal off site at a licensed facility.

To meet NWB guidelines, an environmental overview effects assessment was conducted to characterize environmental resources and determine the anticipated environmental effects of the landfills. Other applicable regulatory guidelines and criteria were also incorporated into this Plan, as discussed in Section 2.

The overall Meadowbank Mine description, landfill siting options and descriptions, and corresponding environmental overview approach are described in the sections below. The Meadowbank Mine Site facility layout is shown in Figure 1.

At the Meadowbank site and Baker Lake Marshalling Area, hazardous waste materials are stored in secure facilities until they can be backhauled for off-site recycling or disposal in an approved facility. Agnico has registered as a Hazardous Waste Storage Facility with the Government of Nunavut Department of Environment; the Meadowbank site waste generator number is **NUG 100031**.

1.2 LANDFILL SITING

The landfills were positioned considering the following criteria:

- Drainage – sites that drain into areas where water will be collected and monitored as part of the overall mine plan are preferred.

- Avoid Ice Rich Soil Excavation – sites where bedrock is at relatively shallow depth are preferred.

- Disturbed Areas – sites that will be within or near areas that will be disturbed as part of the overall mine plan are preferred.

- Access – sites that are located close to existing access roads are preferred.

The first three criteria are recommendations from the Mine Site Reclamation Guidelines for the Northwest Territories (INAC, 2006).

Based on the above criteria, a landfill is planned at each of the two following locations:

- Landfill #1 is developed in the Portage RSF (Figure 2). This landfill consist of multiple sub landfills that are built and buried according to the evolution of the RSF. As the RSF evolves, the elevation and location of the sub landfills change; and

- Landfill #2 will be developed at the top of the Portage RSF during Meadowbank closure.

While the preferred landfill location is the top of the Portage RSF (minimizing the disturbed area), such a landfill would hinder waste rock placement during mining activities. Thus Landfill #1 will be developed first and serve as the non-hazardous waste disposal site for the life of operation. For the closure of the mine, Landfill #2 will serve as the non-hazardous waste disposal site.

2 REGULATORY SETTING

Waste management in Nunavut is regulated under the *Nunavut Public Health Act*, the *Nunavut Environmental Protection Act* and the federal *Environmental Protection Act*. In addition to mandatory requirements, a number of waste management guidelines are commonly used in the NWT and Nunavut. The most recent of these was developed for municipal solid waste, and is titled "*Guidelines for the Planning, Design, Operations and Maintenance of Modified Solid Waste Sites in the NWT*" (Ferguson Simek Clark, April 2003, on behalf of the Department of Municipal and Community Affairs, Government of Northwest Territories). While not all of the recommendations provided in this guideline are appropriate for the management of industrial waste such as those generated at a gold mine, those principles that are considered applicable have been adopted in the Plan.

In addition, the NWB guidelines *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2006) were followed in this current document regarding specific landfill design and mitigation for impacts pertaining to waste. The recommendations from *Implications of Global Warming and the Precautionary Principle in Northern Mine Design and Closure* (BGC 2003) were also incorporated into this document, where appropriate.

3 PLAN FOR THE ON-SITE DISPOSAL OF SOLID WASTE

3.1 APPROACH

The strategy for the disposal of solid waste is to first identify and segregate acceptable disposal items from non-acceptable items. Acceptable items that can be disposed of at the on-site facility are those that are non-hazardous, non-organic, with a low leachate and heat generation potential. All other materials are either incinerated or hauled offsite. This strategy for limiting the materials that can be placed in the landfills greatly reduces the potential for leachate.

All solid wastes that may contain food waste, food packaging waste or other organic waste that could attract wildlife are incinerated in the on-site incinerator (see the Meadowbank Incinerator Waste Management Plan - Ver.7, March. 2017 for more details). This includes all garbage from the camp, camp kitchen, site lunchrooms and offices. The ash from the incinerator are placed in a container and disposed of at the landfill. Incinerator ash samples are collected and tested for metals according to the Government of Nunavut Environmental Guideline for Industrial Waste Discharges (D of SD, 2002). Ash that does not meet these guidelines will be buried within the TSF.

The second part of the strategy is to concentrate disposal of solid waste at two landfills, Landfill #1 and Landfill #2. Landfill #1 is located in the Portage RSF. It consists of multiple sub landfills that are built and buried according to the evolution of the RSF. As the RSF evolves, the elevation and location of the sub landfills change. It will serve the mine for the life of operation. Landfill #2 will be located near the top of the Portage RSF, on the last rockfill lift, and would serve the mine for mine closure. Demolition waste from the plant site removal / reclamation will be disposed of in Landfill #2.

The development of the two landfills minimizes the area disturbed and the re-handling of waste. Landfills at the selected locations allow any leachate that may be generated to be collected, monitored and managed with seepage and runoff water from the Portage RSF. The leachate from the landfills is very weak or simply absent due to the controls on materials placed in the landfill and thus site specific landfill leachate management is not considered to be required. Any leachate that may become present would runoff into the Tailings Storage Facility which will be capped at the end of mine life.

Based on the above strategy, a liner is not required for the landfills, nor is any special monitoring being completed or foreseen to be recommended in the future. However, the landfills conform to the Type A Water License requirements and closure plan for each landfill site for orderly landfill development and to reduce the potential for windblown debris.

The Type A Water License requires the following landfill related monitoring:

- Part I, Item 8 stipulates that the monthly runoff/seepage flow from both Landfill #1 and #2 in cubic meters must be measured, recorded and reported to the Water Board;
- Part I, Item 10 stipulates that the annual geotechnical inspection to be carried out by a geotechnical engineer between the months of July and September should include all earth works including the two landfill sites with the results being included in the report to the Water Board;

- Part I, Item 13 stipulates that seepage and runoff from the landfills is to be observed at a minimum of once per quarter; and

- Part I, Item 14 stipulates that the results and interpretation of the Seepage monitoring required in Part I, Item 13 in the Annual Report required under Part B, Item 2.

3.2 ACCEPTABLE WASTE FOR LANDFILLING

3.2.1 Acceptable waste

The following materials are acceptable for disposal at the landfills:

- Plastic (except expanded polystyrene);
- Steel, copper, aluminum, iron (most of this metal is recycled);
- Wood;
- Fiberglass insulation;
- Fiberglass;
- Roofing;
- Cardboard
- Concrete;
- Carpet;
- Bricks;
- Ceramics;
- Rubber;
- Empty caulking tubes;
- Hardened caulk;
- Clothing;
- Glass;
- Wire;
- Small appliances (with batteries removed);
- Gyproc;
- Ash provided it has cooled to 60ºC or less and follows procedures laid out in the Incinerator Management Plan; and
- Vehicles and machinery provided all liquids, grease, batteries, and electronics have been removed (see Section 3.3.2 for more details on ozone depleting substances).

3.2.2 Asbestos

Asbestos being present naturally in rock formations, asbestos related waste will be generated within the milling and production processes. As such, this type of waste will be disposed according to the MBK-HSS-IH-PRO Asbestos Waste Management procedure (Appendix A). Once ready for disposal, asbestos waste will be capped quickly to minimize exposure, using mini-landfill type of disposal within the existing Landfills.

3.3 UNACCEPTABLE WASTE FOR LANDFILLING

Materials that are not listed above are unacceptable for placement at the landfills, unless approved in writing by the Meadowbank Environment Superintendent or General Supervisor Environment. These materials include:

- Organic matter including food, septic tank pumping or sludge from waste water treatment, dead animals, paper;
- Food containers and wrappings, unless cleaned;
- Whole tires;
- Hazardous waste including mercury, medical waste, batteries, solvents, glues, ethylene glycol antifreeze, adhesives (except empty caulking tubes);
- Electronics;
- Light bulbs or Fluorescent Lamp Tube;
- Petroleum products, including materials contaminated with petroleum products; and
- Expanded polystyrene.

In particular, organic matter is not accepted in the landfill, thus eliminating the attraction to carnivores and/or raptors. This is accomplished by requiring all personnel to dispose domestic waste in designated receptacles and by sending all collected domestic waste (e.g. from kitchens and living quarters) to the site incinerator.

3.3.1 Fluorescent Lamp Tubes

Fluorescent tubes contain mercury phosphor powder and traces of lead and cadmium, which are considered environmental contaminants under the Nunavut *Environmental Protection Act* (EPA). The only disposal method for fluorescent tubes is through an approved hazardous waste recycling or disposal facility (Government of Nunavut, Environmental Protection Service, 2003) and as per the *Disposal Guidelines for Fluorescent Lamp Tubes*.

3.3.2 Ozone Depleting Substances

Ozone depleting substances (ODSs) include chlorofluorocarbons (CFCs) or halons and common sources include refrigeration equipment, air conditioning equipment, motor vehicle air conditioners and fire extinguishing equipment (Government of Nunavut, Environmental Protection Service, 2002b). These materials are hazardous in nature; consequently, all disposal of ODS take place at an approved facility.

3.4 TOTAL VOLUME OF WASTE

An estimate of waste volume is required to estimate the approximate size of the landfills; however, an exact waste volume is not a critical parameter in the design because of the flexibility of design to accommodate extensions (larger to accept more waste) or contractions (smaller to accept less waste) of the landfill.

In 2016, the recorded amount of waste that went to the Landfill for disposal was 9,576 m^3. It is expected with latest life of mine assessment to have sufficient space within the existing planned landfills.

3.5 INCINERATOR ASH TESTING PROTOCOL

Please see the Meadowbank Incinerator Waste Management Plan - Ver.7, March, 2017 for all information regarding the disposal of ash at the landfill.

4 LANDFILL LOCATION AND CONSTRUCTION

4.1 LANDFILL #1

The location of Landfill #1 is shown on Figure 2 in the northwest side of the Portage RSF. This landfill will serve as the solid waste disposal facility for the first 9 years of mine life. The design of Landfill #1 does not require imported materials or exacting survey data or measurement. This is due to the restriction on materials that can be landfilled and the location of the landfill within the catchment of the Portage RSF. These factors reduce the need for leachate collection or control or mitigation measures against vectors such as carnivores or raptors. Thus, the main environmental mitigation measure required is a wind screen to reduce windblown debris. As of March 2017, the Landfill #1 has evolved in sub landfills that are built and buried according to the evolution of the RSF. As the RSF evolves, the elevation and location of the sub landfills change.

The area to receive waste is bounded by a rock fill berm. The purpose of the rockfill berm is to act as a wind shield for the waste. The sub landfills have a rectangular shape with the length perpendicular to the prevailing wind direction so that much of the waste could be protected from wind by the rockfill berm.

Provided the materials that go into the incinerator are controlled to exclude all hazardous materials (i.e., even small quantities of hazardous waste such as batteries are not disposed in the landfill), then the incinerator ash should be non-hazardous. As discussed in Section 3.5, an ash testing protocol has been implemented to ensure that the incinerator ash is suitable for disposal in the landfills.

4.1.1 Landfill #1 Protocol for Placement of Material

Wastes is disposed of directly on the ground and compacted with heavy equipment against the berm or existing row. When the sub landfill is either full of compacted waste or the RSF evolution causes the sub landfill to be moved, the waste is compacted and then covered with waste rock. A new sub landfill is then built including rock fill berm to act as a wind shield.

4.2 LANDFILL #2

Prior to the closure and covering of Landfill #1 by waste rock, Landfill #2 will be developed on top of the Portage RSF. Landfill #2 is currently estimated to be a 4 m deep depression in the top of the waste rock pile at the Portage RSF. The depression will be constructed by the waste rock trucks discharging their loads in a controlled manner such that the dimensions of the depression will be approximately as shown on Figure 3 and 4. The area to receive waste will be bounded on the northwest side by a 2 m high rockfill berm. The rockfill berm will act as a wind shield to reduce the amount of wind-blown debris, while providing material for intermediate cover of the landfill. Details and the exact location of Landfill #2 on top of the rock storage facility and the final landfill design will be provided with the Final Reclamation and Closure Plan. At that time, the required size of Landfill #2 will be calculated based on the actual rate of filling of Landfill #1 and the estimated amount of demolition material and decommissioned equipment that will need to be landfilled at the end of the mine life.

Waste will be placed to a maximum thickness of 4 m, after which it will be covered with a minimum of 0.3 m thickness of rock fill. A final cover of 4.0m of NPAG waste rock will then be placed over the waste. This landfill should be provided with a capacity sufficient to allocate for general waste during the active closure, plus an allowance for waste from the demolition of the mine infrastructures and building. The final landfill design will be provided with the Final Reclamation and Closure Plan.

4.2.1 Landfill #2 Protocol For Placement of Material

Materials destined for burial in the demolition landfill will be dismantled as safely and efficiently as possible, stacked in a stockpile and will then be cut by flame, hydraulic shears or saw, into manageable sizes for safe transport and placement in the demolition landfill. The demolition debris will be placed in compacted layers and then buried. Once compacted, waste rock will be placed on the debris to infill voids. Once a continuous layer of waste rock has covered the compacted debris then a final cover of a minimum of 4 m of NPAG rock will be placed over the entire landfill area.

4.3 LEACHATE MANAGEMENT

The leachate from the landfills has a very low strength (dilute) or is simply absent due to controls on materials placed in the landfills, and thus site-specific landfill leachate management is not required. Any leachate generated by the landfill will naturally be directed to the Tailing Storage Facility. Due to the fact that the Portage RSF will cover Landfill #1 and #2, it is not proposed to have a separate water quality monitoring point for leachate.

4.4 LANDFILL ENCAPSULATION WITHIN THE PORTAGE RSF

The Portage Rock Storage Facility contains surplus quantities of waste rock from the Portage and Goose Island pits. A classification system is use to identify the use and storage for all mine rock[1]. Specifically, this system identify potentially acid generating (PAG) or non-acid generating (NPAG) rock types, as well as those with the potential to leach metals.

The Portage RSF is constructed as a cell, or series of cells, such that the interior of each cell is composed of PAG and/or ML waste rock, and the exterior of each cell is composed of NPAG waste rock. Thus, PAG and/or ML waste rock within the RSF is encapsulated within NPAG waste rock, thereby limiting its exposure to oxidizing agents such as air and water, and providing a buffer for any drainage from the interiors of the cells. The material within the Portage RSF freezes, which limits internal drainage as infiltrating water becomes frozen. As a further ARD control measure, the Portage RSF will be capped with a minimum 4 m thick layer of coarse acid-buffering ultramafic rock at closure.

Owing to their placement within the Portage RSF, the landfills are/will also become encapsulated within waste rock. Specifically, the slopes of the sub landfills are covered with an advancing waste rock layer during operations such that the sub landfills are covered by a minimum 0.3 to 1 m thickness of waste rock by the end of each sub landfill operations. Agnico plans to use NPAG waste rock to surround and cover the landfills wherever practical. As noted above, a minimum 4 m thick layer of coarse acid-buffering ultramafic rock would also be placed over the landfill cover as part of planned closure activities for the Portage RSF.

[1] See Operational ARD/ML Testing and Sampling Plan

5 LANDFILL OPERATION

5.1 CONCEPTUAL OPERATIONS PLAN

The following is a conceptual plan for operating the landfills:

a) Materials Acceptable for Disposal

See Section 3.2.

b) Materials Not Acceptable for Disposal

See Section 3.3.

c) Site Development and Landfilling Method

The sub landfills are filled progressively in an orderly manner. Specifically, waste is placed at one end of the sub landfill at full height and then the active waste area progressively advances. Areas where the waste has been placed to full height and leveled are progressively covered by placement of a minimum 0.3 m thickness of rock fill on top of the waste.

d) Staffing and Equipment

The landfills do not require a full-time attendant. Roll off trucks haul waste to the landfills and a dozer is used to spread, compact and level the waste.

e) Leachate Management

The leachate from the landfills is very weak (dilute) or simply absent due to the controls on materials placed in the landfills. Therefore, specific leachate management is not required.

f) Surface Water and Erosion Control

The slopes of the landfills are covered with rockfill, thus protecting them from erosion. Any water that may runoff from the RSF will flow to the TSF.

g) Inspections

The environmental department is conducting periodic inspections to ensure compliance with the permit and operation plan.

5.2 CONCEPTUAL CLOSURE PLAN

The following is a conceptual plan for closing the landfills:

a) Estimate of Total Waste Volumes, Tonnage and Life of Landfills

Upon closure, it is estimated that the landfills will have the volumes as described in Sections 4.2.

b) Final Cover Design

- The waste in the landfills will be covered by 0.3 to 1 m thickness of rockfill, covered with an additional 4 m thickness of coarse acid-buffering ultramafic waste rock material;
- The final landfill slopes will be up to 50%; and
- Drainage water, if present will be naturally directed to the Tailing Storage Facility.

c) End use of Landfill After Closure

There is no planned end use of the landfills post-closure. They will become part of the waste rock storage facility.

d) Water Management

Contact water from the landfills in closure will continue to be managed under the current Water Management Plan.

6 POTENTIAL ENVIRONMENTAL EFFECTS

The landfills are designed and built as part of the Portage RSF. The access road to the Rock Storage Facility is used to access the sub landfills considered as Landfill #1. Access to Landfill #2 will also be by the access road to the Portage RSF.

Landfill activities that were identified to have potential effects on VECs include site preparation and construction, operations and closure.

Potential effects from the landfills on VECs were assessed as follows:

- Degradation of permafrost;
- Change in surface water and groundwater drainage patterns due to proposed landfill footprint (altered landscape);
- Change in groundwater and surface water quality from leachate percolation, leading to degradation of aquatic habitat;
- Change in air quality from dust and windblown debris;
- Loss of vegetation cover and terrestrial mammal habitat due to proposed landfill footprint;
- Attraction of predatory and small mammals to waste; and
- Loss of sites of heritage significance or traditional ways of life.

A number of mitigation measures, including management and monitoring plans were implemented as part of the overall Meadowbank Mine and are also incorporated into landfill construction, operations and closure. The plans that set out detailed site-specific protection measures and procedures that serve to protect the VECs include:

- Water Management Plan;
- Air Quality and Dustfall Monitoring Plan;
- Terrestrial Ecosystem Management Plan;
- Hazardous Materials Management Plan;
- Interim Closure and Reclamation Plan; and
- Water Quality and Flow Monitoring Plan.

6.1 EFFECTS SUMMARY

The primary potential environmental effects from landfill activities included leachate generation, windblown debris and habitat (vegetation) loss. Given the effective implementation of mitigation plans, no residual environmental effects to VECs from construction, operation or closure of the landfills are anticipated. See summary below:

- The leachate that will be generated by the landfills is of very low strength (dilute) or simply absent due to restrictions on the materials that is placed in the landfills. Water drainage from the landfill area would naturally be directed to the Tailing Storage Facility and would be managed under the Water Management Plan during operations and closure.

- Rockfill berm acts as a wind shield to reduce amount of windblown debris.

- Habitat loss is minimized because the landfills is designed and built within the footprint of the Portage RSF. With the implementation of terrestrial habitat reclamation strategies, the final surfaces of the landfills are graded to blend into the existing topography and enhance conditions for wildlife. Terrestrial habitat reclamation strategies will be incorporated as part of the Final Closure and Reclamation Plan.

7 PLAN REVIEW AND CONTINUAL IMPROVEMENT

The Landfill Design and Management Plan will be reviewed regularly by the Meadowbank Environmental Department in consultation with the engineering department, and updated if necessary. Improvements suggested through these reviews would be implemented in consultation with the Nunavut Water Board.

8 REFERENCES

BGC (BGC Engineering Incorporated), 2003. Implications of Global Warming and the Precautionary Principle in Northern Mine Design and Closure. Prepared for Indian and Northern Affairs Canada, March 27, 2003.

Cumberland Resources Ltd. 2006. Meadowbank Gold Project No-Net-Loss Plan (NNLP). Meadowbank EIS Support Document. Final Report November 2006.

Cumberland Resources Ltd., 2005a. Meadowbank Gold Project Final Environmental Impact Statement. Final Report October 2005.

Cumberland Resources Ltd., 2005b. Meadowbank Gold Project Baseline Physical Ecosystem. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd., 2005c. Meadowbank Gold Project Air Quality Impact Assessment. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd., 2005d. Meadowbank Gold Project Noise Impact Assessment. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd., 2005e. Meadowbank Gold Project Baseline Aquatic Ecosystem Report. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd., 2005f. Meadowbank Gold Project Baseline Fish Habitat. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd., 2005g. Meadowbank Gold Project Baseline Terrestrial Ecosystem. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd., 2005h. Meadowbank Gold Project Baseline Archaeology Report. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd., 2005i. Meadowbank Gold Project Baseline Traditional Knowledge Report. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd., 2005j. Meadowbank Gold Project Air Quality & Noise Management. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd. 2005k. Meadowbank Gold Project Aquatic Effects Management Program. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd., 2005l. Meadowbank Gold Project Metal Mining Effluent Regulations (MMER) Plan. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd., 2005m. Meadowbank Gold Project Terrestrial Ecosystem Management Plan. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd., 2005n. Meadowbank Gold Project Socioeconomic & Archaeology Management Plan. Meadowbank EIS Support Document. Final Report October 2005.

Department of Sustainable Development (D of SD), 2002. Environmental Guideline for Industrial Waste Discharges. January 2002.

Ferguson Simek Clark Engineers and Architects, 2003. Guidelines for the Planning, Design, Operations and Maintenance of Modified Solid Waste Sites in the NWT. Prepared for Indian and Northern Affairs Canada, April 21, 2003.

Government of Nunavut, Environmental Protection Service, 2002a. Environmental Guideline for Waste Asbestos.

Government of Nunavut, Environmental Protection Service, 2002b. Environmental Guideline for Ozone Depleting Substances.

Government of Nunavut, Environmental Protection Service, 2003. Disposal Guidelines for Fluorescent Lamp Tubes.

INAC (Indian and Northern Affairs Canada), 2006. Mine Site Reclamation Guidelines for the Northwest Territories.

MMC (Meadowbank Mining Corporation), 2007a. Meadowbank Mine Waste and Water Management. Final Report August 2007.

MMC (Meadowbank Mining Corporation), 2007b. Water Quality and Flow Monitoring Plan. Final Report August 2007.

MMC (Meadowbank Mining Corporation), 2007c. Meadowbank Gold Project Hazardous Materials Management Plan. Final Report August 2007.

MMC (Meadowbank Mining Corporation), 2007d. Meadowbank Gold Project Preliminary Closure & Reclamation Plan. August 2007.

Figure 1: Meadowbank Mine Site Facility Layout

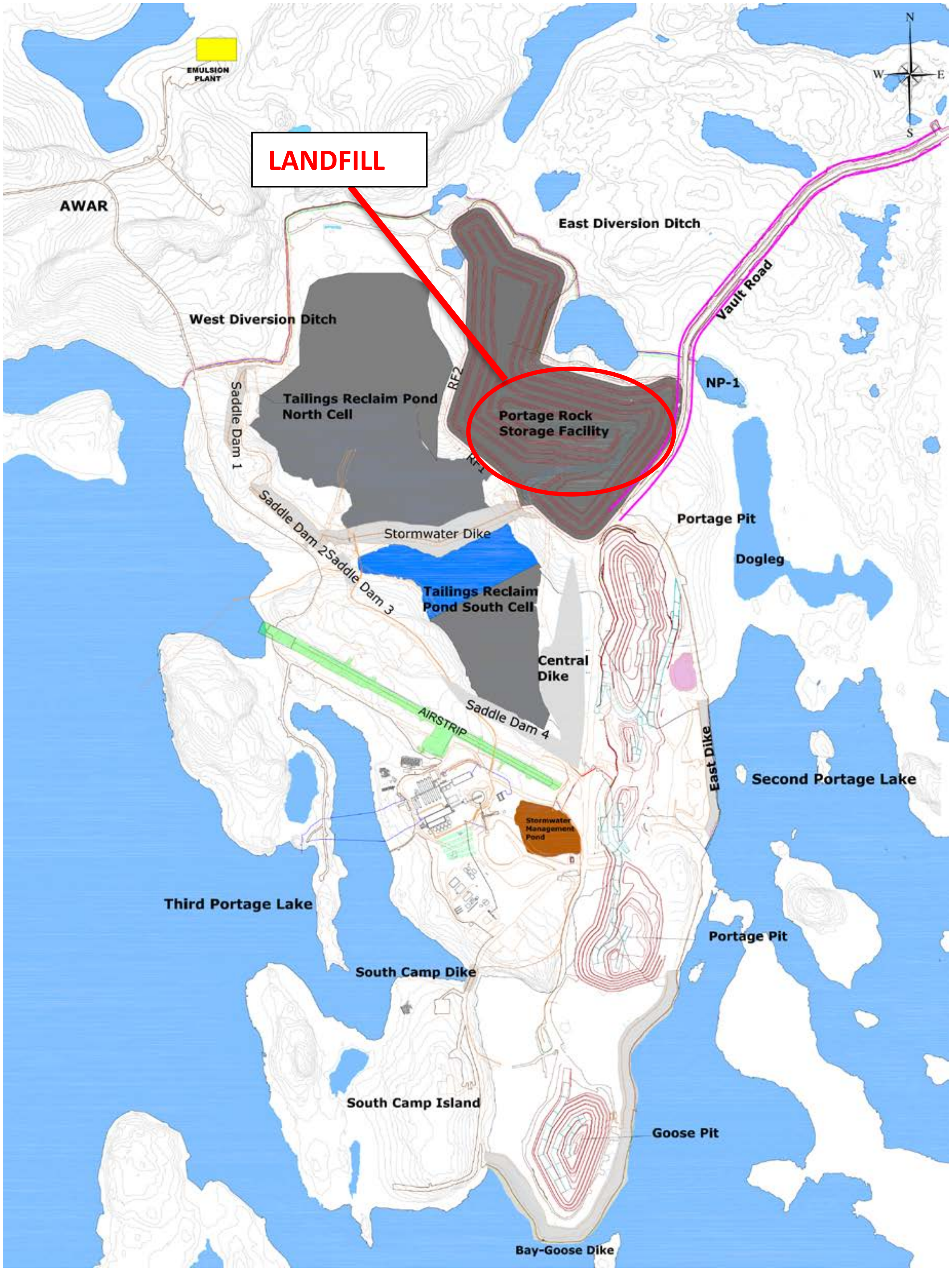


Figure 2: Landfill #1 Location

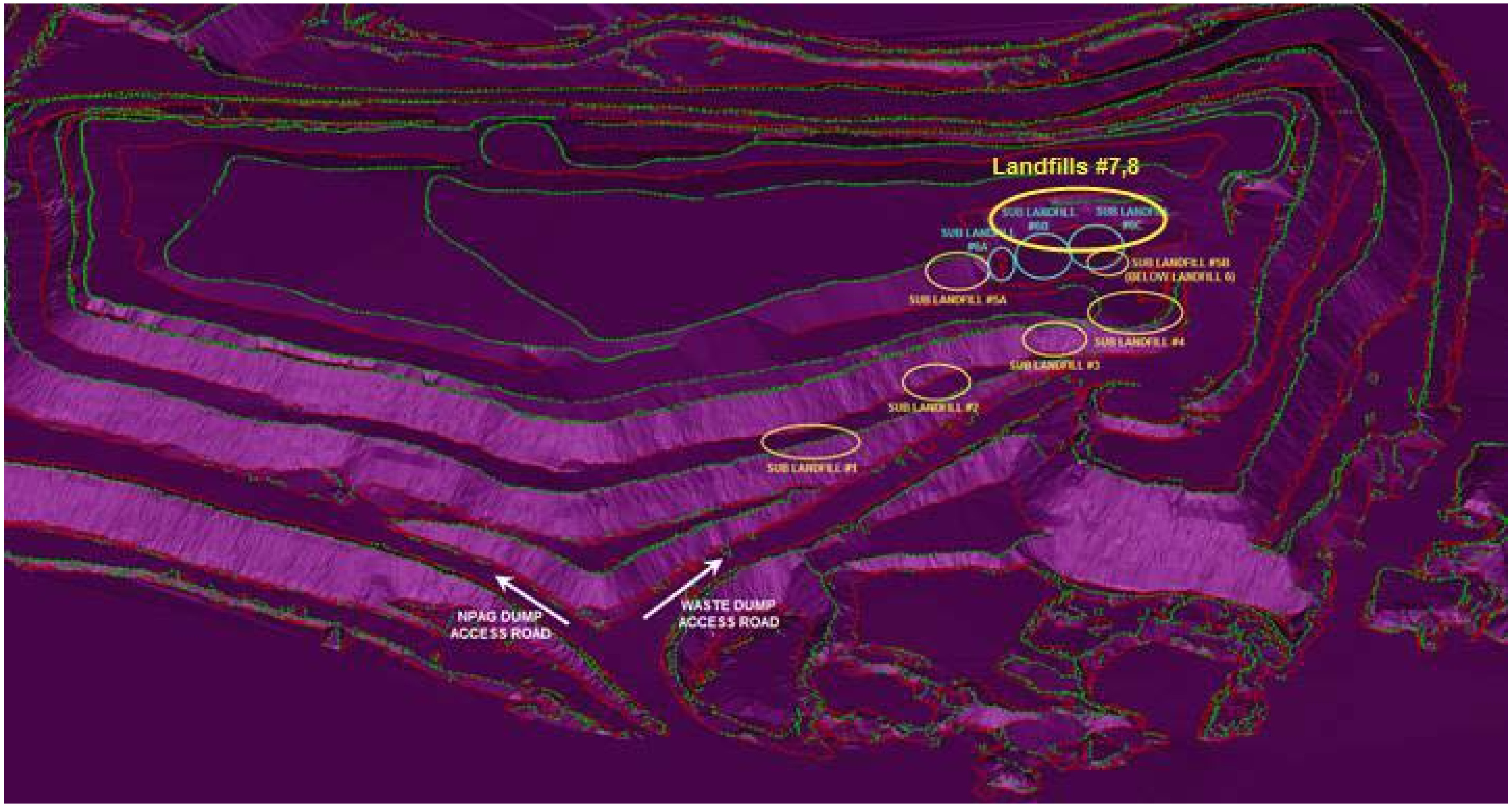
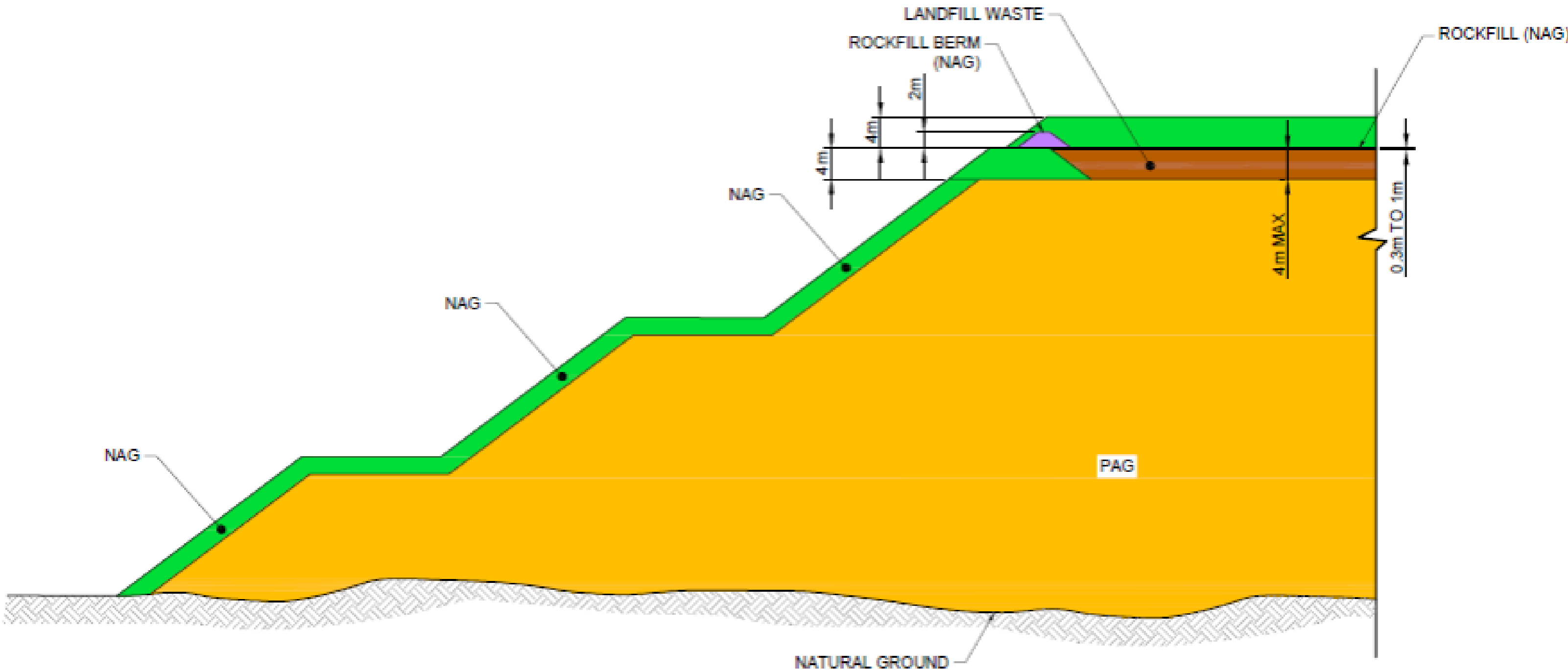


Figure 3: Approximate location of the Landfill #2 on top of Portage RSF

Figure 4: Landfill #2 Conceptual Cross Section



Appendix A

MBK-HSS-IH-PRO Asbestos Waste Management Procedure

AGNICO EAGLE
MEADOWBANK

Asbestos Waste Management

		PROCEDURE NUMBER: **MBK-HSS-IH-PRO Asbestos Waste Management**	
People concerned	• **Agnico-Eagle employees, contractors**	**Prepared by**	**Health and safety**
		Authorized by **Reviewed by**	**Norman Ladouceur** **Health and safety assistant Superintendent** **Rick Maunu – OHSC rep.**
Effective date :	April 29, 2013	***"Safety First, Safety Last … Safety Always!"*** ***"No Repeats" – Our Stepping Stone to ZERO HARM***	

This procedure corresponds to the required minimum standard. Each and everyone also have to comply with the rules and regulations of the Nunavut Government in terms of health and safety at work.

Objective: To ensure a safe means of disposing of Asbestos containing materials.

Concerned departments:	**Required equipment:**
Health and Safety, Energy and Infrastructure, Mine, Engineering and Environment	• HEPA Vacuum cleaners • Proper Protective Equipment (PPE) • Properly labeled Refuse Bins

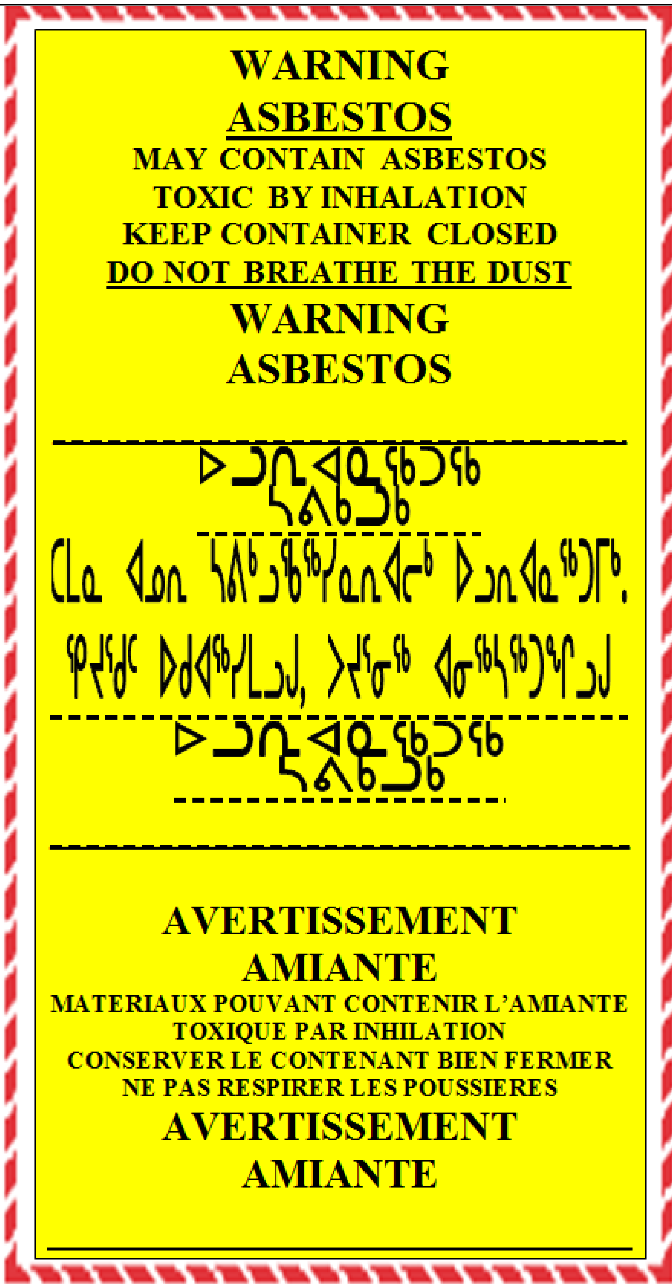
Risks /Impacts legend

Health & Safety Process/Quality Costs Environment

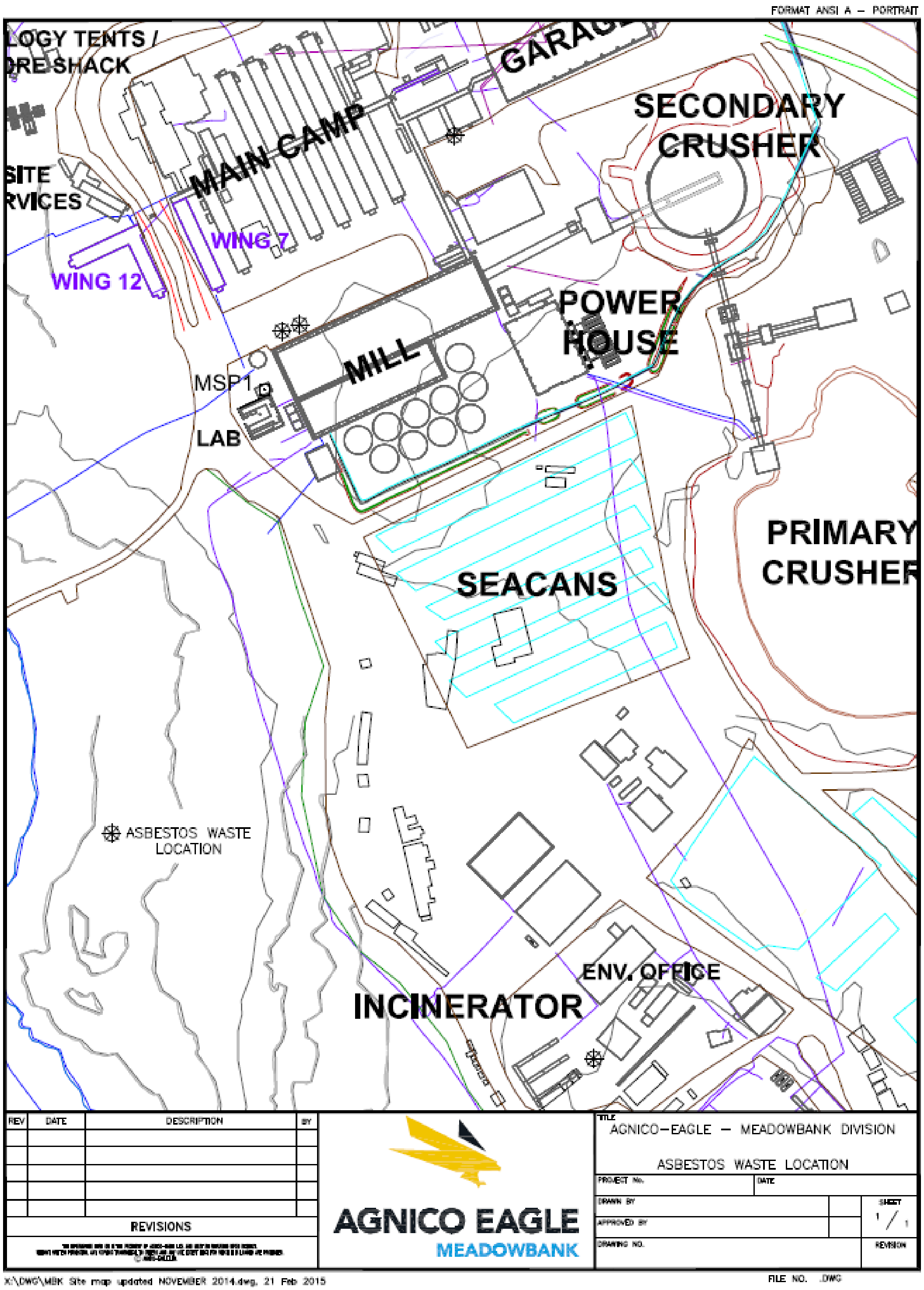
Procedure	Risks/ Impacts
Background With the recent safety and protective measures put in place on site to protect the worker's health and overall exposure to asbestos, several additional waste streams have been identified that require special care when being disposed of. Therefore some new procedures have been developed for implementation. These procedures are designed to minimize workers from exposure to asbestos and also to prevent uncontrolled discharge to the surrounding environment.	Avoid personal injury. Follow established procedures for proper disposal of asbestos containing materials.
Disposal Procedures 1) All used HEPA vacuum filters, HVAC filters, Tyvek coveralls and respirator cartridges/filters are to be place in a designated refuse bin near the HEPA vacuum cleaning stations. These materials will be treated as asbestos waste. Any Asbestos Containing Dust or materials suspected of being contaminated with asbestos that	Dispose of asbesos containing materials as per established procedures.

cannot be thoroughly cleaned and that do not have any substantial value, should be placed in the designated garbage bins as well. 2) The designated bins will be labeled with the proper workplace label for asbestos (See below). The bin will contain double layered, 6 mil polyethylene (plastic) bags. After placing any asbestos containing materials into the bags, workers are requested to tighten the inner bag by hand twisting it and folding it over. The refuse bin lid should then be closed. The bin lid does not have to be air tight as long as the bags are tightened. When the inside bag is full, trained workers (wearing PPE) shall replace the full bags with new double layered (one inside the other) bag. 3) The full bags are to be placed in a labeled sea can by the waste generator. The used filters from the Process Plant HVAC system will be put into cardboard boxes, and placed into the labeled sea can by the Site service department. 4) When the sea cans (4) are full (every 2 to 3 weeks), Field Service Supervisor/Lead Hand is to make arrangement with Mine Operations Supervisor or Auxiliary Supervisor 24 hours in advance to arrange for the cover of asbestos waste. Once a time is determined Field Services will haul the material to a location that is determined by the Mine Production Engineer. The chosen location for asbestos waste disposal must be in the Portage Rock Storage Facility. The asbestos waste should be dumped in the Pag dump <u>ONLY</u> since the N-Pag might be re-used for closure purposes. The Mine Production Engineer will arrange to have this location surveyed. Once the Asbestos Wastes is dumped, a Haul Truck with waste rocks is going to bury the Asbestos Wastes and a dozer will	

ensure it is well covered. Persons handling Asbestos Waste shall be trained in the safe handling and shipping for waste asbestos, have access to material safety data sheets and be provided with appropriate PPE. Only trained asbestos personnel should have access to the designated AW storage area.	
Asbestos Work Place Label – to be used on all containers, refuse bins, garbage cans containing possible asbestos.  	Ensure proper asbestos workplace labels are used on all containers containing or may contain asbestos.


WARNING
ASBESTOS
MAY CONTAIN ASBESTOS
TOXIC BY INHALATION
KEEP CONTAINER CLOSED
DO NOT BREATHE THE DUST
WARNING
ASBESTOS
AVERTISSEMENT
AMIANTE
MATERIAUX POUVANT CONTENIR L'AMIANTE
TOXIQUE PAR INHILATION
CONSERVER LE CONTENANT BIEN FERMER
NE PAS RESPIRER LES POUSSIERES
AVERTISSEMENT
AMIANTE

Map of the Asbestos Waste Sea-Cans (4)



MEADOWBANK GOLD PROJECT

Transportation Management Plan: All Weather Access Road

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

Version 5
March 2017

EXECUTIVE SUMMARY

Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle) is required to implement an access management plan for the All Weather Access Road (AWAR) under covenant #54 of Indigenous and Northern Affairs Canada (INAC) Crown land lease 66A/8-71-2 and condition 47 of Kivalliq Inuit Association (KIA) Right of Way (ROW) Agreement KVRW06F04 and Condition 32 of Project Certificate No.004 issued by the Nunavut impact Review Board (NIRB). This Transportation Management Plan has been prepared to provide information on the planned utilization of the access road for the Meadowbank site. This Plan has been updated to include the criteria and processes used to authorize controlled non-mine use of the road for the purpose of traditional Inuit activities of NIRB Project Certificate No.004, Condition 32.

The Meadowbank Gold Project is located approximately 70 kilometers north of the Hamlet of Baker Lake, Nunavut. The mine plan includes open pit mining from four separate open pits at the site over a 10 year mine life. The AWAR extends from the Hamlet of Baker Lake to the Meadowbank Mine site, a distance of approximately 110 kilometers.

Baseline environmental and geotechnical analysis of the proposed route was conducted prior to the submission of the Final Environmental Impact Statement. The right of way for the road was selected to minimize possible effects on the environment. The AWAR was completed in March 2008 and was constructed above grade, using quarried material from non-acid generating country rock, with a minimum number of bridge crossings (nine).

The AWAR is used to provide access to the site during construction of the mine and milling facilities, and to provide a transportation route from Baker Lake to the site for supplies (dry goods, fuel, etc.) required until the end of production and reclamation (through 2020 at the earliest). Year-round road access reduces the amount of infrastructure required at the site by significantly reducing the volumes of fuel and other consumable supplies that must be stored at the mine in order to support ongoing operations.

IMPLEMENTATION SCHEDULE

This Plan will be implemented immediately.

DISTRIBUTION LIST

Hamlet of Baker Lake

Baker Lake Hunter and Trapper's Organization

Meadowbank Health & Safety Committee

Meadowbank Community Liaison Committee

Government of Nunavut – Department of Environment

Indigenous and Northern Affairs Canada – Water Resources and Land Administration

Kivalliq Inuit Association

Nunavut Impact Review Board

Nunavut Water Board

Agnico Eagle - Health & Safety Superintendent

Agnico Eagle - Environmental Superintendent

Agnico Eagle - Energy and Infrastructure Superintendent

Agnico Eagle - Security Officer

Agnico Eagle - Mine Superintendent

Agnico Eagle - Mine General Manager

Agnico Eagle - AWAR Dispatch & Gatehouse

Post on Environment Page on Agnico Eagle Meadowbank Intranet

Arctic Fuels in Baker Lake

Peter's Expediting in Baker Lake

Dyno Nobel Meadowbank

DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
Draft	07/18/31			Comprehensive plan for AWPAR
Draft	09/04/17			Updated to reflect completion of road construction and compromise solution for limited public access
1	09/10/03	2.2 Appendix A	6	Updated to include criteria and processes to authorize non-mine use of the road pursuant to 2009 revision of NIRB Project Certificate No.004, Condition 32
2	10/05/12	2.2 2.3.2 2.3.4 Appendix A	5 7 8 9 Ap A	Modification of safety procedures in sec 2.2 to address INAC comments Removal of herding of wildlife as per GN Department of Environment; Addition of Section 2.3.4 addressing accidents on AWPAR Appendix A modified to address INAC comments
3	14/03/15	1.1 1.3 2 2.2 2.3 2.4 4	1 3 4 5 6 8 9	Surface material size Update maintenance section Remove paragraph on Emergency Shelters Add paragraph on TDG requirements Remove use of HTO pass Spill kits at each major water crossing AWPAR Procedures New Closure plan document
4	March 2017	All		Comprehensive review. Add 1 Km shooting zone.

Prepared By: *Environment Department - Meadowbank*

Approved By:

Erika Voyer

General Supervisor Environment

TABLE OF CONTENTS

MEADOWBANK GOLD PROJECT ..... **I**

EXECUTIVE SUMMARY ..... **II**

IMPLEMENTATION SCHEDULE ..... **III**

DISTRIBUTION LIST ..... **III**

DYNO NOBEL MEADOWBANKDOCUMENT CONTROL ..... **III**

SECTION 1 • ROAD OPERATION **1**

1.1 Haulage and Road Safety 1
1.2 Road Access 1
1.3 Operational Parameters 3
1.3.1 Mitigation Measures – Potential Effects From Traffic 3
1.3.2 Mitigation Protocols – Wildlife 4
1.3.3 Spill Contingency Plan 5
1.3.4 Accident Procedures 5
1.4 AWAR Procedures 6

SECTION 2 • ROAD INSPECTION AND MAINTENANCE **7**

SECTION 3 • REPORTING **8**

SECTION 4 • DECOMMISSIONING AND RECLAMATION **9**

LIST OF FIGURES

Figure 1: Meadowbank AWAR Shooting Zone
Figure 2: AWAR Road Alignment

LIST OF APPENDICES

Appendix A: AWAR Safety Briefing for Non-Mine Users
Appendix B: AWAR Procedures
Appendix C: 2016 AWAR dust study

SECTION 1 • ROAD OPERATION

The All Weather Access Road (AWAR) connects Baker Lake to the Meadowbank mine site. The AWAR is a 110 km private road built with an 8.2 m running surface. It is composed of nine (9) steel single lane bridges and thirteen (13) culverts. The route traverses lands administered by the Hamlet of Baker Lake, INAC (Crown lands) and the KIA (Inuit Owned Lands). The land tenure along the route is broken down as follows:

- 6.92 km within the municipal boundaries of Baker Lake;
- 61.34 km on Crown Land; and
- 43.08 km on Inuit Owned Lands (25.38 km within IOL BL-14 and 19.24 km within IOL BL-18).

Kilometer markers at each kilometer flexible delineators (flags) at 100 m intervals are located on one side of the road.

The road is designed for use by conventional tractor trailers which transport supplies from the Baker Lake Marshalling Facility and Bulk Fuel Storage area to the site. The road is used year round however the road can be closed on a short term basis for different reason (bad weather, wildlife, heavy traffic, dangerous good transportation, etc.).

The key haulage equipment operating on the road is supported by radio controls. Radio communications are relayed through the Dispatch located at the Baker Lake Gatehouse.

Approximately 60,000 to 70,000 tonnes of dry freight and diesel fuel are transported to the site each year. At approximately 40 tonnes per load, this translates into the delivery of 11,750 loads (or 3,500 passes including return trip) of supplies each year, depending on operations.

The road is maintained by Agnico Eagle to ensure timely delivery of freight for mine operations. Policing of the road is conducted by Agnico Eagle's security, road maintenance and haulage staff.

1.1 HAULAGE AND ROAD SAFETY

All of the required fuel and supplies for the operation of the mine is transported to the site via the AWAR. During the life of the mine, the transportation of freight and road maintenance operations is conducted by an owner operated fleet. All drivers is either employees of the company or a company hired contractor (such as Arctic Fuels) and must possess a valid driver's license from a Canadian province or territory, for the appropriate class of vehicle, in order for them to be allowed to operate vehicles on the access road.

When transporting Dangerous Goods on the AWAR each driver must possess Transportation of Dangerous Goods (TDG) certification from an accredited trainer. Proof of certification must accompany each driver at all times.

1.2 ROAD ACCESS

As mandated by Condition 32 of the NIRB Project Certificate, the AWAR is maintained and operated as a private access road for the Meadowbank Project with controlled access for non-mine use by ATV for the purpose of carrying out traditional activities. The following measures have been implemented to manage access and use of the road:

- A manned gatehouse with lockable gate is in operation at KM 5 (on Commissioner's land administered by the Hamlet of Baker Lake). The gatehouse is manned by an Agnico Eagle employee whenever the road is in operation. This employee acts as the Dispatch for all traffic on the road and all vehicles are required to stop and report in at the gate prior to entering or exiting the road;
- English and Inuktitut signs are posted at the gatehouse, at each bridge crossing, and every 10 kilometers along the road, stating that unauthorized public use of the road is prohibited;
- Signs in English and Inuktitut are posted along the road route to indicate when entering and leaving Crown Land;
- Notices are placed on radio and television regularly to inform the residents of the Hamlet of Baker Lake that the road is private with non-mine use limited to authorized use by ATV for pursuit of traditional Inuit activities; and
- All mine personnel using the road are required to monitor and report unauthorized non-mine use of the road. Dispatch will record all authorized and unauthorized use (when aware of such use) of the AWAR by non-mine vehicles using the data form attached in Appendix A to this Plan.

To ensure safe and controlled use of the AWAR by ATVs for the purpose of traditional Inuit activities, Agnico Eagle has implemented the following measures:

1. The road remains closed to cars and trucks owned by the public. Access is restricted to All Terrain Vehicles (ATVs) only;
2. All ATVs accessing the road are required to report to the gatehouse. The resident will present themselves at the Agnico Eagle gatehouse and will then be given access to the road. Prior to granting access, the Agnico Eagle Dispatch will:
    - Provide a safety briefing on the road, specifically on the prevailing traffic and road conditions of the day and time, the safety rules and procedures and the extent of the no-shooting zone (Appendix A);
    - Record who is traveling on the road, where they are heading and when they expect to return so that other traffic can be warned by radio of their presence;
    - Have the driver acknowledge that they are traveling on a mining road and have been informed of the risks.
3. Agnico Eagle collaborated with the HTO and the Hamlet of Baker Lake to develop the safety rules and procedures for all ATV's using the road including pulling off the road whenever a truck approaches. These safety rules are published in Inuktitut and English and then provided to all ATVs at the gatehouse. Agnico Eagle, the HTO and the Hamlet will jointly educate the residents of Baker Lake on these safety procedures through community radio and through community training sessions;

4. As mandated by Condition 32 e) of the NIRB Project Certificate, Agnico Eagle will hold an annual public meeting in the Hamlet of Baker Lake to review the safety rules of the AWAR and discuss any items of importance in regards to the AWAR;
5. Use of this safety equipment is mandatory while on the AWAR. Agnico will not police safety once the ATV's are off the AWAR;
6. For security purposes, access is forbidden past km 85 for all ATVs. Agnico Eagle has established a second barrier at the mine site end of the road to prevent ATVs from traveling into the active mine zone where special safety equipment and training is required under the Nunavut Mining Act. This consists of a crossing gate constructed at the mine site airstrip terminal building. This structure has been sited so that it can be used both to service the airstrip and to control access onto the mine site;
7. All hunting activity must respect the one kilometer no shooting zone on both sides of the AWAR and avoid cross shooting. Shooting around work area is strictly forbidden to ensure that project workers and all other road users are not inadvertently exposed to the risk of accidental shooting (Figure 1); and
8. Agnico Eagle reserves the right to refuse future access to individuals who do not respect the rules on safety, speed and the no shooting zone when using the road.

1.3 OPERATIONAL PARAMETERS

In general, the operational parameters for the road are summarized below:

- Wildlife has the right of way;
- All vehicles (except ATVs) are to be insured and licensed;
- At each major water crossing Agnico Eagle has placed first response spill kits;
- Hunting and fishing restrictions will be as per HTO's stipulations. All Agnico Eagle employees are not allowed to hunt or fish while they are on their work rotation, unless required by the scope of their work. Outside of the work rotation employees are subject to control measures as set by the Baker Lake HTO;
- All spills of any materials will be reported and cleaned up, as set out in the spill contingency plans. The haulage fleet will be required to have appropriate spill containment and clean-up equipment on hand or available on demand;
- Signs will be posted at key points near and around the site again to advise the public traveling by skidoo or ATVs that they are in a restricted and potentially hazardous area.

1.3.1 Mitigation Measures – Potential Effects From Traffic

Mitigative measures taken to limit potential effects from traffic during mine construction and mine operations are:

- Provide all road operators information regarding the potential for wildlife/vehicle collisions;

- Restrict vehicles to designated roads and approved construction areas (i.e. no off road travel allowed);
- Ban any Agnico Eagle use of off-road vehicles outside exploration to avoid damage to local vegetation (tundra);
- Monitoring and reporting of significant numbers of wildlife observed in the vicinity of roads and immediately reporting to appropriate environmental mine staff who will issue notices to vehicle operators accordingly;
- Posting appropriate speed limits (e.g., 50 km/h)
- Giving wildlife the right of way and reducing traffic speeds when animals are detected near roads or other approved work areas;
- Reporting and disposing of accidental wildlife mortalities near the mine site.
- Dust suppression work will be completed during sensitive summer months in key identified areas on the AWAR. For complete details, refer to the 2016 AWAR dust study report, (Appendix C)

1.3.2 Mitigation Protocols – Wildlife

Wildlife is expected occasionally to be observed on the site roads, the airstrip, or the access road. Caribou and other wildlife will have the right-of-way at all times. All project personnel will be notified by dispatch radio if any wildlife is observed in the site vicinity.

The GN Department of Environment has indicated to Agnico Eagle that herding as a technique to move wildlife from their normal pathways, migration routes, and habitat is not acceptable and may be a violation of sections 73 and 74 of the Nunavut Wildlife Act. Consequently wildlife is not to be herded from the AWAR under any circumstance. When caribou are present on the road they are to be given the right of way. Vehicles should pull over and stop until the animals clear the roadway. Alternatively the vehicle can turn around and try to pass at a later time once the road is clear. This type of action (shutting down or turning around) should be immediately reported by radio to the Dispatch.

Herding is not to be used as a technique to move wildlife without the permission of the Meadowbank Environmental Superintendent or the Environment General Supervisor. The Environmental Superintendent or the Environment General Supervisor will not grant such permission unless he believes that there is an imminent risk to the safety of mine personnel or the wildlife and that he has a valid permit for such activity from the GN Department of Environment. This permission will not be given under normal circumstances. It will only be given in very unique situations where there is an imminent danger that cannot be mitigated by other means.

Wildlife movement will be monitored throughout the mine life and improvements in mitigation plans made as appropriate (adaptively managed).

Wildlife mitigation for potential effects of road and airstrip construction includes:

- Protecting locally sensitive areas;

- Temporarily suspending circulation on the road when the safety of caribou, grizzly bears, or other wildlife is threatened.

1.3.3 Spill Contingency Plan

A trained site-based emergency response and spill clean-up team is available on site with appropriate equipment to respond to all spills. Spill response is implemented by environmental staff who advise, document, and report on initial response and clean-up actions.

1.3.4 Accident Procedures

The following action is to be taken in the event of an accident on the AWAR involving other vehicles (including ATV's) or in the event of an accident involving contact with wildlife such as caribou, musk ox, bear, wolf, etc.;

- ✓ Check condition of people involved in the accident and provide immediate first aid if appropriate;
- ✓ Call Dispatch and report the location and nature of the accident and indicate the type of assistance required (medical help, environmental clean-up, fire and/or mechanical help);
- ✓ Secure the accident site so that the vehicles do not continue to present a hazard to others. This may involve moving the vehicles to the nearest pull off in the event of a minor accident; or blocking off the road back from the site in both directions in the event of a more serious accident.
- ✓ If safe to do so secure the site to prevent continued spill or leakage of contaminants into the surrounding environment.

Upon receiving the accident call, Dispatch will initiate the mine's emergency response procedure passing along the information to the emergency response coordinator. The emergency response coordinator will then call out the required emergency response personnel to assist at the accident site.

Once the accident site is secured and all people requiring assistance have been removed to medical care, the emergency coordinator will turn the scene over to the mine's safety personnel so that an appropriate accident investigation can be initiated.

In the event of an incident involving contact with wildlife the Dispatcher will notify the site security personnel and the Environmental Superintendent (or designate). Security and the site environmental team will then initiate an appropriate accident investigation. The Environmental Department will ensure that appropriate reporting of such incidents is made on a timely basis to the Kivalliq Inuit Association, the Baker Lake HTO and the GN Department of Environment. The reader should refer to the Meadowbank Terrestrial Ecosystem Management Plan for further detail on how accidents involving wildlife are to be investigated.

The AWAR is a private road and is thus not policed by the Baker Lake RCMP. Emergency response is the responsibility of Agnico Eagle. However, in the event of a serious accident, the RCMP will be contacted and advised of the incident. The RCMP will then decide on whether they will become involved or take the lead on any subsequent accident investigation.

1.4 AWAR PROCEDURES

Meadowbank has developed site associated procedures for the AWAR. These procedures can be found in Appendix B of this document, as well as on Intelex at the mine site.

SECTION 2 • ROAD INSPECTION AND MAINTENANCE

Agnico Eagle has sole responsibility for the ongoing inspection and maintenance of all of the components of the AWAR, including road beds, bridges, culverts, and borrow/quarry sites used in the construction and maintenance of the roads. Agnico Eagle has a designated road crew that looks after maintenance of the AWAR all year long. During the summer period (June to August), the road surface is maintained with fresh gravel being spread as required and regular grading of the road. Reject NPAG material from mining activities or from approved quarry along the AWAR is used to repair the surface of the AWAR. By September, the road starts to freeze; therefore, gravel is added for safety reasons. Snow clearing and road sanding along the road is done to operate vehicles on roads safely. The manner in which the snow is cleared also takes into account the road configuration to avoid snow accumulation that could cause problems during the freshet or block skidoo trails.

Any work/repair to stream crossing areas is completed, if needed, only upon receiving authorization of Department of Fisheries and Oceans Canada for work that may have impact on fish habitat. Any minor work from which the self-assessment do not predicted impact to fish habitat can be authorized and should respect the in water work timing windows from DFO _(spring spawners is May 1 – July 15 and fall spawners is August 15- June 30).

During the operational phase, weekly routine inspections of the AWAR are conducted by the Environment team as well as the E&I field services leader. These inspections include spill equipment availability, presence of wildlife, turbidity plumes at watercourse crossings, and areas of ponding, erosion, or sedimentation. An annual geotechnical inspection of the culverts, quarries and bridge crossings is conducted by an external qualified engineer.

SECTION 3 • REPORTING

As per NIRB Condition 32g), dispatch will record all authorized and unauthorized use (when aware of such use) of the AWAR by non-mine vehicles using the data form attached in Appendix A to this Plan. The data will be submitted to DFO, GN, NIRB, Environment and Climate Change Canada, and the Nunavut Water Board annually via the Meadowbank Annual Report.

SECTION 4 • DECOMMISSIONING AND RECLAMATION

Decommissioning of the all-weather access road will be accomplished by loosening compacted surfaces, flattening side slopes, and removing all culverts and other potential obstructions to drainages paths. Details are provided in Section 3.3.3 of the *Interim Closure and Reclamation Plan January 2014 - Report Number: 13-1151-0131* prepared by Golder and Associates.

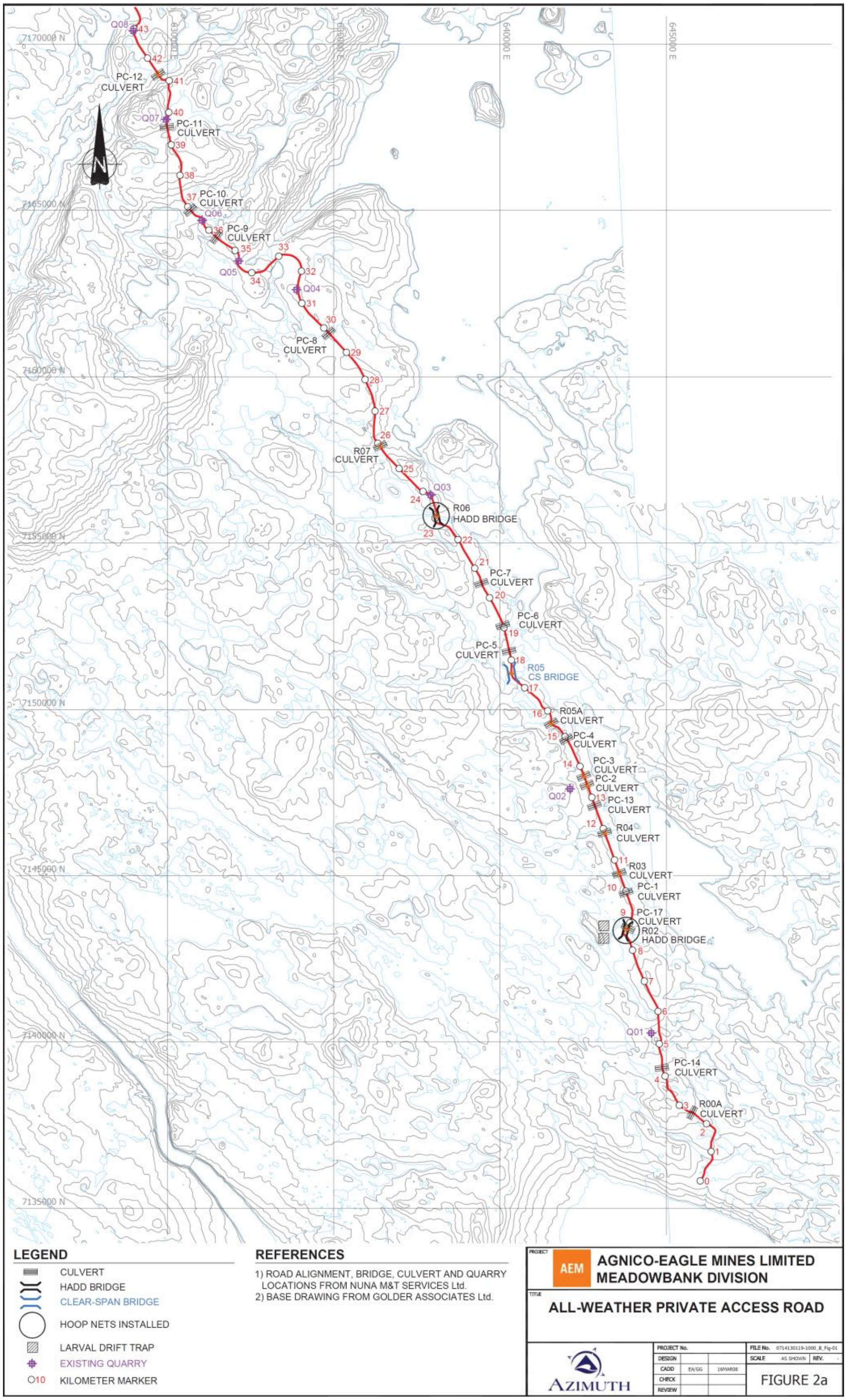
Figure 1

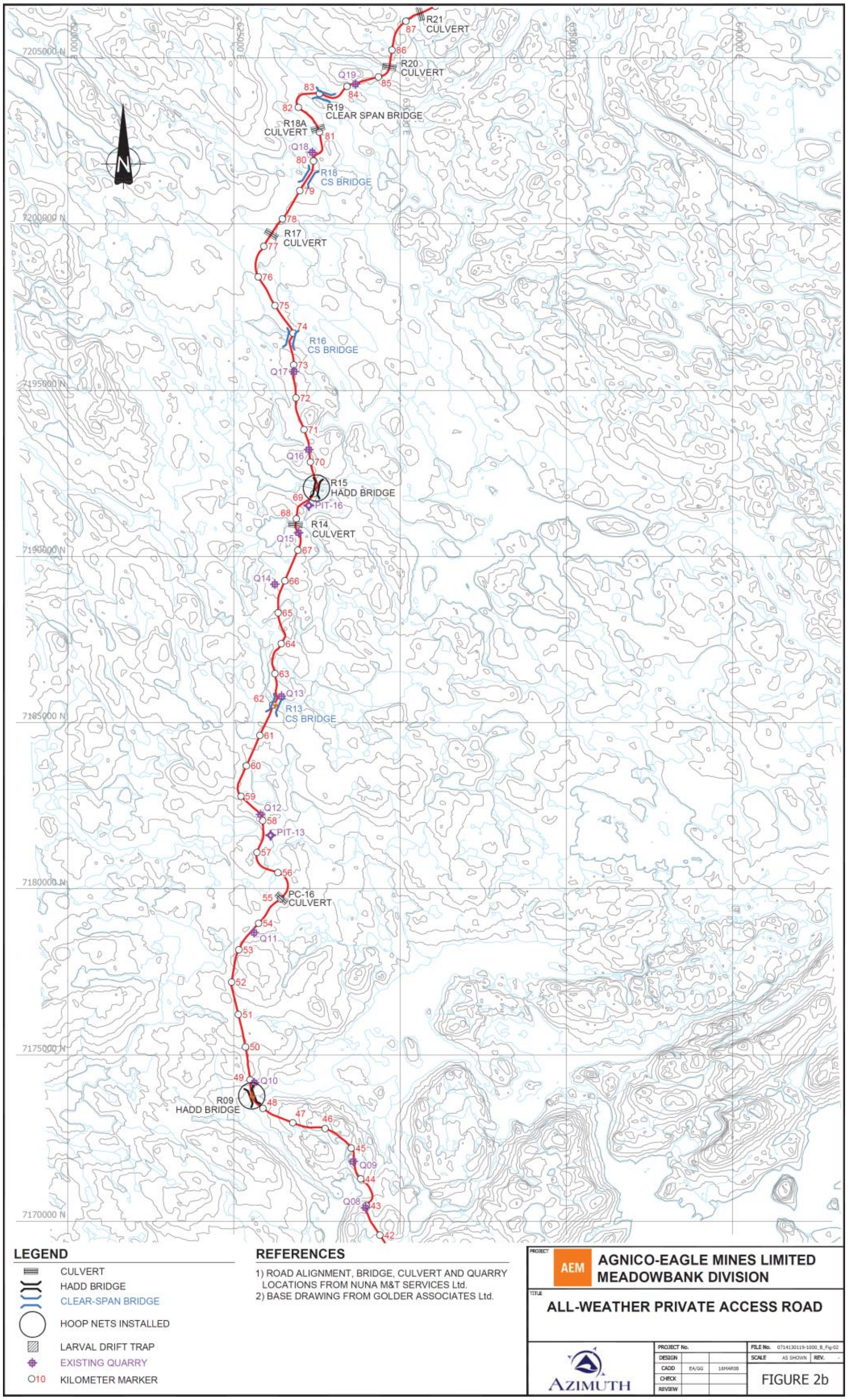
Meadowbank AWAR Shooting Zone


ACCES
FORBIDDEN
PAST KM 85

Figure 2

AWAR Road Alignment


PC-12 CULVERT
PC-11 CULVERT
PC-10 CULVERT
PC-9 CULVERT
PC-8 CULVERT
R07 CULVERT
R06 HADD BRIDGE
PC-7 CULVERT
PC-6 CULVERT
PC-5 CULVERT
R05 CS BRIDGE
R05A CULVERT
PC-4 CULVERT
PC-3 CULVERT
PC-2 CULVERT
PC-13 CULVERT
R04 CULVERT
R03 CULVERT
PC-1 CULVERT
PC-17 CULVERT
R02 HADD BRIDGE
PC-14 CULVERT
R00A CULVERT
Q01
Q02
Q03
Q04
Q05
Q06
Q07
Q08
7170000 N
7165000 N
7160000 N
7155000 N
7150000 N
7145000 N
7140000 N
7135000 N
640000 E
645000 E
N
LEGEND
CULVERT
HADD BRIDGE
CLEAR-SPAN BRIDGE
HOOP NETS INSTALLED
LARVAL DRIFT TRAP
EXISTING QUARRY
O10 KILOMETER MARKER
REFERENCES
1) ROAD ALIGNMENT, BRIDGE, CULVERT AND QUARRY LOCATIONS FROM NUNA M&T SERVICES Ltd.
2) BASE DRAWING FROM GOLDER ASSOCIATES Ltd.
AEM
AGNICO-EAGLE MINES LIMITED
MEADOWBANK DIVISION
ALL-WEATHER PRIVATE ACCESS ROAD
AZIMUTH
FIGURE 2a


R21 CULVERT
R20 CULVERT
R19 CLEAR SPAN BRIDGE
R18A CULVERT
R18 CS BRIDGE
R17 CULVERT
R16 CS BRIDGE
R15 HADD BRIDGE
PIT-16
R14 CULVERT
R13 CS BRIDGE
PIT-13
PC-16 CULVERT
R09 HADD BRIDGE
7205000 N
7200000 N
7195000 N
7190000 N
7185000 N
7180000 N
7175000 N
7170000 N
LEGEND
CULVERT
HADD BRIDGE
CLEAR-SPAN BRIDGE
HOOP NETS INSTALLED
LARVAL DRIFT TRAP
EXISTING QUARRY
KILOMETER MARKER
REFERENCES
1) ROAD ALIGNMENT, BRIDGE, CULVERT AND QUARRY LOCATIONS FROM NUNA M&T SERVICES Ltd.
2) BASE DRAWING FROM GOLDER ASSOCIATES Ltd.
AEM
AGNICO-EAGLE MINES LIMITED
MEADOWBANK DIVISION
ALL-WEATHER PRIVATE ACCESS ROAD
AZIMUTH
FIGURE 2b

Appendix A

AWAR Safety Rules and Procedures

AWAR non-mine vehicles use data form

ALL WEATHER ACCESS ROAD

SAFETY RULES

-This is not a public road. Access to the road is not allowed without valid ID and authorization from AEM dispatch at the Baker Lake gatehouse.

-If the gatehouse is closed, the road is closed and access is not allowed. This is unlikely due to unsafe weather, road conditions or safety reasons.

-Use of the meadowbank road is at your own risk. AEM is not responsible for personal injury or damage to your property.

-AEM reserves the right to deny entry to anyone who does not respect safety rules and procedures. AEM also reserves the right to restrict public access during heavy mine traffic. Example: During barge season.

PROCEDURE FOR ROAD ACCESS

1. Report to Baker Lake Gatehouse to access the road. Show your valid ID or NTI card number to AEM dispatch and fill out the road access form provided. AEM dispatch will provide traffic conditions before you leave.

2. A safety vest must be worn at all times by the driver and passenger and keep your headlights on. If you do not have a vest the dispatcher will lend you one but it will have to be returned on the same day.

3. AEM traffic has the right of way. ATV's must pull up on the side for oncoming traffic and heavy equipment. Wait until the traffic passes before you continue.

4. Maximum speed limit is 50 km an hour.

5. All hunting must occur at least 1 km away from the road. This is implemented for safety reasons.

6. No access is permitted past km 85 for all field workers safety.

____________________	____________________	____________________
PRINT NAME	DATE	SIGNATURE

AWAR Record of Non-Mine Use

DATE	FIRST NAME LAST NAME	EXPECTED RETURN DATE	EXPECTED TIME OF RETURN	HTO PERMIT #	ATV LICENSE PLATE	SECURITY VEST #	BUGGY WHIP #	RESP. WAVER	EXPL. SHOOTING ZONE/ ROAD ACCESS	PHONE #	RETURN DATE	RETURN TIME	RETURNED SECURITY VEST	RETURNED BUGGY WHIP	SECURITY GUARD PRINT NAME
06/13/09	HUNTER FISHER	6/14/2009	1:30 PM	123	ABC	10	20	√	√	793-1234	6/14/2009	1:40 PM	√	√	WILLIAM SCOTTIE

Appendix B

MBK-SIT-0071

MBK- ENV-PRO-Transportation of Dangerous Goods

All weather Access road AWAR

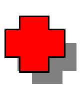
		PROCEDURE NUMBER:	**MBK-SIT-0071**
People concerned	**Agnico-Eagle employees and contractors' employees working on the Meadowbank site** **Visitors on site**	**Prepared by**	Site Services
		Authorized by	Christian Soucy, Energy & Infrastructure Superintendant.
Effective :	2016-11-06	***"Safety First, Safety Last … Safety Always!"*** ***"No Repeats" – Our Stepping Stone to ZERO HARM***	
This procedure corresponds to the required minimum standard. Each and every one also has to comply with the rules and regulations of the Nunavut Government in terms of health and safety at work.			

Objective:

- To obtain access, communication and drive safely on the All Weather Access Road (AWAR)

Concerned departments:	**Required equipment**
 E&I Dept.	

Risks /Impacts legend



Health & Safety

Process/Quality

Costs

Environment

Procedure	Risks/ Impacts
1. Agnico-Eagle Mines Limited, Meadowbank Division (AEM-Meadowbank) is the owner of the AWAR between Baker Lake and the Meadowbank mine site. Depending on climate and road conditions, AEM-Meadowbank will decide whether the AWAR must be opened or closed. The road supervisor is responsible for informing concerned parties about the status of the AWAR. However, it is the responsibility of every AWAR user to adjust his driving with the following: • Weather and road conditions • Capacity and performance of vehicle used • His competence and experience in driving • All road deterioration that may occur due to the weather change has to be notified directly or via dispatch by radio immediately to the AEM supervisor responsible or his replacement.	Prevent incident and /or accident
2. Mandatory radio communications : • Upon reaching one of the two gatehouses, the driver must provide the following information to the dispatch: • Vehicle unit number. • Destination. • His name. • Amount of passengers. • When seeing a blind hill sign and before going by it, the driver must communicate the following information on the road channel: • Type of vehicle. • Location (blind hill kilometer). • Direction (northbound or southbound).	Prevent incident and / or accident.

• This information also has to be communicated upon reaching switchback (clearly indicated by sign). • If a special situation that could affect traffic is encountered, the operator must communicate the following information on the road channel: • Nature of the situation. • Location. • Precautions to be taken. • These special situations include but are not limited to large wildlife activities, problematic road conditions and incidents. **3. Use radios as follows** • While in Baker Lake, use RD Baker Channel. (AEM handheld radio channel 14), and when traveling towards Meadowbank. • When you reach the signs to switch channels, switch to RD KL037 (AEM handheld radio channel 15). • When you reach road sign KM 77, change to RD MBANK (AEM handheld radio channel 16) and remain on this channel until you reach Meadowbank camp. • RADIO CALLING / MESSAGE MUST BE KEPT TO A MINIMUM in order to maximize access to radio system for safety and emergency use. **In any circumstance, when an AWPR user finds himself in dangerous driving conditions, he will:** • Immediately stop vehicle on the side of the road • Call the dispatch, report on the situation and exact location	

• Make a request if equipment or material is required • If possible, find a safe parking space • Wait for help • Ensure follow up on the situation with the Dispatch if possible	

4. Information on the road conditions
 	
• In the event of bad temperature/inclement weather, AEM-Meadowbank road supervisors will monitor road conditions with the Baker Lake Security guard (Dispatch).
• When the ROAD IS CLOSED, before 6 AM, the AEM supervisor will publish road conditions through Intranet and email.
• Important phone numbers (and/or road channel): ROAD CHANNELS ARE: #14, #15, #16
    • AEM Baker Lake Office (867)793-4610, ext. 6624
    • Road Supervisor (867)793-4610 ext. 6902
      Cell (867)793-1303
    • Mine Supervisor (night shift) call Mine dispatch.
    • Mine Dispatch (867)793-4610 ext. 6949
    • Security Office (867)793-4610 ext. 6748
	Prevent incident and /or accident

5. All vehicles using the road require the following items: AEM approved VHF base Radio, a full tank of fuel, a good spare tire, jack and wrenches as well as a First Aid Kit.	Ensure proper safety equipment when travelling on AWPR.
6. Take note that in the "Dress code for Meadowbank division HR-002" is applicable on AWPR. June to September: • Warm jacket/ wind cutter • Warm closed toe shoes	Ensure that you are dressed for the weather and season.

• Pants October to May: • Parka • Winter pants (suggested) • Mittens/ gloves • Tuque • Winter boots (-40 approved) • Warm underwear (suggested)	
7. The AEM-Meadowbank road supervisor will be responsible to determine when vehicles must travel in convoys.	
8. A pilot vehicle is required for all oversize loads; it must travel 500 meters ahead of the oversize loads and could be another tractor/ trailer unit providing it is not oversized.	
9. For loads exceeding 8.5 feet wide, the driver and the Security Guard will fill in the "*All Weather Road Non-standard heavy loads transportation report"* before accessing the road and the report will be kept at the Gatehouse.	
10. Overtaking another vehicle or road maintenance equipment working on the road requires the following: • Radio communications or clear visual contact must be established with the operator of the vehicle/ equipment you intend to overtake including dozers or loaders clearing the snow banks. • You must wait for the operator's clear signal before overtaking. • Unless these 2 conditions have been met, overtaking is not permit.	
11. Right of way priorities on the AWPR are in the following order: • Wildlife • Emergency vehicles with flashing lights and sirens • Crew buses • Explosive vehicles • Fuel trucks • Freighter trucks • Pick-up trucks	Know the right away of vehicles.

• Snowmobiles/ All-Terrain Vehicles (ATV)	
12. All vehicles shall yield based on the above priority list. The yielding vehicle shall stop on the side of the road leaving enough space to let the priority vehicle pass. The priority vehicle shall reduce speed to a maximum of 20 km/ hour to pass.	
13. Maximum speed on the AWAR is 50 km/ hour.	Follow the speed limit – reduce speed in inclement weather.
14. No vehicle shall leave the road to pass or overtake another vehicle.	
15. The following emergency radio communication applies to all vehicles using the AWPR	

EMERGENCY RADIO COMMUNICATIONS	
• CODE 1 • EMERGENCIES INJURIES	• Call for Emergency on your radio frequency. Repeat the following: Code 1, Code 1, Code 1, your name, your exact location and state the nature of the emergency. All activity on the road should come to halt, except for the responders.
	• Inform Dispatch what the problem is. Security Guard will assess the situation and contact the Mine Dispatch ext. 6949. The closest responder will go to the emergency location to help you.
	• If the surface rescue team is required, they will be dispatched from the Meadowbank site.

16. Compliance • Failure to comply with this procedure will result in disciplinary action.	

Meadowbank Transportation of Dangerous Goods

PROCEDURE NUMBER: MBK- ENV-PRO- Transportation of Dangerous Goods	

People concerned	• **Agnico-Eagle employees, contractors, visitors on the Meadowbank site**	**Prepared by**	**Environmental Department**
		Authorized by	**Erika Voyer** **Environmental General Supervisor**
Issuing date :	**March 31, 2017**		
This procedure corresponds to the required minimum standard. Each and everyone also have to comply with the rules and regulations of the Nunavut Government in terms of health and safety at work.			

Objective:

- To ensure the health and safety of workers and contractors working for the Meadowbank Gold Project and to ensure the sustainability of the environment that surrounds the Meadowbank Project and its transportation route
- To comply with the International Cyanide Management Code and Transportation of Dangerous Goods

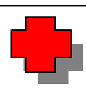
Concerned departments:

All departments

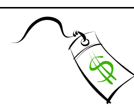
Required equipment:

- Vehicle log
- Working Radio with AWAR and Baker Lake Channels
- Proper placards

Risks /Impacts legend



Health & Safety



Operation Quality/Costs

Environment

Procedure	*Risks/ Impacts*

1. Visual inspections of the road and bridges between Baker Lake Marshalling Area to the Meadowbank Mine Site are to be undertaken by the Road Supervisor and recorded 2-3 days prior to the beginning of Dangerous goods being transported between Baker Lake Marshalling area to the Meadowbank Site, and every day during the transportation of Cyanide. Any hazards identified must be reviewed, reassessed and mitigated immediately, or transportation of Dangerous Goods will cease.	In proper road or bridge conditions can result in major incidents or spills.
2. Drivers travelling between Baker Lake Marshalling area to the Meadowbank Site are to advise Baker Lake Dispatch of any changes to the road or any hazardous conditions. Baker Lake Dispatch will immediately contact the Road Supervisor about the situation.	In proper road or bridge conditions can result in major incidents or spills.
3. Only equipment fit for transport shall be used to haul Dangerous Goods from the Baker Lake Marshalling area to the Meadowbank Site. Maintenance records shall be kept for equipment servicing.	In proper road or bridge conditions can result in major incidents or spills.
4. Vehicle inspection log must be completed prior to each shift.	Improper maintenance can cause equipment to break down and transport cannot be possible and or can result in major incidents or spills.
5. All drivers transporting Dangerous Goods between Baker Lake Marshalling area to the Meadowbank Site must hold a valid driver's license from a Canadian province or territory. In addition, they must also hold a valid Transportation of Dangerous Goods (TDG) certification. A copy of both shall be held by the transporter at all times during transportation.	Not having the proper training can result in major incidents
6. All drivers must keep a log book / transport document. This will include: a. Driver Name	

b. Product being hauled c. UN Number d. Dangerous Good Class e. Quantity f. Drivers shift start time g. MSDS present h. Etc. *****This log must be completed prior to each transport.**	Knowing what you are hauling and being prepared to react if there is a problem is improtant.
7. All transporters must have minimum of 8 hours of rest in between each 12 hour work shift.	Not having adequate rest makes for unfit work conditions
8. All drivers are required to take the most direct route the from Baker Lake Marshalling area to the Meadowbank Site. **Under no circumstances is any Dangerous Goods to be transported into the Hamlet of Baker Lake.**	By taking the most direct route this avoids inhabitted areas, therefore avoid affecting the public in the event of an incident
9. All personnel are to ensure the proper placards, UN Number, and shipping labels are in place prior to any shipping of Dangerous Goods. As well the transporter must have an up to date MSDS for the product they are hauling.	Knowing what you are hauling and being prepared to react if there is a problem is important.
10. All speed limits must be obeyed between Baker Lake Marshalling area and the Meadowbank Site.	Not following can result in major incidents.
11. Radio contact with Baker Lake Dispatch must be kept during transport of all Dangerous Goods between Baker Lake Marshalling area and the Meadowbank Site.	The dispatch keeps a special

	eye on the time you are travelling to ensure there are no problems during your travel.
12. In the event of an emergency please follow the up to date Meadowbank: Emergency Response Plan. In the event of a spill please follow the up to date Meadowbank: Spill Contingency Plan.	 These documents will help you in theinstance of a major incident or spill.
13. In addition to the above mentioned the following Meadowbank procedures should be reviewed prior to initial transport should also be reviewed: o MBK-SIT-0071 – All weather private road AWAR	 Ensure you know all the procedures.

Appendix C
2016 AWAR Dust Study

AGNICO EAGLE

MEADOWBANK GOLD PROJECT

2016 All-Weather Access Road Dust Monitoring Report

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

March, 2017

EXECUTIVE SUMMARY

In response to community concerns of dust generation, Agnico Eagle has conducted studies of dustfall along the Meadowbank AWAR since 2012. These studies characterize dust deposition rates to help determine the potential for impacts to wildlife in excess of those predicted in the Final Environmental Impact Statement (FEIS).

In 2016, Agnico Eagle initiated a dust suppression pilot study along the AWAR, in addition to the regular dustfall monitoring program. This study aimed to compare the effectiveness of three dust suppression techniques (Dust Stop™, TETRA Flake, speed limit reductions) in several test locations.

Cumulative results to date indicate that without dust suppressant application, average rates of dustfall decline below Alberta Environment's guideline for recreational areas within 100 m of the AWAR, and meet the range of background rates within 200 m. Based on these results, it is unlikely that impacts to VECs (vegetation community productivity and wildlife) due to dust are occurring beyond FEIS assumptions. As described in past reports (2015 AWAR Dustfall Monitoring Report), these conclusions are supported by wildlife monitoring conducted under the Terrestrial Ecosystem Management Plan, including the 2015 Breeding Bird Study and the most recent (2014) Wildlife Screening Level Risk Assessment.

Nevertheless, Agnico Eagle plans to apply a dust suppressant in a number of locations along the AWAR in 2017, based on results of the 2016 dust suppression pilot study. Results of the visual assessment and dust sampling program indicated that TETRA Flake is the optimal product for use in this program. Agnico Eagle plans to apply TETRA Flake to the three areas of concern along the AWAR identified by the HTO, as well as to the locations treated annually in the hamlet of Baker Lake and near the Meadowbank site. One application of TETRA Flake is planned for the summer 2017. Agnico Eagle also identified two additional potential areas of concern between km 50 – 89 (the northern limit for public use), where dust suppressant will be applied. The planned locations and rationale are as follows:

Table 1. Planned locations for dust suppressant application in 2017.

AWAR Location	Rationale
Agnico Eagle spud barge area	High traffic area near hamlet
Agnico Eagle tank farm to Arctic Fuel site	High traffic area near hamlet
km 0 - 5	High traffic area near hamlet
km 10 - 12	Area of concern to HTO – proximity to lake
km 24 - 26	Area of concern to HTO – proximity to lake
km 48 - 50	Area of concern to HTO – water crossing
km 68 - 70	Location identified by Agnico Eagle – water crossing
km 80 - 84	Location identified by Agnico Eagle – proximity to water & crossing
Emulsion plant turn off to Meadowbank site (km 103 – 110)	High traffic area

TABLE OF CONTENTS

EXECUTIVE SUMMARY II

SECTION 1 • INTRODUCTION 25

1.1 Background 25
1.2 Dust Suppression to Date 25
1.3 Past Study Design 25
1.4 2016 Study Objectives 26

SECTION 2 • METHODS 27

2.1 Dust Suppression Pilot Study 27
2.1.1 Community Consultations 27
2.1.2 Dust Suppressant Selection 29
2.1.3 Trial Locations 29
2.1.4 Visual Observations 29
2.1.5 Dustfall Sampling 30
2.1.5.1 Locations 30
2.1.5.2 Methods 30
2.2 Regular Monitoring Program 30
2.3 QA/QC 31
2.3.1 Sample Handling 31
2.3.2 Field Duplicates 31
2.3.3 Travel Blanks 32
2.4 Data Analysis 32
2.4.1 Regular Monitoring Program 32
2.4.2 Dust Suppression Pilot Study 32

SECTION 3 • 2016 RESULTS 33

3.1 Visual Assessment 33
3.2 Dustfall Sample Results 35
3.3 QA/QC 37
3.3.1 Field Duplicates 37
3.3.2 Travel Blanks 37

SECTION 4 • DISCUSSION 38

4.1 Dust Suppression Pilot Study 38
4.2 Regular Sampling Program 40
4.2.1 Comparison to Regulatory Guidelines and Background Values 41
4.2.2 Trends Over Time 42
4.2.3 Effect of Distance from the Road 42

SECTION 5 • CONCLUSIONS 43

5.1 Regular Monitoring Program 43
5.2 Dust Suppression Pilot Study 43

SECTION 6 • 2017 DUST SUPPRESSANT APPLICATION 44

6.1 Locations and Timing 44
6.2 2017 AWAR Dustfall Monitoring Program 46
6.2.1 Dust Suppression Monitoring 46
6.2.2 Regular Dustfall Monitoring 46

SECTION 7 • REFERENCES 47

LIST OF TABLES

Table 1. Planned locations for dust suppressant application in 2017. ii
Table 2. Dust suppressant locations and application dates. 29
Table 3. 30-d fixed dustfall rates ($mg/cm^2/30d$) for samples collected in 2016 along the Meadowbank AWAR in areas undergoing dust suppression trials. Values in parentheses are duplicates. NA = not available (lost sample jar, or location inaccessible). 36
Table 4. 30-d total and fixed dustfall rates for samples collected from two transects (1 & 2) in two locations without dust suppression (km 18 and 78) in 2016 along the Meadowbank AWAR. Values in parentheses are duplicates. NA = not available (lost sample jar, or location inaccessible). 37
Table 5. Planned locations for dust suppressant application in 2017. 44

LIST OF FIGURES

Figure 1. Areas of concern for dustfall along the Meadowbank AWAR identified by the HTO in 2016. 28
Figure 2. Dust generation in the TETRA Flake test area (km 10 – 12) before (top) and after (bottom) application. 33
Figure 3. Dust generation in the Dust Stop™ test area (km 48 – 50) before (top) and after (bottom) application. 34
Figure 4. Dust generation in the speed limit test area (km 24-26) at 50 km/h (top) and 40 km/h (bottom). 35
Figure 5. Month 1 - Measured rates of fixed dustfall at 25. 50, 100, 150, 300, and 1000 m on both upwind (positive) and downwind (negative) sides of the Meadowbank AWAR in a references location and areas of dust suppression trials. Samples were collected over 32 days immediately following dust suppressant application. Dashed line represents the highest recorded background dustfall rate (1000 m upwind, km 18, 2016). No regulatory guidelines are available for fixed dustfall. 39
Figure 6. Month 2 - Measured rates of fixed dustfall collected at 25. 50, 100, 150, 300, and 1000 m on both upwind (positive) and downwind (negative) sides of the Meadowbank AWAR in 2016 in a references location and areas of dust suppression trials collected over 29 days beginning 32 days after dust suppressant application. The sample from -25 m for the speed limit test (4.099 $mg/cm^2/30d$) is omitted as an outlier, and to facilitate visual interpretation of the graphed data in this report. Dashed line represents the highest recorded background dustfall rate (1000 m upwind, km 18, 2016). No regulatory guidelines are available for fixed dustfall. 40
Figure 7. Total dustfall rates ($mg/cm^2/30d$) for all samples collected since 2012 along the Meadowbank AWAR. Negative distances represent the downwind (east) side of the road, and positive distances represent the upwind (west) side. Solid line represents the average total dustfall rate. 41

Figure 8. Supplemental areas for dust suppressant application in 2017, as identified by Agnico Eagle........ 45

APPENDICES

APPENDIX A – Minutes from community consultations
APPENDIX B – Product data sheets for Dust Stop™ and TETRA Flake dust suppressants

SECTION 1 • INTRODUCTION

1.1 BACKGROUND

Since 2012, Agnico Eagle Mines Ltd. (Agnico Eagle) has conducted annual dustfall monitoring studies along the 110-km All Weather Access Road (AWAR) between the Meadowbank minesite and the hamlet of Baker Lake, NU.

Through these studies, Agnico Eagle has aimed to quantify dustfall with respect to distance from the AWAR, and compare results to background levels, regulatory guidelines, and FEIS predictions. While predicted dustfall rates were not specified, the FEIS indicated that the majority of dustfall was anticipated to occur within 100 m of the road. The smallest zone of influence (ZOI; area where habitat is assumed lost due to sensory disturbance and other factors) for any wildlife valued ecosystem component (VEC) was also 100 m, and impacts to VECs outside this zone were not expected to be significant. Therefore, AWAR dustfall studies have focused around the 100 m distance, and particularly on the downwind (most impacted) side of the road.

Results through 2015 indicated that FEIS predictions regarding AWAR dust are not being exceeded, so excess impacts to wildlife VECs as a result of road dust are not anticipated. These conclusions are supported by wildlife monitoring conducted under the Terrestrial Ecosystem Management Plan, which indicated no significant effect of the road on breeding bird abundance or risk to wildlife from consumption of chemical contaminants.

Nevertheless, Agnico Eagle recognizes the concerns raised by the hamlet of Baker Lake, the Nunavut Impact Review Board (NIRB) and the Government of Nunavut (GN) regarding dust generated by AWAR traffic, and is working with these groups to identify an optimal solution. In 2016, Agnico Eagle hosted meetings and a tour with the Baker Lake Hunter’s and Trapper’s Organization (HTO) to determine specific areas of concern along the AWAR, and, in addition to the regular monitoring program, conducted a trial study with three types of dust suppression - Dust Stop™ (Cypher Environmental), TETRA Flake (Tetra Technologies Inc.), and speed limit reductions.

1.2 DUST SUPPRESSION TO DATE

Beginning in 2012, Agnico Eagle has provided calcium chloride to be applied annually between km 1 and km 5 of the AWAR. Agnico Eagle also applies chemical dust suppressants on minesite roads and on the most heavily-travelled section of the AWAR, between the main minesite and the former Meadowbank Exploration Camp site. Dust suppression for the airstrip and some minesite roads is also accomplished through continuous watering during summer months.

1.3 PAST STUDY DESIGN

The initial dustfall study was conducted along the AWAR in 2012, and included sampling of two single transects along the road (km 76 and 78) to a 100 or 150 m distance, and two clusters on the minesite. This initial study was used to assess methods, and assist in the design of the larger scale study to be completed in 2013. In 2013 an expanded study was conducted to more fully characterize dustfall rates in relation to distance from the AWAR. Two duplicated transects of samplers were deployed at km 18 and 78, up to 300 m from the AWAR, as well as a number of single canisters at 50 m (km 1, 103, Vault haul road) and two background samples at 1000 m upwind. However, due to disruption by extreme winds, only 7 of 35 samplers could be analyzed. This study was conducted again in 2014 after establishing more robust sampling methods. Locations were the same as 2013, except background samplers were moved to an established reference site on the east side of Inuggugayualik Lake, which is approximately 10 km northwest (upwind) of the mine site. The 2015 study design was nearly identical, with the addition of samplers at 25 m, as well as reference samples along the proposed Amaruq AWAR route.

1.4 2016 STUDY OBJECTIVES

In 2016, two dustfall studies were conducted. As in previous years, the regular monitoring program aimed to characterize dust deposition rates with respect to distance from the Meadowbank AWAR in two locations (km 18 and 78). In addition, a dust suppression pilot study was conducted to compare the effectiveness of three dust suppression techniques (Dust Stop™ (Cypher Environmental), TETRA Flake (Tetra Technologies Inc.), and speed limit reductions). Moving forward, Agnico Eagle plans to apply a dust suppressant in areas of concern as identified by the HTO and Agnico Eagle (see Section 2.1 and 5.2). The 2016 study was conducted to determine which product or technique would be optimal, based on effectiveness, ease of application, cost, and operational considerations.

SECTION 2 • METHODS

2.1 DUST SUPPRESSION PILOT STUDY

2.1.1 Community Consultations

In 2016, Agnico Eagle conducted an initial meeting with the Baker Lake Community Liaison Committee (including an HTO member) on March 18 to discuss the planned dust suppression pilot study. A field visit with HTO members was planned to identify specific areas of concern related to dust along the AWAR. The field visit by members of the HTO and the Meadowbank Environment Department was conducted May 11th 2016, and examined AWAR km 1 – km 50. Three areas of concern (Figure 1) were identified, generally due to proximity of Whitehills Lake and water crossings:

- km 7, 10, and 11
- km 22, 24, and 25
- km 49

Based on this assessment, one of three dust suppression methods was tested in each area during the summer months, as described below. Following conclusion of the pilot study, preliminary results were presented to the community at a meeting on February 10th 2017.

Minutes of the community meetings and report on the May 11, 2016 field visit are provided in Appendix A.

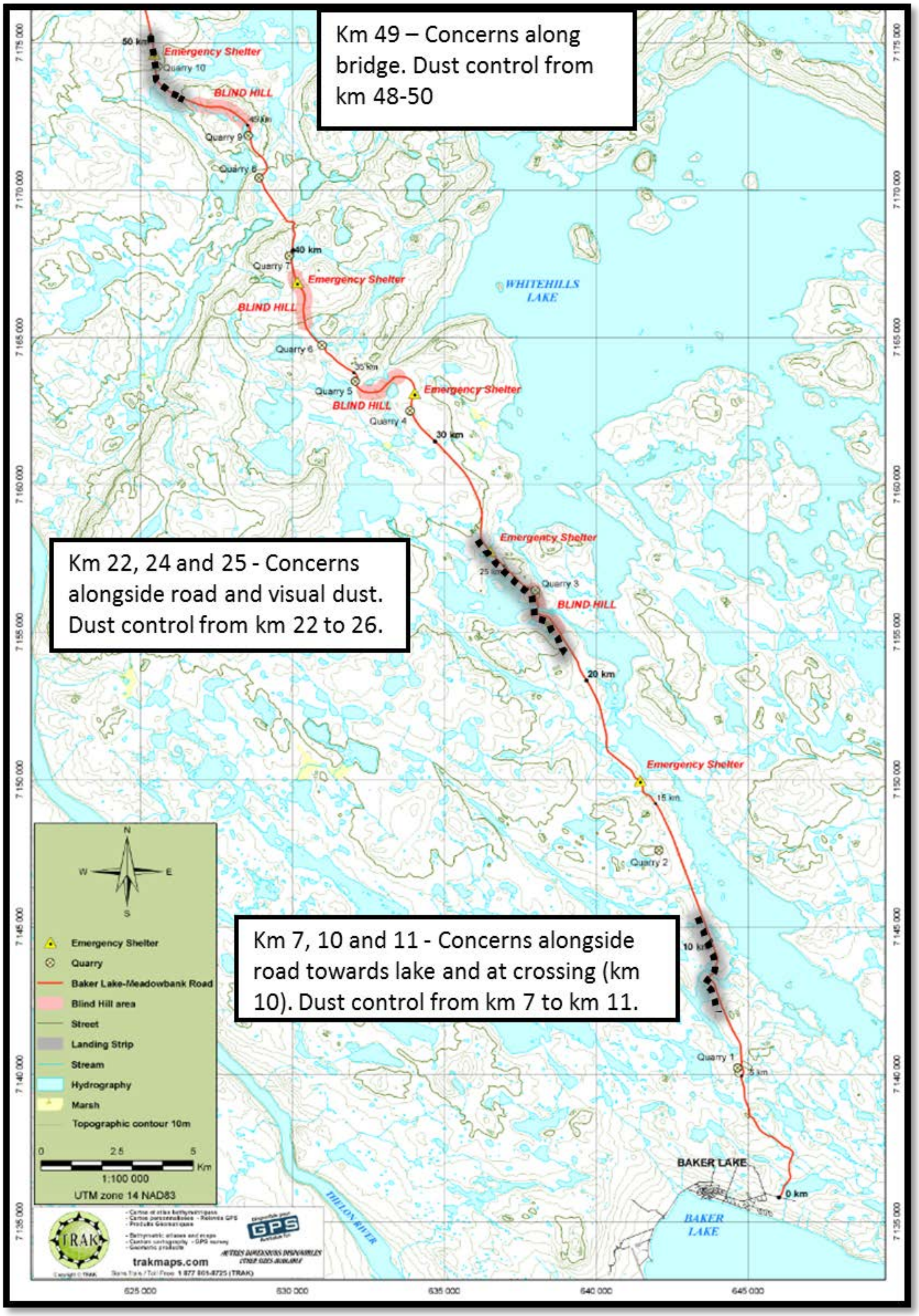


Figure 1. Areas of concern for dustfall along the Meadowbank AWAR identified by the HTO in 2016.

2.1.2 Dust Suppressant Selection

The choice of tested products was based primarily on acceptability under Government of Nunavut regulations (Environmental Guideline for Dust Suppression, 2002) and product availability. Due to time constraints with the shipping season, test products for 2016 were limited to those already onsite. Therefore, the following two products were chosen for the pilot study, along with speed limit reductions:

- Dust Stop™ (Cypher Environmental); polymer with dry or liquid applications
- TETRA Flake (Tetra Technologies Inc.); dry calcium chloride

While Dust Stop™ is not listed in the GN's Environmental Guideline for Dust Suppression (2002) as an approved product, Agnico Eagle has previously sought and received approval from the GN Department of Environment for its use.

Data sheets for both products are included as Appendix B.

2.1.3 Trial Locations

Based on the identified areas of concern, dust suppression methods forming part of the pilot study were applied as described in Table 2.

Table 2. Dust suppressant locations and application dates.

AWAR Location	Method	Application Date
km 10 - 12	TETRA Flake	July 11,2016
km 18	None – reference location	N/A
km 24 - 26	Speed limit reduction to 20 or 40 km/h	July 11, 2016 (signs posted)
km 48 - 50	Dust Stop™ (dry application)	July 15, 2016

As in previous years, Agnico Eagle also applied TETRA Flake to assist in dust suppression near the hamlet of Baker Lake. On July 7, the product was applied from km 3 – 5, in the area of the spud barge, and between Arctic Fuel and the Baker Lake Tank Farm. It was not applied from km 0 – 3, since new material was being added to the road. In addition, Agnico Eagle applied Dust Stop™ on the most heavily travelled segment of the AWAR, between the minesite (km 110) and the emulsion plant (km 103). This application of Dust Stop™, using the wet application method, took place from July 9-12.

2.1.4 Visual Observations

Visual inspections of the road surface and photographs of dust generated by passing vehicles were conducted before and during the pilot study (July 7, July 30, August 8) for each location. Observations were also recorded on July 22, but rain the day before resulted in low dust at all locations.

2.1.5 Dustfall Sampling

2.1.5.1 Locations

For the purposes of comparing dust suppressants, two sets of dustfall samples were collected in 2016. The first round of sampling was conducted immediately after dust suppressant application, from July 10 – August 11 (32 days). The second set of samplers were installed from August 11 – September 10 (29 days). Both rounds of sampling included a single transect at the three locations with dust suppressants (km 11, 25, 49), as well as a reference transect (km 18). Sample jars were located at 25 m, 50 m, 100 m, 150 m, 300 m and 1000 m from the road on both sides (east/downwind and west/upwind).

2.1.5.2 Methods

In accordance with ASTM methods for dustfall measurement (ASTM, 2004), dustfall samples were collected in open vessels containing a purified liquid matrix provided by an accredited laboratory (Maxxam Analytics). Particles are deposited and retained in the liquid, which is then filtered to remove large particles (e.g. leaves, twigs) and analyzed by the accredited laboratory for total and fixed (non-combustible) dustfall. This sampling method is widely used in air quality studies in Nunavut and elsewhere for dustfall monitoring (e.g. Baffinland, 2014; Sabina, 2012; Pretium, 2013; Taseko, 2011).

ASTM and Ontario MOE methods suggest collection of the dustfall sample at 2-3 m height on a utility pole to prevent re-entrainment of particulates from the ground, and to reduce vandalism and potential for wildlife interaction. Due to the difficulty of constructing and deploying stands to hold the large number of sample containers used for AWAR dustfall sampling, and the remote location, the 2012 study compared dustfall at ground level and at 2 m height to inform future sampling method decisions. Based on these results and the assumption that any re-entrainment would result in conservatively high estimates of dustfall, all sampling canisters have been deployed at ground level in since 2013.

Difficulty with maintaining canisters upright in 2013 during strong winds resulted in the use of heavy plastic pipe pieces to surround and support canisters starting in 2014. These supports were maintained at a height lower than the canister opening so that dust deposition was not impeded. These supports have proven very effective, maintaining canisters upright even during high wind events.

Dustfall samplers were placed open in the field for approximately one month, and all calculated dustfall rates were normalized to 30 days (mg/cm^2/30 days, per ASTM 1739-98).

2.2 REGULAR MONITORING PROGRAM

As part of the regular AWAR monitoring program, dustfall samples were collected from August 12 – September 10 (28 days) in the same locations as previous years (km 18 and 78). These samples included a duplicated transect at each location, with sample jars 20 m apart. For each transect, jars were placed at 25 m, 50 m, 100 m, 150 m, 300 m and 1000 m from the road on both sides (east/downwind and west/upwind). These distances were chosen to bracket the smallest predicted zone of influence (ZOI) of 100 m. The zone of maximum dustfall has previously been reported to be within 300 m of roads under heavier use than the Meadowbank AWAR (Auerbach et al. 1997). Sampling transects were located perpendicular to road segments that are relatively straight with few notable topographical features, in order to limit confounding factors that alter prevailing winds and create different micro-climates.

2.3 QA/QC

2.3.1 Sample Handling

Sample canisters and analytical services were provided by an accredited laboratory (Maxxam Analytics Inc.). Canisters were received and deployed by appropriately trained personnel. Sample collection containers remained sealed until they were installed at the specified sampling points. Once containers were installed, container lids were removed and sampling commenced. All sample collection containers were labeled with time, date and sampling location. To avoid contamination or sample loss, no material was removed from the containers and lids were stored in a clean, sealed bag. All efforts were made to ensure canisters remained upright throughout transport. Only canisters that were upright at the time of collection were used in data analyses. By following these sample handling techniques, Agnico Eagle is confident that any controllable external contamination of dustfall jars is minimized. Discussions with the analytical laboratory have identified the following additional recommended measures, which will be implemented in subsequent studies:

- Seal the dustfall jar lid with electrical tape when retrieving samples.
- Ensure coolers being used for shipment are clean and in good shape for transport.

2.3.2 Field Duplicates

Field duplicates are separate samples of environmental media collected in the same location at the same time. Field duplicates are collected, stored, and analyzed independently, and are used to help assess the combined precision of the analytical and sampling methodology. Field duplicates do not assess accuracy (i.e. differences between measured results and “true” values), nor do they contribute to understanding contamination due to transport, which is assessed through travel blanks (see Section 2.4.2).

Precision of the study results was assessed by calculating the relative percent difference (RPD) between duplicate measurements. For samples that are > 5x the method detection limit, RPD can be calculated as:

$$RPD = \frac{(A-B)}{((A+B)/2)} \times 100$$

where: A = analytical result

B = duplicate result

A total of six canisters were duplicated to determine precision of the measurements. These duplicates consisted of two canisters within approximately 30 cm proximity. One duplicate was not recovered (km 11, 1000 m west, July event), likely due to animal interference.

No specific regulatory guidance on field duplicate RPDs is available for total or fixed dustfall, and recommendations of the analytical laboratory are limited to samples of soil and water media. Therefore, results of the field duplicate analysis are presented for reference only, to help understand the potential for variability in dustfall samples, and assist in providing context to field measurements. Given the inability to homogenize samples during collection, and the inherently variable nature of dustfall, relatively large RPDs may be anticipated and have been observed in previous years (up to 45%). Variability of this magnitude does not appear to be uncommon; an average difference between

12 duplicate samples of 25% was previously reported in a study assessing passive dustfall collector design, with individual duplicates varying by up to 99.5% (Sanderson et al. 1963).

2.3.3 Travel Blanks

Travel blanks (unopened dustfall jars) are supplied by the analytical laboratory to assess the potential for contamination due to transit. One travel blank was deployed during the dustfall study in 2016. Laboratory guidance indicates that the impact on results should be investigated when travel blank results exceed 5x the RDL.

2.4 DATA ANALYSIS

2.4.1 Regular Monitoring Program

Cumulative results to date for AWAR dustfall sampling in areas without dust suppressant application are presented.

No regulatory standards for dustfall are available for the territory of Nunavut, and those available elsewhere are based on aesthetic or nuisance concerns. On this basis, Alberta Environment has published a guideline for total dustfall in recreational/residential areas of 0.53 $mg/cm^2/30d$, and a guideline for commercial/industrial areas of 1.58 $mg/cm^2/30d$. Total dustfall results are compared to these guidelines to provide context.

Results are also compared to the range of background dustfall rates (samples collected at the Inuggugayualik Lake reference site in 2014, proposed Amaruq road location in 2015, and 1000 m upwind samples in 2016).

Trends over time (year-over-year, and July vs. August sampling in 2016) are identified.

2.4.2 Dust Suppression Pilot Study

Unlike the regular monitoring program, the objective of the dust suppression pilot study in 2016 was to collect data on the effectiveness of three different dust suppression methods. Therefore, the primary analysis consisted of a qualitative comparison of fixed dustfall rates between transects at km 11, 18, 25, and 49 for each of the July and August sampling periods. Fixed (non-combustible) dustfall was primarily considered in this assessment, since it was determined to be more representative of road material than total dustfall, which includes organic components (e.g. pollen, plants, animal particles). Results of the visual assessment of dust generation were also considered in forming conclusions regarding the optimal dust suppression technique.

SECTION 3 • 2016 RESULTS

3.1 VISUAL ASSESSMENT

Observation records indicate that the greatest reduction in visible dust occurred in the area treated with TETRA Flake. On both July 30 and August 5, no dust was visible when trucks passed through this area (Figure 2).

Visible dust was also reduced in the zone where Dust Stop™ was applied, but more dust was raised compared to the TETRA Flake zone (Figure 3).

At a speed limit of 20 km/h, visible reductions in dust generation occurred. However, this speed limit was determined not to be operationally sustainable, and was raised to 40 km/h at the end of July. A slight reduction in visible dust at this speed was noted, but impacts were not as great as the other test areas (Figure 4). This option was also determined not to be operationally feasible.

Figure 2. Dust generation in the TETRA Flake test area (km 10 – 12) before (top) and after (bottom) application.

Figure 3. Dust generation in the Dust Stop™ test area (km 48 – 50) before (top) and after (bottom) application.

Figure 4. Dust generation in the speed limit test area (km 24-26) at 50 km/h (top) and 40 km/h (bottom).

3.2 DUSTFALL SAMPLE RESULTS

Results for all samples collected in 2016 for the purposes of comparing dust suppressants are provided in Table 3. Results for all samples collected under the regular monitoring program (no dust suppressants) are presented in Table 4.

Table 3. 30-d fixed dustfall rates ($mg/cm^2/30d$) for samples collected in 2016 along the Meadowbank AWAR in areas undergoing dust suppression trials. Values in parentheses are duplicates. NA = not available (lost sample jar, or location inaccessible).

Side of Road	Distance from Road (m)	TETRA Flake (km 11) Jul.	TETRA Flake (km 11) Aug.	Dust Stop™ (km 50) Jul.	Dust Stop™ (km 50) Aug.	Speed Limit (km 25) Jul.	Speed Limit (km 25) Aug.	Reference (km 18) Jul.	Reference (km 18) Aug.
West (upwind)	1000	0.062 (NA)	0.029	0.083	0.068	0.083	0.206	0.034	0.044
	300	0.034	0.088	0.083	0.076	0.110	0.140	0.083	0.208
	150	0.096	0.228	0.158	0.129	0.257	0.283	0.255	0.191
	100	0.090	0.279	0.103	0.213	0.207	0.353	0.227	0.298
	50	0.124	0.455	0.269	0.296	0.255	0.331	0.510	0.875
	25	0.372	1.058	0.579	NA	0.771	4.099	0.448	0.771
East (down wind)	25	0.048	0.360	0.840	0.312	0.220	0.375	0.565	0.588
	50	0.179	0.242	0.379	NA	0.158 (0.186)	0.235	0.269	0.367
	100	0.083	0.242	0.103	0.160	0.275	0.171	0.179	0.272
	150	0.048	0.176	0.062	0.099	0.062	0.118	0.152	0.197
	300	0.069	0.146	0.055	0.076	0.145	0.148	0.158	0.094
	1000	0.076	0.088	0.021	0.076	NA	NA	NA	NA

Table 4. 30-d total and fixed dustfall rates for samples collected from two transects (1 & 2) in two locations without dust suppression (km 18 and 78) in 2016 along the Meadowbank AWAR. Values in parentheses are duplicates. NA = not available (lost sample jar, or location inaccessible).

Side of Road	Distance from Road (m)	km 18				km 78			
		Total Dustfall (mg/cm^2/30d)		Fixed Dustfall (mg/cm^2/30d)		Total Dustfall (mg/cm^2/30d)		Fixed Dustfall (mg/cm^2/30d)	
		1	2	1	2	1	2	1	2
West (upwind)	1000	0.228	0.125	0.191	0.073	0.236	0.357	0.106	0.076
	300	0.191	0.214	0.162	0.163	0.160	0.239	0.122	0.213
	150	NA	0.213 (0.220)	NA	0.176 (0.162)	0.258	0.258	0.220	0.220
	100	0.274	0.294	0.249	0.242	0.312	0.365	0.281	0.342
	50	0.588 (0.634)	0.566	0.588 (0.600)	0.522	0.821	0.790	0.790	0.752
	25	0.911	1.242	0.823	1.183	1.193	1.463 (1.672)	1.155	1.392 (1.604)
East (down-wind)	25	1.041	0.660	0.992	0.600	1.018	1.452	0.973	1.383
	50	0.389	0.463	0.367	0.411	0.410	0.441	0.380	0.410
	100	0.353 (0.331)	0.250	0.316 (0.301)	0.198	0.281	0.281	0.251	0.266
	150	0.235	0.206	0.213	0.163	0.228	0.220	0.205	0.205
	300	0.206	0.147	0.162	0.103	0.160	0.175	0.137	0.144
	1000	NA	NA	NA	NA	NA	NA	NA	NA

3.3 QA/QC

3.3.1 Field Duplicates

The relative percent difference (RPD) values calculated for fixed dustfall for duplicate canisters were 14, 2, 5, and 8% at distances of 25, 50, 100, and 150 m from the road, respectively (regular monitoring program). In addition one duplicate was collected where speed limit reductions were tested, at a distance of 50 m from the road, with and RPD of 16%. These values were within the range of those occurring in previous years.

3.3.2 Travel Blanks

One travel blank was assessed, with a measured total dust content of 2 mg. This is less than 5x the reportable detection limit of 1 mg, so no impacts to the data due to contamination during shipment and handling are expected.

SECTION 4 • DISCUSSION

4.1 DUST SUPPRESSION PILOT STUDY

Results of the dustfall sampling are compared in Figure 5 and 6. For the July event (Figure 5), reference samples were collected from one transect at km 18 only. For the August event, samples from three transects at km 18 and two transects at km 78 are included as reference values (i.e. all data from both the dust suppression pilot study and regular sampling program), and the maximum and minimum result for each distance from the road is presented.

During the first month after application of dust suppressants (Figure 5), only TETRA Flake produced a reduction in measured fixed dustfall compared to the reference site for all distances from the road. Both TETRA Flake and Dust Stop™ reduced the distance from the road at which measured dustfall dropped below the range of background values, particularly on the downwind side of the road. Changes in speed limit to 20 km/h did not appear to have a substantial effect on measured dustfall.

During the second month after application, no substantial differences in measured dustfall were observed between trial plots at and beyond a distance of 100 m. At a distance of 50 m, dustfall rates were lower than the minimum reference value at all three dust suppressant locations (Dust Stop™ result unavailable for 50 m east). Similarly, all three suppressants reduced dust compared to the minimum reference value at 25 m on the east side of the road. On the west side, only TETRA Flake and speed limit results were available. The measured value for the TETRA Flake zone was between the minimum and maximum reference sites. The measured value for the speed limit reduction zone was substantially higher than any fixed dustfall value recorded to date (4.099 $mg/cm^2/30d$), so can likely be considered an outlier, and was excluded from the figure to facilitate interpretation.

These data, combined with the visual assessment indicate that generally, TETRA Flake provides the greatest reduction in dustfall rates. Effects are especially apparent during the first month after application. Measured dustfall in the TETRA Flake test zone during the first month was within the range of background values at all distances from the road, except the closest sampling point (25 m) on the downwind side.

Furthermore, consultations with road maintenance crews indicated that the TETRA Flake product application was more straightforward and less time-consuming than the Dust Stop™ application, likely resulting in more efficient dust control. It was also determined that it would be difficult from a management perspective to effectively control speed limits in specific zones. These additional factors provide further rationale for use of TETRA Flake in future years.

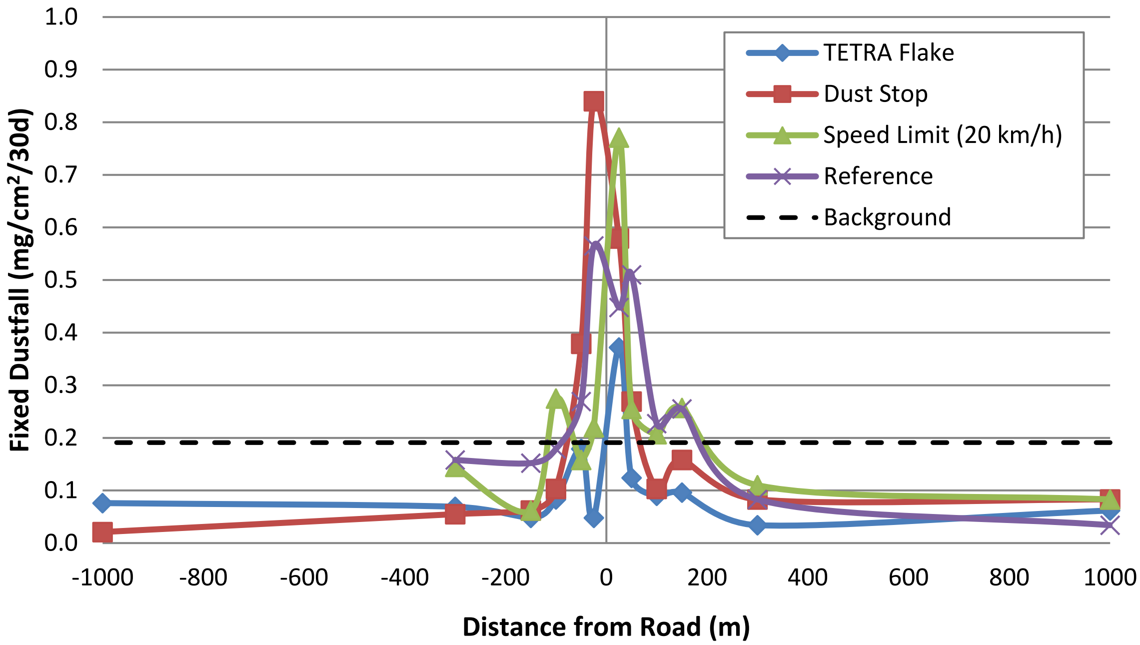


Figure 5. Month 1 - Measured rates of fixed dustfall at 25. 50, 100, 150, 300, and 1000 m on both upwind (positive) and downwind (negative) sides of the Meadowbank AWAR in a references location and areas of dust suppression trials. Samples were collected over 32 days immediately following dust suppressant application. Dashed line represents the highest recorded background dustfall rate (1000 m upwind, km 18, 2016). No regulatory guidelines are available for fixed dustfall.

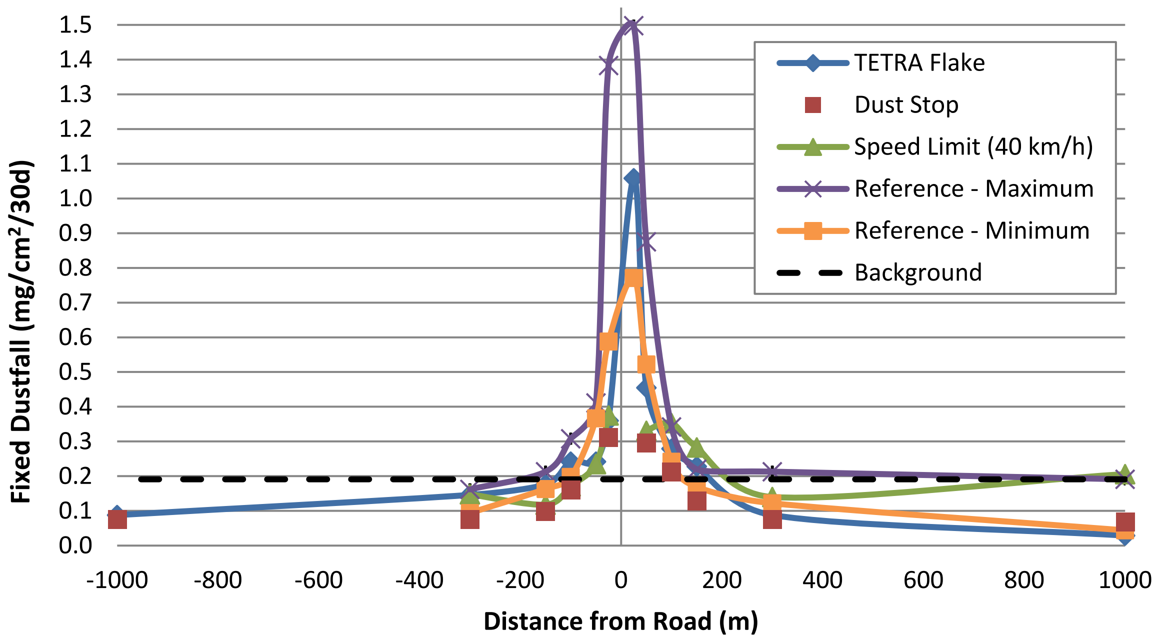


Figure 6. Month 2 - Measured rates of fixed dustfall collected at 25. 50, 100, 150, 300, and 1000 m on both upwind (positive) and downwind (negative) sides of the Meadowbank AWAR in 2016 in a references location and areas of dust suppression trials collected over 29 days beginning 32 days after dust suppressant application. The sample from -25 m for the speed limit test (4.099 mg/cm^2/30d) is omitted as an outlier, and to facilitate visual interpretation of the graphed data in this report. Dashed line represents the highest recorded background dustfall rate (1000 m upwind, km 18, 2016). No regulatory guidelines are available for fixed dustfall.

4.2 REGULAR SAMPLING PROGRAM

All results collected along the Meadowbank AWAR to date in the absence of dust suppression are presented in Figure 7 in relation to Alberta Environment guidelines for total dustfall and the range of background values observed to date. Results from canisters for the one transect at km 18 set in July, 2016, were excluded for consistency, since all other sampling programs were conducted in August. Dustfall rates in July were generally lower than those in August (see Section 4.2.3). The range of background concentrations (grey bar) was determined from 2 samples collected at an established external reference site (near Inuggugayualik Lake) in 2014, 22 samples collected along the proposed Amaruq AWAR route in 2015, and 5 samples collected at 1000 m upwind of the road at km 18 and 78 in 2016.

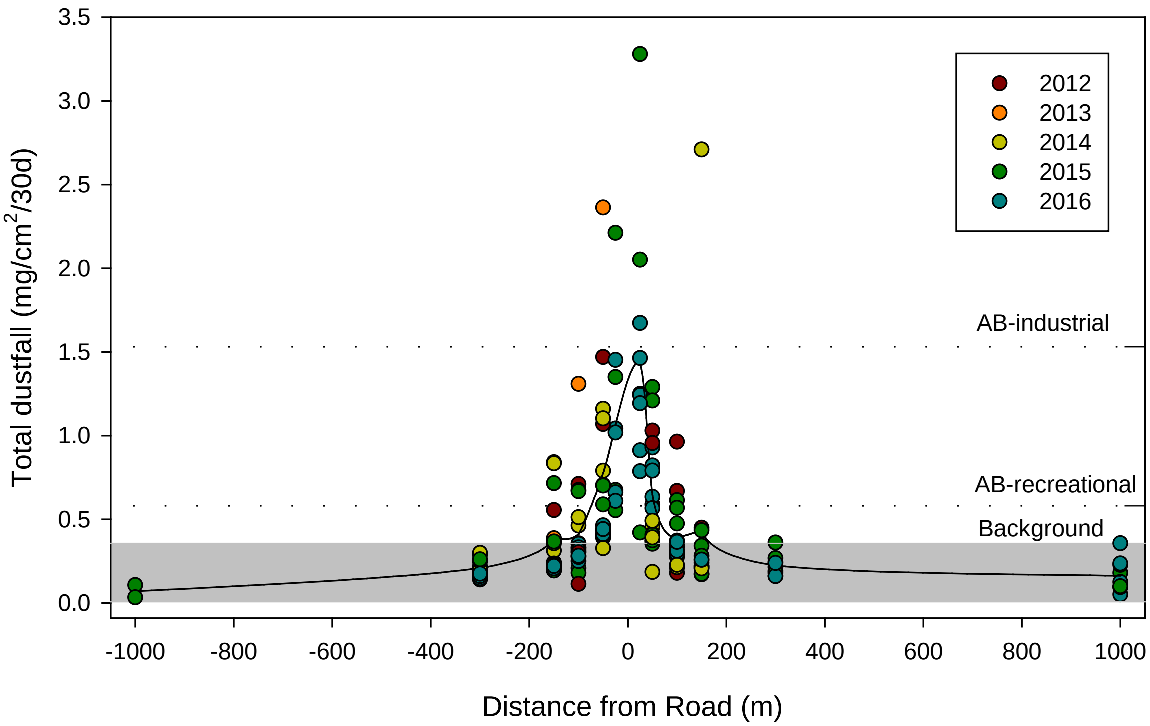


Figure 7. Total dustfall rates (mg/cm^2/30d) for all samples collected since 2012 along the Meadowbank AWAR. Negative distances represent the downwind (east) side of the road, and positive distances represent the upwind (west) side. Solid line represents the average total dustfall rate.

In addition to the results shown in Figure 7 for the Meadowbank AWAR, extra samples were collected on the Meadowbank site in 2013 and 2014 at 50 m from the road at the emulsion plant turnoff (AWAR km 103), and in one location along the Vault haul road. Assessment of those exploratory samples was discussed in prior reports (e.g. AWAR Dustfall Study Report, 2015). Dustfall samples are also collected continually throughout the year at four locations around the Meadowbank site as a component of the Air Quality and Dustfall Monitoring Program, and results are presented in Meadowbank's Annual Report to NIRB/NWB.

4.2.1 Comparison to Regulatory Guidelines and Background Values

To date (2012 – 2016), 6 samples have exceeded the Alberta Environment total dustfall guideline for industrial areas of 1.58 mg/cm^2/30d, with 5 out of 6 occurrences at the 25 or 50 m distance (i.e. within the zone where all habitat was assumed lost in the FEIS). One sample exceeded the industrial guideline at 150 m (upwind) in 2014, but all other samples at that distance have been well below the recreational area guideline, suggesting an anomaly occurred either due to natural variability, sample interference, or sampling/analytical error.

At and beyond the 100 m distance (smallest assumed ZOI), the majority of samples have been below the Alberta Environment recreational area guideline of 0.53 mg/cm^2/30d. In total, 11 out of 101 samples collected at this distance have exceeded the guideline, all at 100 or 150 m (none in 2016).

Average total dustfall to date at 100 and 150 m is below the guideline for recreational areas, at 0.403 and 0.398 $mg/cm^2/30d$, respectively (n = 37 and 32).

All samples collected at the 300 or 1000 m distance have been within the range of background values measured to date (0.007 – 0.357 $mg/cm^2/30d$). Average dustfall rates meet background values between 100 and 200 m from the road.

4.2.2 Trends Over Time

While sampling effort for each distance has varied by year, the results provided in Figure 7 do not demonstrate any clear trends towards increasing rates of dustfall along the Meadowbank AWAR.

An examination of the reference transect data (km 18) for July and August samples (Table 2) indicates that overall dustfall rates are higher in August. This is likely due to increased traffic rates due to arrival of goods into Baker Lake by barge and subsequent shipment to the Meadowbank site. This data supports the decision of Agnico Eagle to run the dustfall monitoring program in August, in order to obtain results representative of the highest dustfall rates.

4.2.3 Effect of Distance from the Road

Results of the 2012-2016 AWAR dustfall studies have shown that average dustfall rates decline by more than 70% from 25 m to 100 m on the downwind (most impacted) side of the AWAR, from an average of 1.35 $mg/cm^2/30d$ (n = 8) at 25 m to 0.41 $mg/cm^2/30d$ (n = 20) at 100 m (km 18, 76 and 78 data; all study years combined). A further halving of dustfall rates to an average of 0.21 $mg/cm^2/30$ d (n=15) occurs by 300 m.

SECTION 5 • CONCLUSIONS

5.1 REGULAR MONITORING PROGRAM

Under assumptions of continuous, long-term dust emissions from AWAR traffic, the FEIS predicted that effects of dust on vegetation and wildlife would not be significant, even without the use of mitigation measures such as minimizing traffic and applying dust suppressants. Results of AWAR monitoring to date continue to indicate that the majority of dust does settle within 100 m of the road, as predicted. In addition, average rates of dustfall decline below Alberta Environment’s guideline for recreational areas within 100 m, and meet the range of background dustfall rates within 200 m of the AWAR. Based on these results, it is unlikely that FEIS predictions with respect to VECs (vegetation community productivity and wildlife) are being exceeded due to dust. As described in past reports (2015 AWAR Dustfall Study Report), these results are supported by wildlife monitoring conducted under the Terrestrial Ecosystem Management Plan, including field surveys and the Wildlife Screening Level Risk Assessment.

Nevertheless, Agnico Eagle plans to apply dust suppressant at various set locations along the AWAR in 2017, based on results of the 2016 dust suppressant pilot study, as described below.

5.2 DUST SUPPRESSION PILOT STUDY

Results of the visual assessment and dust sampling program indicate that TETRA Flake is the optimal product for dust control on the Meadowbank AWAR.

SECTION 6 • 2017 DUST SUPPRESSANT APPLICATION

6.1 LOCATIONS AND TIMING

In 2017, Agnico Eagle plans to apply TETRA Flake to the three areas of concern along the AWAR identified by the HTO, as well as to the locations previously treated in the hamlet of Baker Lake and near the Meadowbank site. Agnico Eagle also identified two additional areas of concern between km 50 – 89 (the northern limit for public use), where dust suppressant will be applied, based on the same principles identified to be of concern to the HTO (generally, proximity to water). These locations are identified in Figure 8. The planned locations and rationale are as follows:

Table 5. Planned locations for dust suppressant application in 2017.

AWAR Location	Rationale
Agnico Eagle spud barge area	High traffic area near hamlet
Agnico Eagle tank farm to Arctic Fuel site	High traffic area near hamlet
km 0 - 5	High traffic area near hamlet
km 10 - 12	Area of concern to HTO – proximity to lake
km 24 - 26	Area of concern to HTO – proximity to lake
km 48 - 50	Area of concern to HTO – water crossing
km 68 - 70	Location identified by Agnico Eagle – water crossing
km 80 - 84	Location identified by Agnico Eagle – proximity to water & crossing
Emulsion plant turn off to Meadowbank site (km 103 – 110)	High traffic area

One application of TETRA Flake is planned for the summer 2017. The application of TETRA Flake is planned to be performed from mid-July to early August.

Agnico Eagle also continues to investigate alternative dust suppression products, but understands that a primary consideration is acceptability under Government of Nunavut regulations (Environmental Guideline for Dust Suppression, 2002).

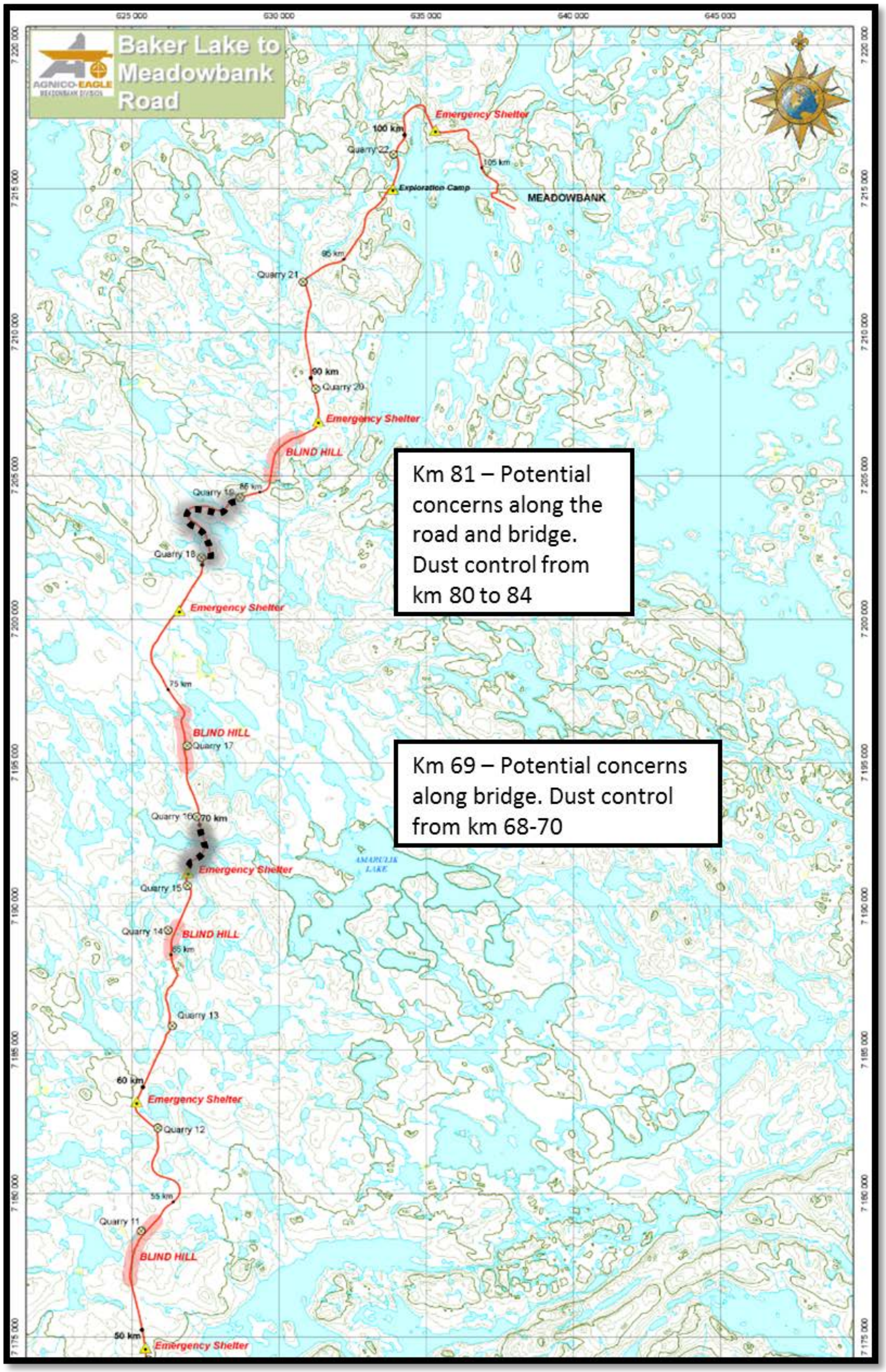


Figure 8. Supplemental areas for dust suppressant application in 2017, as identified by Agnico Eagle.

6.2 2017 AWAR DUSTFALL MONITORING PROGRAM

6.2.1 Dust Suppression Monitoring

Dustfall monitoring in 2017 will focus on confirming that reductions in dustfall continue to occur as a result of dust suppressant application in the five identified areas of concern. As in 2016, dustfall canisters will be deployed immediately following TETRA Flake application (planned for mid-July to early August), for a period of one month. A second round of sampling will follow, for an additional one month period. Dustfall sampling will occur at each of the five identified areas of concern along the AWAR, as well as at a reference location (km 18). For each TETRA Flake location, one transect will be sampled, with canisters located upwind and downwind at 25, 100, 300, and 1000 m from the road. Since the goal of the program is to confirm reductions in dustfall continue to occur, a lower spatial frequency of sampling is warranted compared to previous years. Each specific transect location will be determined based on field considerations, but they will be placed as close as possible to the middle of the segment where dust suppressant was applied. The specific locations will be recorded. For the reference location (km 18), a duplicated transect (canisters approximately 20 m apart, as in previous years) will be sampled, to better document natural variability under un-mitigated conditions. Visual observations will also be recorded every two weeks throughout the monitoring period.

6.2.2 Regular Dustfall Monitoring

In addition, the regular dustfall monitoring program will be continued at km 18 and 78, where no dust suppressant is applied. Samples will be collected in a duplicated transect at 25, 50, 100, 150, 300, and 1000 m from both sides of the roadway. As in previous years, samples will be collected mainly during the month of August, and will be deployed to coincide with timing of the dust suppression monitoring program. Canisters deployed at km 18 will be used as reference samples in this program.

SECTION 7 • REFERENCES

Alberta Environment, 2006. Guidelines for Quality Assurance and Quality Control in Surface Water Quality Programs in Alberta. Prepared by Patricia Mitchell Environmental Consulting. July, 2006. Web Site: http://www3.gov.ab.ca/env/info/infocentre/publist.cfm

American Society for Testing and Materials (ASTM). 2004. Standard Test Method for Collection and Measurement of Dustfall (Settleable Particulate Matter) Designation D 1739-98 Reapproved 2004, West Conshohocken, PA.

Auerbach, N.A., Walker, M.D. and D. A. Walker 1997. Effects of roadside disturbance on substrate and vegetation properties in arctic tundra. Ecological Applications: Vol. 7, No. 1, pp. 218–235.

Baffinland, 2014. Mary River Project, Terrestrial Environment Management and Monitoring Plan. Dustfall Monitoring Program. January, 2014.

Cumberland (Cumberland Resources Ltd.), 2005. Meadowbank Gold Project- Terrestrial Ecosystem Impact Assessment. October 2005.

Pretium Resources Inc., 2013. Brucejack Gold Mine Project, 2012 Air Quality Baseline Report. Prepared by Rescan Environmental Services Ltd. April, 2013.

Sabina Gold and Silver Corp., 2012. Back River Project, 2011 – 2012 Air Quality Baseline Report. Prepared by Rescan Environmental Services Ltd. December, 2012.

Taseko Mines Limited, 2011. Air Quality Monitoring Program Data Report, Prosperity Mine Site, 2010 – 2011.

APPENDIX A

Consultation Records

MEADOWBANK

Field visit recap

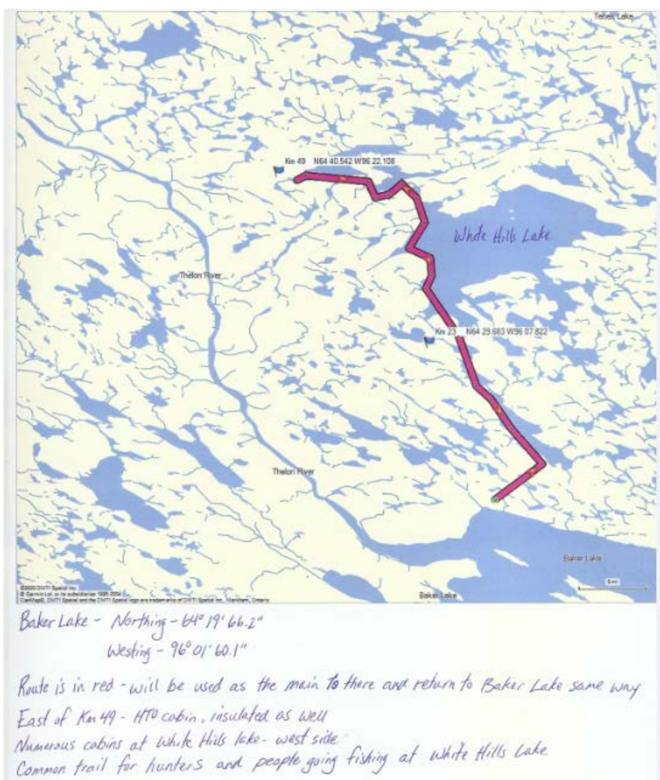
Dust Assessment

May 11, 2016 12:30 pm

Attendees –	Robin Allard	AEM Environmental Coordinator
	Jamie Kataluk	AEM Environmental Sr Technician
	Philippa Iksiraq	BL HTO
	Thomas Anirnirq	BL HTO

The field visit started on the north side of the Baker Lake Hamlet. Snowmobiles were provided by Agnico Eagle and qamutik provided by Jamie Kataluk. HTO member were riding inside the protective enclosure of the sleigh with Agnico staff riding the snowmobiles. One machine pulling the qamutik. On site translation was done by Jamie Kataluk

See map of planned route below.



Departure was at 12:45. Heading north then east, the first stop was alongside the river at km 7 on the east side of the AWAR.

- *Comments were made about dust being visible in summer times. Creating a surface cloud on the water.*
- *Vegetation was also said to be dusty, on both sides of the road.*
- *No dark colored snow was visible.*

Next stop was north-west at km 10 and 11 along the AWAR.

- *Comments were made about dust being visible in summer times. Creating a surface cloud on the water.*
- *Vegetation was also said to be dusty, on both sides of the road.*
- *No colored snow was visible.*

Heading along the road, on the lake alongside the next stop was at km 22, 23 and 24.

- *Comments were made about dust being visible in summer times. Creating a surface cloud on the water.*
- *Vegetation was also said to be dusty, on both sides of the road.*
- *Visual - colored snow was observed on both side of the road.*
- *Comments were also made in regards to the diesel spill (tanker) that happened in 2010. Some remnant smell during summer and sheen was also reported at this area.*

Heading north on Whitehills Lake, we stopped at the northern edge of the lake. Distance from the road was roughly at 7 kilometers in strait line (km 47).

- *Comments were made about dust being visible in summer times.*
- *Water and fishes were mentioned to be different at this area, smaller in size and paler in color. Quantity being also smaller than in the past. Bottom of the lake also said to be different and water not as clear.*
- *No dark colored snow was visible.*

Heading west we stopped at the bridge at km 49.

- *Comments were made about dust being visible in summer times. Creating a surface cloud on the water.*
- *Dark colored snow was visible.*
- *Vegetation was also said to be dusty, on both sides of the road.*

We then proceeded east to a cabin on the edge of the lake.

- *Tea was served in the cabin. Unfortunately for logistic reason, snow and/or ice from the area was not used to prepare it. Hot water was brought from Baker.*
- *Stories of previous years hunting and fishing trips were told by the members of the HTO. Going as far back as memory could tell.*

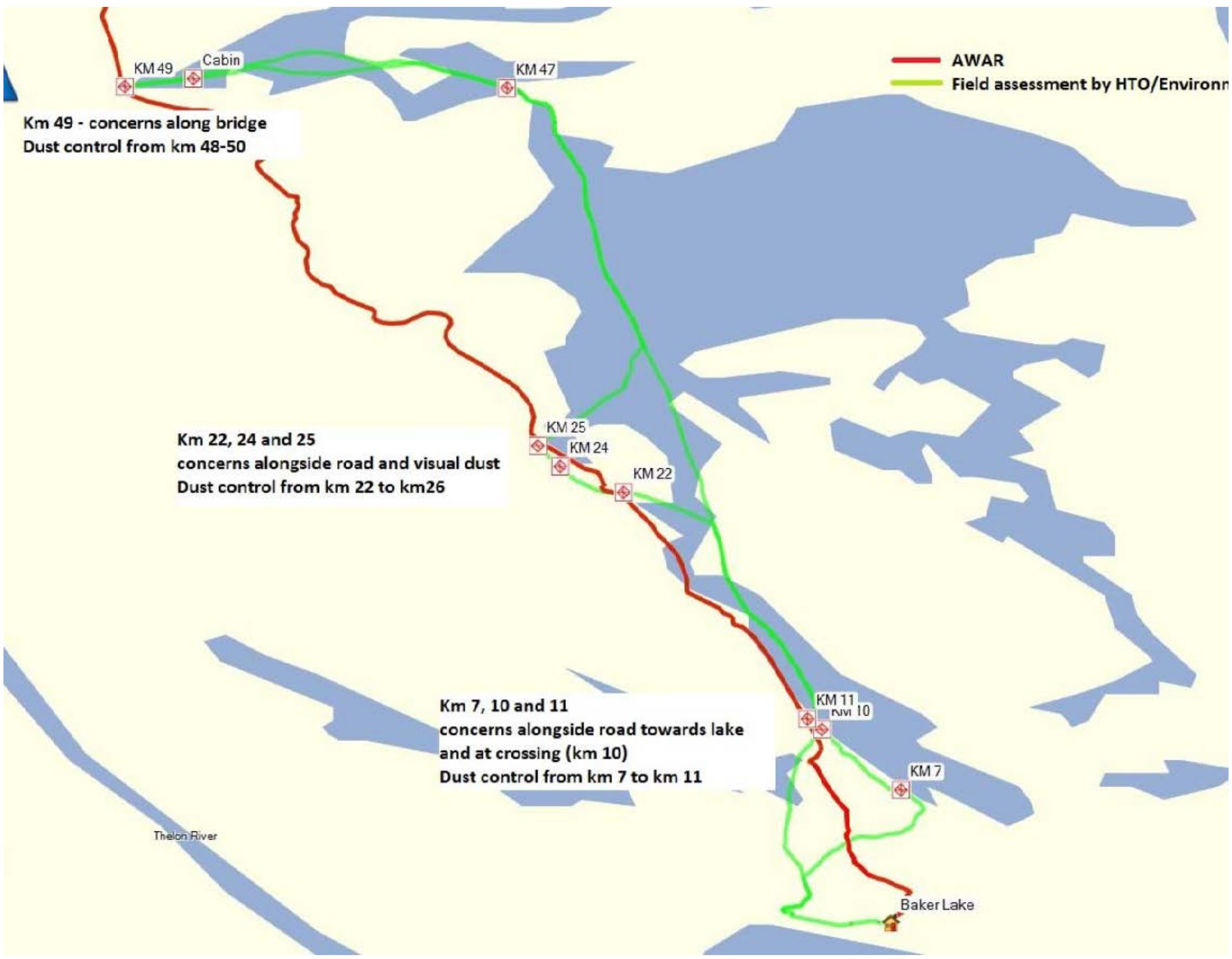
It was decided at this point to head back to Baker because of time of day and wind increasing. Arrival in Baker at 19:50.

Conclusion:

Field trip was useful to provide information on sensitive areas along Whitehills area. As well, it should help creating discussion channels with the HTO. HTO members present mentioned that once dust control has started on the AWAR, signs should be put to identify area. This suggestion was agreed to by Environment. A field study should be done in at least one of the areas of concern. Right now, km 1, 18, 78 and EMR are part of the dust sampling program. Ideally, areas of km 22-26 and 7-11 should be sampled.

Our intentions will have to be presented to the HTO at a future meeting.

See map below for proposed dust suppression that could be done on the AWAR.



APPENDIX B

Dust Suppressant Product Data Sheets

TETRA FLAKE DRY CALCIUM CHLORIDE

TETRA

Product Data Sheet

TETRA CHEMICALS

General Description

TETRA Flake calcium chloride is a white, flaked, dihydrate product with 80 weight percent calcium chloride.

Applications

Chemical Industry. Provides good source of soluble calcium

Oilfield. Can be used as fluid for drilling, cementing, and workover operations

Ready Mix Concrete. Accelerates setting times

Snow and Ice Melting. Facilitates deicing on highways and pavement

Soil Conditioning. Stabilizes roadbeds and facilitates salt remediation

Availability

FLAKE PACKAGING			
Package	Pallet Size	Units/ Pallet	Pallets/ Truckload
50 lb Plastic Bag	A variety of palletization and stow options are available.		
1000 kg Bulk Bag			

TETRA Flake is made in the USA.

TETRA's new flake product is available for shipment from our El Dorado, Arkansas facility.

Safety and Handling

TETRA Flake dry calcium chloride when in solution forms a strong salt solution. Wear appropriate protective, impervious clothing. Wear safety glasses with non-flexible side shields or chemical goggles for proper protection of the eyes. Wear appropriate protective non-leather protective gloves and boots. Chemical protective gloves and boots such as PVC or Nitrile are recommended. Leather products do not offer adequate protection and will dehydrate with resultant shrinkage and possible destruction. This product should be handled in areas with proper ventilation. Before using this product, refer to the SDS which is available on the Company's website for complete safety and handling guidelines.

PHYSICAL PROPERTIES	
Chemical Formula	$CaCl_2 . 2H_20$
Appearance	White flakes
Bulk Density	Approx. 50 lb/cubic foot

CHEMICAL PROPERTIES	
Calcium Chloride ($CaCl_2$)*	80 wt% minimum
Total Alkali Chlorides as NaCl**	6.0 % maximum
Total Magnesium Chloride ($MgCl_2$)**	0.5% maximum
*EDTA titration similar to ASTM E449-08	
**Active ingredient basis	

PARTICLE SIZE	
Screen Number:	**Mass % Passing**
3/8 (9.5 mm)	100
4 (4.75 mm)	80-100
30 (0.59 mm)	0-5

TETRA Chemicals
24955 Interstate 45 North
The Woodlands, Texas 77380
Phone: 281.367.1983
Customer Service: 800.327.7817
Fax: 281.298.7150

www.tetrachemicals.com

Dust Stop

CYPHER ENVIRONMENTAL

Significantly reduce operational costs through better haul road management

Dust Stop is a 100% environmentally friendly, concentrated dust suppressant consisting of high-grade polymers specifically engineered for the mining industry. The solution is applicable to any soil type and is applied using standard equipment and techniques. Dust Stop is designed to be extremely flexible and can withstand the weight of even the world's heaviest haul trucks. It is also non-soluble, so it will not run off or get sticky in the rain, and will even maintain engineering properties of the road in wet weather.

- **Significantly reduces long term maintenance costs**
  - Significant reduction in grading frequency
  - Significant reduction in watering frequency
  - Improved tire life
- **Reduction in maintenance requirements produces significant fuel savings**
  - Resulting from minimal use of graders and water trucks to maintain roads
- **Improved productivity due to increased visibility, leading to increased haul truck speeds**
- **Improved engineering properties resulting in reduced rolling resistance**
  - **Better fuel economy**
  - **Further improvements in productivity**
  - **Improved CBR Value**
- **Increased water resistance resulting in better performance in all weather conditions**
  - **Reduction in maintenance requirements as a result of wet weather**
- **Long lasting results**

Driven by Innovation – Partners in Performance

1149 St. Matthews Ave | 204.489.1214 | CypherEnvironmental.com

CYPHER ENVIRONMENTAL

Applications

- Haul Roads
- Secondary Roads
- Logging Roads
- Construction Sites
- Parking Lots
- Erosion Control
- Tailings Piles / Stock Piles
- Tarmacs, Runways & Helipads

Testimonials

Treating our roads would permit us to get going much sooner after heavy rain due to the fact that its (Dust Stop) stabilizing effect would allow us to maintain the proper profiling and allow rain water to run off.
– Mike Proulx, Acting Mine Manager of SMD Lefa Gold Mine, Guinea, West Africa

Since we have used it (Dust Stop), we have had no issues with dust and are happy with its long lasting capabilities – once cured, it is insoluble in the rain.
– Jose Fernandes, Airfields Maintenance Supervisor, Pierre Elliott Trudeau Airport, Montreal, Quebec

Even with an extremely wet summer, we were pleased with the performance of this product. We are definitely planning to use Dust Stop again next season.
– Richard Gamble, Mayor, Village of Dunnottar, Manitoba

Driven by Innovation – Partners in Performance

1149 St. Matthews Ave | 204.489.1214 | CypherEnvironmental.com