MEADOWBANK
MINING CORPORATION

MEADOWBANK GOLD PROJECT

EMERGENCY RESPONSE PLAN

AUGUST 2007

PREFACE

General Information

The Emergency Response Plan (ERP) is activated when a project-related emergency, accident or malfunction occurs, or if such an incident is foreseeable. The Meadowbank Gold Project is in the design and engineering phase, and as such, some specific information and procedures required for the operation of the mine site are at this time unconfirmed. Meadowbank Mining Corp., formerly known as Cumberland Resources Ltd., is committed to providing specific information prior to the operation of the mine site, and to updating this ERP accordingly.

MMC is also committed to producing an Environmental Management System (EMS) to systematically control, manage and update all environmental and health and safety requirements and procedures for the Project, including this ERP. The EMS will provide a mechanism for continual improvement in environmental and health and safety performance.

Annual Review

The ERP will be reviewed and updated at least annually. Completion of the annual review of the ERP will be documented through signatures of the personnel responsible for reviewing, updating and approving the ERP.

Record of Changes

A record will document all significant changes that have been incorporated in the ERP 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

Meadowbank Mining Corp. will maintain a distribution list for the ERP providing information about all parties that receive the plan including mine personnel, departments, and outside agencies.

Plan Reviewed by:________________________ Date:

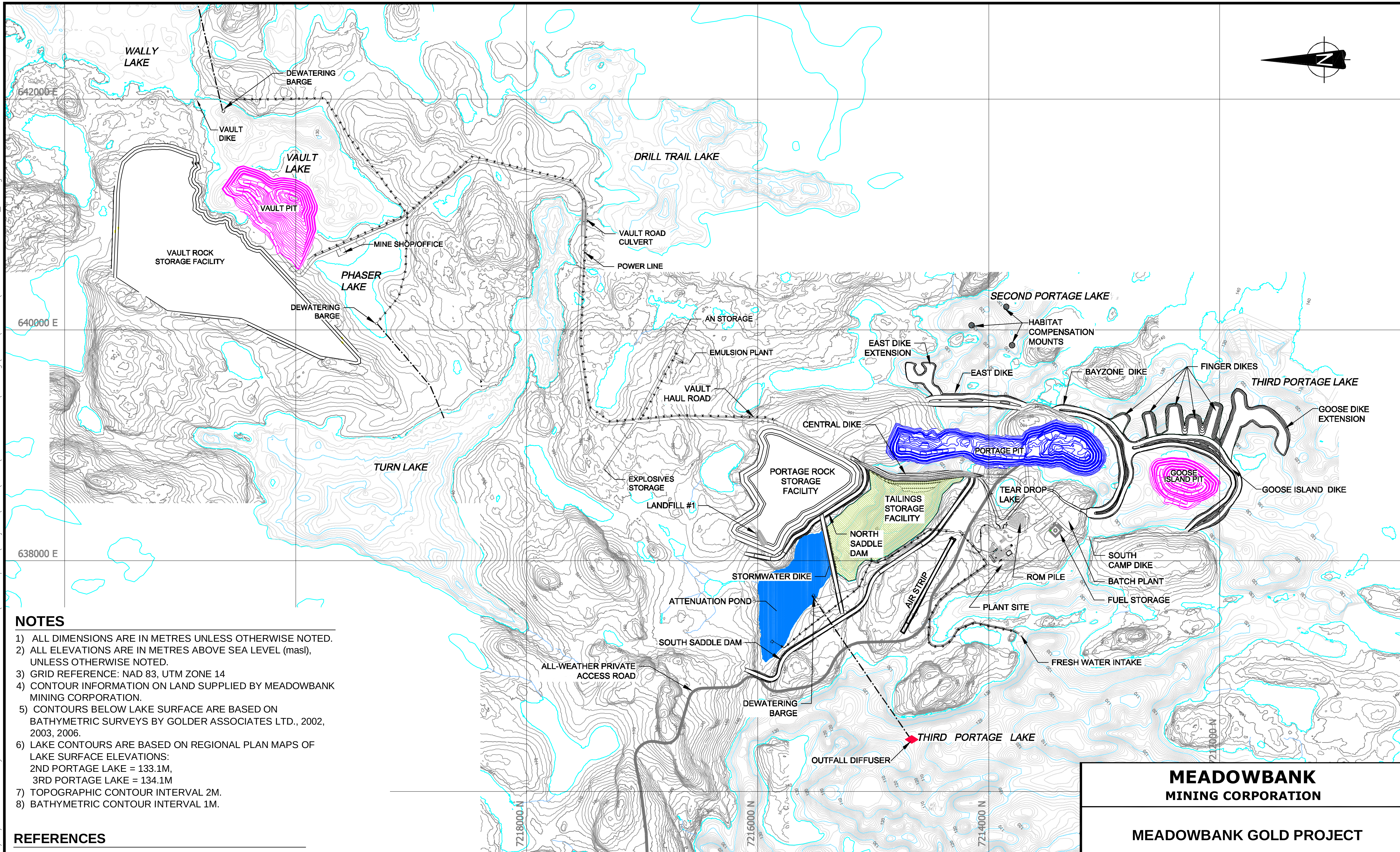
Plan Approved by:________________________ Date:

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

PROJECT LOCATION MAP



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 MEADOWBANK MINING CORPORATION.
5) CONTOURS BELOW LAKE SURFACE ARE BASED ON BATHYMETRIC SURVEYS BY GOLDER ASSOCIATES LTD., 2002, 2003, 2006.
6) LAKE CONTOURS ARE BASED ON REGIONAL PLAN MAPS OF LAKE SURFACE ELEVATIONS:
   2ND PORTAGE LAKE = 133.1M,
   3RD PORTAGE LAKE = 134.1M
7) TOPOGRAPHIC CONTOUR INTERVAL 2M.
8) BATHYMETRIC CONTOUR INTERVAL 1M.

REFERENCES

1) AMEC AMERICAS LTD., DRAWING NUMBER A1-131395-100-C-0001 (100-C-0001.DWG), MEADOWBANK FEASIBILITY STUDY, APRIL 2005.

NOT FOR CONSTRUCTION

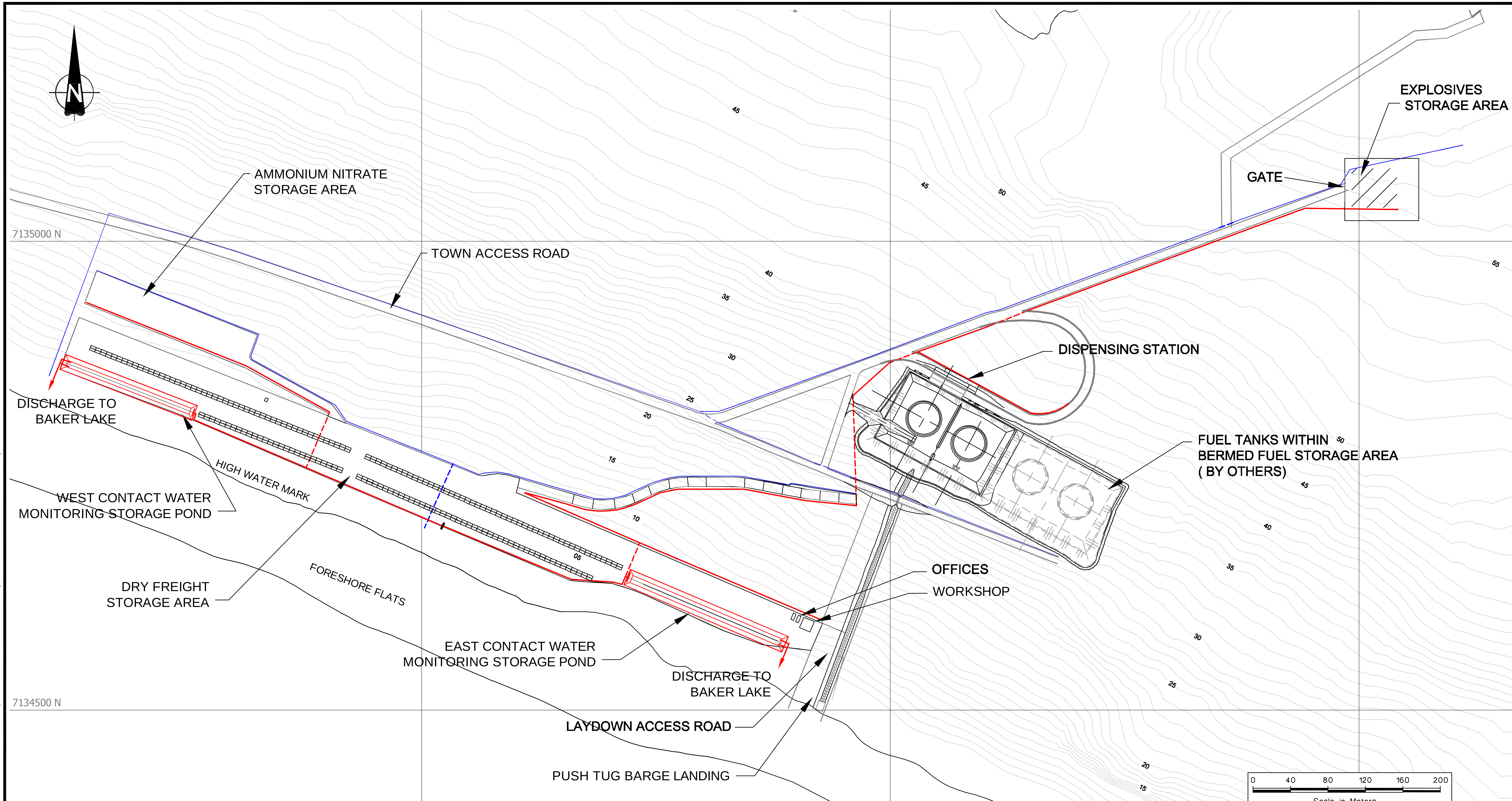
MEADOWBANK
MINING CORPORATION

MEADOWBANK GOLD PROJECT

GENERAL SITE PLAN

CADD FILE: N:\Bur-Graphics\Projects\2006\1413\06-1413-089\Drafting\FINAL\Doc.482\061413089-1400-A_01.dwg

REVISION DATE: 07/08/23 01:33PM By: ASalvador



LEGEND

- CONTACT WATER DIVERSION CHANNELS
- NON-CONTACT WATER DIVERSION CHANNELS
- CONTACT WATER CULVERTS
- NON-CONTACT WATER CULVERTS
- ROAD

NOTES

1. NORTHING AND EASTING ARE IN METRES REFERENCED TO UTM ZONE 14, NAD83.
2. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES REFERENCED TO GEODETIC DATUM UNLESS OTHERWISE NOTED.

NOT FOR CONSTRUCTION

MEADOWBANK
MINING CORPORATION

MEADOWBANK GOLD PROJECT

BAKER LAKE STORAGE AND MARSHALLING AREA

REVISION DATE: 07/08/21 12:28PM By: ASalvador GOLDER CADD FILE: N:\Bur-Graphics\Projects\2006\1413\06-1413-089\Drafting\FINAL\Doc.482\061413089-1400-A_02.dwg

SECTION 1 • INTRODUCTION

1.1 PURPOSE & 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 will form 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. 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
- accountability for safety and health performance
- well-defined corporate expectations regarding safety and health
- comprehensive hazard prevention and control methods
- record-keeping requirements to track program progress.

Meadowbank Mining Corp. (MMC), formerly known as Cumberland Resources Ltd. (Cumberland), 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.

In addition to this ERP, MMC has also developed an Occupational Health & Safety Plan (OHSP); a Spill Contingency Plan (SCP); and a Hazardous Materials Management Plan (HMMP). These plans are provided under separate cover.

1.2 MMC'S POLICY STATEMENT

MMC 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, MMC 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 (for more information, see the OHSP), and that they are provided with the proper tools to do so, including Personal Protective Equipment (PPE).
- An emergency response team and coordination centre will be established at the Meadowbank site when the project becomes active.
- The ERP will be tested on a periodic basis to ensure its effectiveness.

1.3 POLICY WITH RESPECT TO CONTRACTORS & VISITORS

Every person working at or visiting the Meadowbank site will be apprised of, and required to follow, the ERP policies and procedures set forth in this manual. For a list of responsibilities, see Section 2.

A pre-hire assessment will be made of all contractors and subcontractors based on screening that eliminates companies with a poor safety record and give preference to the selection of “best-in-class” companies based on their safety performance.

Major contractors, such as those for mining and hauling, will be required to have their own emergency response procedures. This will be verified by MMC management prior to engagement of the contractor.

1.4 ENVIRONMENTAL POLICY

MMC is committed to achieving a high standard of environmental care in conducting its mineral exploration activities. MMC’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 MMC’s exploration activities.
- Assurance that the employees are aware of their responsibilities and comply with MMC’s Environmental Policy and field guide.

It is the policy of MMC 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.

MMC also subscribes to the principle of sustainable development in mining. While mining cannot occur without an impact on the surrounding natural environment and communities, MMC will make it our responsibility to limit negative environmental and social impacts and to enhance positive impacts.

To achieve these goals MMC is committed to:

- Assess the potential environmental impacts of any new undertaking with an objective to minimise them;
- Design and operate MMC facilities to ensure that effective controls are in place to minimise risks to health, safety and the environment;
- Implement an emergency response plan to minimise the impacts of unforeseen events;
- Provide a professional environmental staff to plan and direct environmental compliance programs and to assist in training and education activities;
- Provide training and resources to develop environmentally responsible employees;
- Ensure that environmental factors are included in the purchase of equipment and materials;
- Ensure that contractors operate according to MMC environmental policy and procedures;
- Comply with all applicable environmental laws and regulations;
- Communicate with employees, the public, government agencies and other stakeholders on activities involving health, safety and the environment;
- Regularly verify environmental performance and implement any required corrective action;
- Minimise the generation of hazardous and non-hazardous waste and ensure proper disposal of all wastes;
- Implement measures to conserve natural resources such as energy and water; and
- Rehabilitate sites in accordance with regulatory criteria and within the established time-frame.

1.5 CORPORATE STRUCTURE

Pursuant to a take-over bid, Agnico-Eagle Mines Limited (AEM) acquired approximately 92% of the shares of Cumberland. AEM invoked the compulsory acquisition provisions of the British Columbia Companies Act and in early July 2007 Cumberland became 100% wholly-owned subsidiary of AEM. Through a series of steps, AEM amalgamated with Cumberland and MMC (a wholly-owned subsidiary of Cumberland) on August 1, 2007. As a result of this amalgamation, all of the rights, title, interests, liabilities and obligations of Cumberland and MMC are automatically, by law, transferred to and assumed by AEM. Therefore in all Type-A Water License documents, the terms ‘Cumberland’, ‘Meadowbank’, ‘MMC’ and ‘AEM’ are to mean the same entity: ‘Agnico-Eagle Mines Limited’.

SECTION 2 • ORGANIZATION & JOB RESPONSIBILITIES

This section details the roles and responsibilities of all parties involved in emergency response planning and implementation at the Meadowbank mine site. Additional roles and responsibilities are also provided in the OHSP, HMMP and SCP.

2.1 INTERNAL RESOURCES

2.1.1 All Employees

All employees are responsible for:

- ensuring site and personnel safety
- knowing the location of first aid stations and supplies, emergency and safety equipment (e.g., fire water pumps, fire extinguishers, monitors, self-contained breathing apparatus), Materials Safety Data Sheets (MSDS), emergency exits, and muster stations
- wearing appropriate personal protective equipment (PPE) for the task at hand
- reporting all emergencies to their supervisor
- calling the emergency phone number **(to be defined in finalized version of ERP)**, reporting by radio on the dedicated emergency channel #2, or by contacting the On-Scene Coordinator to describe the type, location, and nature of the emergency, including possible injuries or trapped personnel, and the presence of any chemical or explosive hazards.

2.1.2 Supervisor

The supervisor is responsible for:

- ensuring personnel under their supervision are provided with and are wearing appropriate PPE for the task at hand
- performing a preliminary assessment of the emergency
- notifying the On-Scene Coordinator of the emergency to provide details regarding the type, location, and nature of the emergency, including possible hazardous materials involved and health and safety concerns
- taking roll calls at muster stations to confirm that all employees are present and accounted for in the case of evacuations, and immediately notifying the On-Scene Coordinator if any employee(s) does not report to his or her muster station.

2.1.3 On-Scene Coordinator

The On-Scene Coordinator is responsible for:

- assuming overall authority in the emergency (other than medical)
- evaluating the emergency and developing a response plan
- ensuring the safety of all personnel and the site
- activating any required contingency plans (see OHSP, HMMP, and SCP)
- ensuring that the emergency is reported to appropriate regulatory officials and Meadowbank project personnel
- alerting and assembling all required resources (people, equipment, and materials) to handle the emergency
- assessing the requirements for additional resources in light of what resources are immediately available
- mobilizing additional resources that may be required and arranging for the transportation of necessary personnel, equipment and/or materials to the site
- with aid of the Emergency Response Team Coordinator, assuring that the emergency response team is provided with proper personal protective equipment
- providing regulatory agencies, MMC, and mine management personnel with information regarding the status of the emergency
- if authorized by the General Mine Manager, acting as a spokesperson with the public and media, as required
- assisting the General Mine Manager with regulatory and licensing reporting requirements, including gathering relevant information and submitting any formal reports (within the required time frame) to the applicable regulatory agencies and MMC management detailing the occurrence of an emergency; this includes submitting an incident reporting form
- assisting in developing and implementing emergency response training programs and exercises
- involvement in annual reviews of the ERP with the Occupational Health & Safety Committee (HSC).

2.1.4 Emergency Response Team

The site will have an Emergency Response Team (ERT) that will be trained and responsible for fire fighting, controlling spills, and assisting with medical and other emergencies that may occur at the Meadowbank site. These team members will attend regular training sessions.

2.1.5 Emergency Response Team Coordinator (ERTC)

The responsibilities of the Emergency Response Team Coordinator (ERTC) are to:

- mobilize all ERT personnel, equipment, personal protective equipment and supplies as required to the site of the emergency
- assist in developing and implementing emergency response training programs and exercises

- assist the On-Scene Coordinator in handling the emergency
- assume fire safety coordination until a Fire Safety Coordinator is appointed.

2.1.6 Environmental Advisor

The following are the responsibilities of the Environmental Advisor:

- provide technical advice on probable environmental effects resulting from a spill and how to minimize them
- provide advice to the On-Scene Coordinator for appropriate spill response procedures
- if authorized by the General Mine Manager, act as a spokesperson with the public, media, and government agencies, as required
- be involved in emergency response training exercises
- contribute to the annual review of the ERP with the HSC
- assist in implementing a routine site inspection and recording/reporting program for environmental spills. This program will address all applicable issues in relevant legislation pertaining to chemical handling, storage, labelling, use, reporting, and health and safety requirements
- assist in developing sampling and testing or monitoring programs of water or soil that has been or may have been directly affected by a spill
- Maintain and update the EMS.

2.1.7 Fire Safety Coordinator

The role of Fire Safety Coordinator is currently assumed by the ERTC; however, these roles will be separated once operations begin at the mine site. The General Mine Manager will ensure that a Fire Safety Coordinator is identified. The following are the responsibilities of the Fire Safety Coordinator:

- Review and update Emergency Fire and Evacuation Procedures on a minimum annual basis
- Consolidate and maintain site Fire Prevention and Fire Response Plans
- Maintain all plans, records, and logs relating to fire prevention and response
- Ensure fire incident reports are filed detailing the causes and responses to fires
- Assist in developing and implementing emergency fire response training and exercises
- Ensure that all fire fighting equipment is inspected regularly and maintained functional
- Ensure that fire fighting personnel is properly trained, including routine fire fighting exercises.

2.1.8 Safety Superintendent

The Safety Superintendent will be responsible for:

- monitoring contractors' health and safety performance for compliance with applicable legislation and their own safety programs
- ensuring that all new site personnel are properly oriented
- maintaining up-to-date copies of all site procedures and making them available to new personnel
- acting as secretary for the HSC
- performing monthly HSC tours and meetings
- ensuring that the HSC contains representatives from employers, employees, and all major contractors
- ensuring proper and timely documentation/reporting of inspections, investigations, and meetings
- in cooperation with the environmental department, dealing with wildlife issues (such as animals getting into garbage, etc.) in accordance with the mitigation measures set out in the wildlife section of the Environmental Impact Assessment (EIA)
- assisting in conducting emergency response exercises
- sending inspection reports and minutes to the Worker's Compensation Board (WCB) Prevention Services Mines Inspection Group
- if authorized by the On-Scene coordinator, contacting external resources to assist in assessing the scope of losses as a result of the emergency,
- implementing a routine site inspection and recording/reporting program for environmental spills. This program will address all applicable issues in relevant legislation pertaining to chemical handling, storage, labelling, use, reporting, and health and safety requirements.

The Safety Superintendent may require the assistance of outside persons to conduct damage assessments beyond the scope of the capabilities of on-site personnel. The Safety Superintendent, with the assistance of the General Mine Manager, will identify an appropriate resource for damage assessment. When identified, this person or organization will be listed in this ERP.

2.1.9 General Mine Manager

The General Mine Manager is responsible for implementing and maintaining the ERP. In addition, the General Mine Manager's responsibilities are to:

- act as a spokesperson on behalf of MMC with the public, media, and government agencies, as required
- prepare and submit any formal reports (within the required time frame) to regulators and MMC management detailing the occurrence of an emergency; this includes submitting an incident reporting form
- co-chair the HSC

- ensure that the On-Scene Coordinator has the means (financial and otherwise) to ensure that all required resources are made available, or provided from off-site if required
- work with the Human Resources 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 at least semi-annually (four times per year for emergency fire, power system failure, and fuel storage/distribution system failure response), and emergency response training is completed 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 HSC, with particular emphasis on the objectives and methods of the plan, and the job descriptions of all positions named within
- ensure that this ERP remains up-to-date, and that updated versions are distributed to the personnel on site, and external agencies, organizations and selected qualified external responders
- 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
- keep a formal record of distribution and amendments to the ERP
- complete annual internal audits of the EMS, including ERP, and arranging for external audits of the system every three years by independent specialists.

2.1.10 Project Construction Manager

The Project Construction Manager is potentially required to inform team members of the detailed nature of the operations to be performed in the event of a facility malfunction causing an emergency during the construction phase. The responsibilities of the Project Construction Manager are as follows:

- liaise with MMC personnel resources and keep them informed of emergency activities
- assist the On-Scene Coordinator and ERT as needed, particularly in obtaining any additional resources not available onsite for emergency response.

2.1.11 Human Resources Superintendent

The following are the responsibilities of the Human Resources (HR) Superintendent:

- maintain emergency and health and safety records

- assist in conducting emergency response exercises
- track all emergency and health and safety training that on-site staff have received, and when retraining will be required
- notify the On-Scene Coordinator when retraining is required
- ensure that employees are retrained in appropriate emergency response skills, Workplace Hazardous Materials Information System (WHMIS) training, Hazard Communication (HAZCOM), Occupational Health and Safety Administration (OHSA) training, first aid, and respirator fit-testing prior to expiry of existing training certification
- consult with appropriate organizations regarding retraining requirements and schedules.

2.1.12 Health Professional (Site First Aid)

The on-site health professionals are responsible for the following:

- providing on-site first aid and other medical support
- providing additional training for ERT members
- ensuring that the first aid room is properly organized and equipped with advanced first aid equipment
- ensuring that the first aid room is maintained at all times.

2.1.13 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. The roles and responsibilities of these individuals in the event of an emergency are clearly defined in the various emergency procedures. The Camp Maintenance Personnel are responsible for the following:

- ensuring that smoke detectors and site fire extinguishers are in proper working order
- ensuring that muster stations remain clear of debris and any other materials that may restrict or limit access
- performing regular inspections of fire warning and firefighting equipment.

2.1.14 Emergency Response Contact Information

Emergency response personnel, their duties, and phone numbers will be compiled in Table 2.1 prior to construction and will be in effect once the project becomes active. Important external contacts such as regulatory agencies, health organizations and transportation companies providing evacuation support are listed in Table 2.2. This information will be made available to all necessary personnel and regulators.

Table 2.1: Emergency Response Contact Information Chart

Position	Name/Location	24-Hour Contact #
Territory Government	NT-NU 24-HOUR SPILL REPORT LINE	Ph 867.920.8130
On-Scene Coordinator	To be announced	Ph Fax Radio channel #2 Globalstar
Emergency Response Team Coordinator	To be announced	Ph Fax Radio channel #2 Globalstar
Emergency Response Team	Emergency response personnel available on site to assist with spill and emergency response activities	Ph Cell 24 Hr Pager
General Mine Manager	Martin Bergeron	Ph Fax Radio channel #2
Assistant General Mine Manager	To be announced	Ph Fax Radio channel #2
Environmental Advisor	To be announced	Ph Cell 24 Hr Pager
Health Professionals	To be announced	Ph Cell 24 Hr Pager
MMC Management Representative	Daniel Kivari	Ph Fax
Meadowbank Senior Environmental Manager	To be announced	Ph Fax

Note: This table to be filled in at a later date as appropriate.

A number of the above positions are being filled right now and an update of this table will be forwarded to the authorities as soon as the people are hired.

Table 2.2: Other Important 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
Environment Canada, Environmental Protection Branch	867.669.4700	867.873.8185
Environment Canada: 24-hour emergency pager monitored by Emergency and Enforcement	867.920.5131	
Manager Pollution Control & Air Quality Environmental Protection, GN	867.975.5907	867.975.5981
INAC – Water Resources Manager Nunavut Regional Office	867.975.4550	867.975.4585
INAC – Land Administration Minister Nunavut Regional Office	867.975.4280	867.975.4286
INAC – General Inquiries	867.975.4275	
KivIA - Reporting Line	867-645-2810 or 867-645-2800	
DFO – Nunavut Regional Office	867.979.8000	867.979.8039
Baffin Regional Hospital (Iqaluit)	867.979.7300	
Cambridge Bay RCMP	867.983.2111	
Fire Marshall's Office	867.873.7944	
Department of Environment Health	867.983.7328	
Poison Control Centre	867.920.4111	
CANUTEC (Spill Support Information)	613.996.6666	
Charter Aircraft (for Evacuation)		
Air Tindi	867.669.8200	
First Air	867.983.2077	
Arctic Sun West	867.873.4464	
Nunasi Helicopters	867.873.3306	
Canadian Helicopters	867.669.9604	
Great Slave Helicopters	867.873.2081	
Adlair Aviation	867.983.2569	

2.2 EMERGENCY COORDINATION CENTRE

Emergency operations will be directed out of the Emergency Coordination Centre (ECC) and the Incident Command Centre (ICC). The ECC will be located in a safe, secure place, 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
- information on the emergency will be stored and disseminated to all necessary internal and external parties.

The following information will be 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
- copies of the ERP, media and communications plan, specific action plans (e.g. Emergency Preparedness Plan for Dikes)
- 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.

2.3 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, MMC 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 and spill response 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:

- a review of the SCP and responsibilities of the team members
- the nature, status, and location of fuel and chemical storage facilities
- the location of on-site and off-site spill response equipment, and how to use it
- emergency contact lists
- desktop exercises of “worst case” scenarios
- the likely causes and possible effects of spills.

All employees will be offered standard first aid training by certified first aid instructors on an annual basis. All instructors will also be highly qualified in emergency response and prevention methods.

All personnel and contractors at the project site will be familiar with emergency reporting requirements. This will be maintained by ensuring that all contractors and new personnel attend an orientation and training program on initial emergency response procedures. Retraining will occur annually.

Fuel handling crews will be trained in safe operation procedures, spill prevention techniques, and initial spill and emergency response. Staff working with the process and wastewater systems will also be trained in safe operation procedures. Retraining of these crews will occur annually. Training will include regular WHMIS and Transportation of Dangerous Goods (TDG) training given by certified trainers to all employees that use, or are responsible for, chemicals on site.

Additional safe chemical handling training will be conducted for employees handling or working in the vicinity of dangerous chemicals such as acids, explosives, and fuels. Retraining will occur annually. Retraining for TDG will be completed every three years.

OSHA or Mine Safety and Health Administration (MSHA) health and safety training will be given by certified trainers to all new employees that will be handling, or be responsible for, chemicals. Annual refresher courses will also be provided. Certified trainers will provide the OSHA or MSHA training.

International Air Transport Association (IATA) training will be provided by qualified instructors to all individuals responsible for shipping and receiving materials by air.

Contractors who will be on site for extended periods will be required to have trained supervisors in first-aid, mine rescue and emergency response and to offer training to their employees. Retraining for these contractors will be tracked by the HR Superintendent. 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.

2.4 EXTERNAL RESOURCES

2.4.1 External Emergency Response Contractors

In certain emergency situations, particularly those that occur off-site, MMC may call on External Emergency Response Contractors to assist at the scene. MMC will compile a list of approved specialist emergency response contractors, including their expertise and contact details, prior to the commencement of operations on site. This list will be included as Table 2.3 in future versions of the ERP.

Table 2.3: External Emergency Response Contractors

Company Name and Contact	Mobilization Location/Estimated Time	General Number	24-Hr Response Number	Response Area of Expertise

Note: This list will be completed before the start of the mine construction activities.

2.4.2 Legal Counsel

The responsibilities of the Legal Counsel are to:

- advise the General Mine Manager and Environmental Advisor on the legislative authority of various government agencies
- provide advice on questions of due diligence
- determine costs, fines and liabilities, including penalties associated with regulations
- consult with the Corporate Insurance Coordinator and advise the General Mine Manager on insurance matters.

2.4.3 Fisheries and Oceans Canada

Fisheries and Oceans Canada (DFO) is responsible for protecting watercourse/marine habitat as specified in the *Federal Fisheries Act*. DFO`s application of the Fisheries Act in Nunavut works on the premise that there should be “no-net-loss” of fish habitat.

2.4.4 Indian & Northern Affairs Canada

Indian and Northern Affairs Canada (INAC) is responsible for land tenure agreements on Crown land. Therefore, the activities of waste disposal, open pit mining, road alignment, land reclamation, and closure, as well as sources of borrow materials, on crown lands fall within their jurisdiction. Resource Management Officers may conduct inspections for INAC from time to time. The INAC general inquiries number is (867) 975-4275.

2.4.5 Environment Canada

Environment Canada enforces the *Canadian Environmental Protection Act* and Section 36 of the *Federal Fisheries Act* through its Environmental Protection Branch. The Canadian Wildlife Service, a division of Environment Canada, governs issues pertaining to wildlife. The Environment Canada 24-hr Emergency Pager number is (867) 920-5131.

2.4.6 Nunavut Water Board

Water licenses will be issued by the Nunavut Water Board according to the Acts and Regulations governing the project area. These licenses govern limits of water use, sources of water use, effluent discharge limits, monitoring and reporting requirements. Inspections of water license conditions are conducted from time to time by INAC inspectors.

2.4.7 Nunavut Department of Environment

The Department of Environment is responsible for ensuring that spill contingency planning and reporting regulations are enforced as outlined in the *Environmental Protection Act*. Cleanup orders for spills are issued from the Department of Environment.

SECTION 3 • EMERGENCY RESPONSE EQUIPMENT

The ERTC 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, skimmers, 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
- location of first aid stations and muster areas.

The General Mine Manager, On-Scene Coordinator, ERTC, 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.

External emergency response equipment includes the mobile emergency response equipment described in the SCP.

SECTION 4 • COMMUNICATION SYSTEMS

The primary basis for communication will be the phone system; back-up communication will be available via satellite. For on-site communication, hand-held radios will be mandatory for all employees working or travelling in remote areas from the main camp. 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 Professional will carry a hand-held radio and will be available at all time. 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. A notice will be posted weekly providing the name and room number of the person on call. 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.

A procedure for emergency communications will be developed prior to the start of operations to describe the proper use of these components.

SECTION 5 • EMERGENCY SCENARIOS

This section identifies possible emergency scenarios and outlines the proper response to each situation.

5.1 FIRE

Fires may occur in any area within the surface facilities on-site. It is the responsibility of the Fire Safety Coordinator to ensure that Emergency Fire and Evacuation Procedures are developed and maintained for the different mine areas where fires may occur. These will include, but are not limited to, the following:

- the process plant
- the security office
- maintenance areas
- the helicopter pad/fuel storage area
- the airstrip and associated facilities
- the tank farm
- accommodations/office complexes
- explosives storage, mixing, and supply areas.

The Emergency Fire and Evacuation Procedures will, at a minimum, include the following:

- an up-to-date general site plan
- plans showing fire escape routes as appropriate (any escape route plans will be prominently posted in the immediate working areas), and muster areas
- a camp plan showing room numbers
- an accommodations list highlighting, for example, the key site ERT personnel, the Health Professional, and the first aid room
- building floor plans showing fire extinguisher and other fire fighting equipment locations for all site buildings and facilities (including contractor buildings)
- the locations of spill kits and other spill cleanup equipment/supplies
- the locations of emergency first aid supplies and equipment
- up-to-date development plans for the underground excavation
- roles and responsibilities for all applicable employees, with a chain-of-command clearly stated
- a plan of action
- a follow-up reporting and documentation process

- a tracking system to ensure that the Procedure is up-to-date, and to ensure that the most current document is being used by personnel.

The Fire Safety Coordinator will also ensure that up-to-date Fire Prevention and Fire Response plans are maintained and prominently displayed in the camp as well as the process plant buildings.

The Fire Prevention Plan will:

- include roles and responsibilities of personnel involved in fire prevention
- ensure that records obtained from previous fire reports and training exercises are used to determine areas for improvement
- address the requirements of territorial and federal fire codes at all site facilities regarding fire prevention
- identify all sources of combustion or sparks and ensure that procedures are in place to eliminate “fuel” from being stored in the vicinity of these combustion sources—these include smoking policies and “hot work” procedures
- be tracked through document control processes to ensure that the most recent version is available
- be audited to ensure that the procedures and activities described in the plan are being carried out.

The site Fire Response Plan will include instructions for all personnel in the event of a fire, designated muster areas, designation and duties of various emergency response personnel, coordination of fire training and drills, as well as maintenance of all plans, records, and logs relating to fire prevention and response.

The ERTC currently assumes the dual role of Fire Safety Coordinator. In future stages of operations, these roles will be separated. The General Mine Manager will ensure that a Fire Safety Coordinator is identified, and that fire response and prevention procedures and plans are kept current as facilities change or expand, or as chemical use changes. The General Mine Manager will also ensure that training exercises in Emergency Fire Response Procedures (i.e., “fire drills”) occur at least four times per year, and that records of these training exercises are retained for a period of no less than two years. The results of these exercises will be used to refine procedures, where necessary, to minimize response time and maximize employee safety.

Adequate numbers of fire extinguishers and other fire control systems will be available and checked monthly by the Mine Maintenance Personnel. A log of the inspections will be kept. Large-capacity wheeled fire extinguishers will be located near high-risk areas such as the generator facilities, the Camp Kitchen, Tank Farm Fuel Distribution Module, and the power generators. ERT firefighting equipment will be in one location. Equipment such as fire pumps and hoses will be located on board a dedicated vehicle that will be used only for emergencies. In addition, all mobile equipment (pickup truck size and larger) will be equipped with either a built-in fire suppression system or appropriately sized hand-held fire extinguishers mounted in a readily accessible location.

The Camp Complex and Process Plant will be equipped with a fire detection and audible fire warning system. All site operating personnel will receive basic training in the use of fire extinguishers. This training will be tracked by the HR Superintendent, and retraining will occur annually. In addition, a fire fighting plan will be in place and the ERT will practice monthly. These practices will be tracked, and records will be kept 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. Attendance will be taken to account for all personnel. Employees will remain in this area until assigned other duties by the ERT or until given clearance that the emergency is over.

In the event that a fire causes damage to mining equipment, site buildings, or chemical containers, particulates and/or gases could be released into the air, and hazardous materials and/or other chemicals (e.g., fuels, oils, battery acid, lime, etc.) could be spilled. In the short-term, this could result in air quality degradation, and potentially affect the local vegetation in the case of a spill or burn scar. Should such scenarios occur, the following actions will be taken, as required and WHEN IT IS SAFE TO DO SO:

- air quality monitoring for airborne emissions
- collection and incineration of all putrescibles (food items)
- removal of debris and contaminated soil for disposal on-site or off-site at a licensed disposal facility
- segregation of debris by material type (e.g. metals and plastics)
- disposal of residue in an appropriate disposal facility.

Further details on the cleanup of chemical spills are provided in the Spill Contingency Plan.

Incident Reports are to be filed detailing the causes of the fires and responses undertaken. This information will be used by the Fire Safety Coordinator in subsequent fire prevention activities.

5.2 SERIOUS INJURIES

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. If required, the Health Professional will make immediate contact with the closest hospital to await instructions and initiate an emergency evacuation.

As soon as steps have been implemented to properly attend to the injuries, the On-Scene Coordinator 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.

5.3 PIPELINE BREAKAGE

Pipelines will be used to transport tailings solids, reclaim water, freshwater, and domestic sewage on site. Upon finalization of the mine facility plan, a plan and procedure will be developed by the On-Scene Coordinator, the ERTC, and the Safety Superintendent to address the potential for pipeline breakage. The plan and procedure will be reviewed by the HSC, approved by the General Mine Manager and maintained by the On-Scene Coordinator.

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 substances (domestic sewage only). 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
- 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
- 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 SCP.

5.4 TOXIC GAS RELEASES

A plan and procedure for toxic gas releases will be developed upon finalization of the mine facility plan and chemical use/storage facilities. Potential sources of gas release will be identified, and appropriate safety and environmental measures will be described to mitigate this issue. The plan and procedure will be developed by the On-Scene Coordinator and the ERTC, reviewed by the HSC, and approved by the General Mine Manager.

In the event of a toxic gas release, the following actions will be taken:

- Immediately evacuate the area/building and notify the ERTC
- If possible and safety permits, turn off the source of the gas and ventilate (i.e., open windows/doors to outdoors) the area
- Isolate the area and restrict access to ERT personnel only

- Implement air quality monitoring.

A general response procedure for the release of compressed gases is provided in the SCP.

5.5 EXPLOSIONS

MMC commits to develop and document appropriate spill and emergency response plans for all explosives and explosive materials. Potential sources of explosions will be identified, and appropriate safety and environmental measures will be described to mitigate this issue.

The plans and procedures will be developed in consultation with the On-Scene Coordinator and the ERTC upon finalization of the mine facility plan and chemical use/storage facilities. The plans and procedures will require review by the HSC and approval by the General Mine Manager.

General action plans for spills of ANFO explosives and ANFO explosive materials are outlined in the SCP. MMC will review this information prior to mine operations to assess the requirement for further site specific details.

5.6 WATER & WILDERNESS INCIDENTS

All employees will notify their supervisors prior to conducting any wilderness or water work. The supervisors are responsible for ensuring that the employees receive the appropriate training to safely work in these conditions. Whenever anyone has to travel in remote areas outside the main camp, the emphasis will be on proper up-front planning and preparation to prevent an incident or minimize the danger in the event of a problem. All employees will ensure that the following pre-travel preparations are implemented:

- notify your supervisor as to where you will be, how you are travelling, and when you expect to return—the supervisor is responsible for monitoring this and identifying any loss of contact or delay in returning
- dress appropriately
- maintain contact using a two-way radio
- carry ‘bear bangers’
- bring basic emergency supplies, including appropriate safety equipment
- travel in pairs when possible (two snowmobiles in winter)
- if travelling by snowmobile or boat, make sure basic mechanical spares (tools, drive belt, etc.) are with you.

5.7 MOBILE EQUIPMENT/AIRCRAFT INCIDENTS

All mobile equipment or aircraft accidents (whether or not the incident involves an injury) will be investigated by the General Mine Manager, who will in turn generate a report. The report will be delivered to MMC management, and applicable federal and/or territorial regulatory bodies, depending on the environments affected by the incidents. The On-Scene Coordinator will retain the reports and review them for potential improvements that can be made to existing procedures to prevent further incidents or to improve response activities according to continuous improvement processes.

If the incident involves personal injuries, it will be dealt with as noted in the Serious Injuries section of this plan (Section 5.2). In all cases, the safety of the rescue personnel and the removal of any victim (under the direction of the Health Professional, if possible) to a safe location is a priority.

In the event of a significant aircraft incident, the company owning the aircraft will be notified as soon as possible. If the incident involves an aircraft crash, residual fuel, batteries, lubricants, and other hazardous materials will be secured in suitable containers and transported to site for temporary storage for off-site disposal at a licensed disposal facility. Any dispersed debris will be collected, segregated and transported to the site landfill or incinerated.

In the event that a transport truck overturns causing its contents to spill, the site crane, boom truck, excavator and vacuum truck will be mobilized to the scene to contain and absorb/remove the spilled material. The construction of temporary isolating dikes, berms, booms, sumps, collection ditches, etc. may be required to locally contain spilled materials prior to any removal or neutralization activities. Spill residues in the affected area will be neutralized following the procedures detailed in the SCP, and monitoring for residual contaminants and effects will be undertaken.

Any remaining cargo will be removed, pumped out, transferred, and/or otherwise suitably contained for transport to the mine site.

5.8 POWER SYSTEM FAILURE

A Power System Failure Plan and Procedure will be developed during detailed project design. Specifically, the plan will address, but will not be limited to, back-up power systems, emergency responses to evacuate personnel from the mine if dewatering or ventilation systems fail, and emergency heating and lighting systems. The General Mine Manager will be responsible for development and implementation of this plan and procedure. The plan and procedure will be reviewed by the HSC. Exercises will be scheduled and conducted by the On-Scene Coordinator at least four times per year to test this emergency procedure. Records will be retained for the On-Scene Coordinator to improve the plan; improvements will be documented and approved by the General Mine Manager.

5.9 FUEL STORAGE OR DISTRIBUTION SYSTEM FAILURE

A plan and procedure will be developed to address the potential of fuel storage or distribution system failures at the site upon finalization of the mine facility plan. The plan and procedure will be developed by the On-Scene Coordinator, the ERTC, and the Safety Superintendent. The plan and procedure will be reviewed by the HSC. The procedure will be approved by the General Mine Manager and maintained by the On-Scene Coordinator.

The procedure will be tested during exercises conducted by the On-Scene Coordinator at least four times per year. Improvements may be made to the procedure or plan upon approval by the General Mine Manager in accordance with the records, monitoring and measurement, and continual improvement processes.

5.10 WATER TREATMENT SYSTEM FAILURE

Failure of the water treatment system will be addressed by a plan and procedure to be developed upon finalization of the mine facility plan by the On-Scene Coordinator, ERTC, and Safety Superintendent. The plan and procedure will be reviewed by the HSC, approved by the General Mine Manager and maintained by the On-Scene Coordinator.

The plan and procedure will require the development of a protocol for the storage of untreated water in the water management pond until the treatment system can be brought back into service. Timelines for repairs and storage capacities of this water management pond would be detailed in this plan and procedure, if applicable.

5.11 DIKE FAILURE

A detailed Emergency Preparedness Plan (EPP) and procedures will be developed to address the consequences of failure of any of the dikes on site. The procedure will be developed the ERTC and the Safety Superintendent with the assistance of the dike designer. The plan and procedures will be reviewed by the HSC, approved by the General Mine Manager, and maintained by the On-Scene Coordinator.

Potential failure scenarios of the dikes and Tailings Storage Facility are provided in Appendix A. Dike details are provided following the detailed designs for the dike structures (Golder 2007a, 20067b). MMC commits to updating this ERP to include as-built conditions following the completion of dike construction.

SECTION 6 • INITIAL ACTIONS FOR EMERGENCIES

6.1 ON-SITE EMERGENCIES

In the event of an emergency, the employee who first notices the event shall immediately notify his or her supervisor and provide details regarding the type of emergency and its location. The supervisor responding to the emergency notification will:

- quickly assess the emergency
- notify the On-Scene Coordinator of the emergency and provide details regarding the type of emergency, location, possible hazardous materials involved, and health and safety concerns
- notify all employees in the immediate area of the emergency
- be prepared to evacuate employees if necessary.

The On-Scene Coordinator will assess the emergency to determine if it can be handled readily by staff and resources in the area or whether a specialized ERT is necessary. If the emergency is minor, the coordinator will follow the Level 1 Emergency Procedure (minor). If the emergency cannot be handled by the staff and available on-site resources, the coordinator will initiate a Level 2 Emergency Procedure (serious). If help is required from outside sources, the coordinator will initiate a Level 3 Emergency Procedure (outside help required). These three emergency designations are explained below.

Additional information on emergency procedures, including hazardous materials and MSDS, can be found in the OHSP, HMMP and SCP.

6.1.1 Level 1 Emergency (Minor)

If the emergency is minor, the On-Scene Coordinator will supervise response activities and control the emergency. Qualified employees will address and control the emergency under the direction of the On-Scene Coordinator.

6.1.2 Level 2 Emergency (Serious)

In the event of a Level 2 Emergency, the steps outlined below will be followed:

- the Emergency Response Team will be contacted and mobilized to address the emergency
- all supervisors will be contacted by radio by the On-Scene Coordinator to inform them that an emergency has occurred
- if deemed necessary, the On-Scene Coordinator will authorize the sounding of the general alarm and order supervisors to evacuate personnel as necessary
- the On-Scene Coordinator will notify the Environmental Advisor of the emergency and a course of action for the appropriate response to protect the environment will be determined

- the On-Scene Coordinator will notify the Safety Superintendent of the emergency (external resources may be used to assist in assessing the scope of losses).

The On-Scene Coordinator will notify MMC and Legal Counsel, in writing, of an emergency. The written report will include all information pertaining to the emergency, from initial call records to all activities carried out to address the emergency. All external parties contacted to assist in the emergency will be noted, and follow-up documentation of cause and future prevention options will be included in the report. The General Mine Manager will review and co-sign the report, which will be delivered within 48 hours of the emergency.

MMC management and Legal Counsel, or their designates, will advise the General Mine Manager, and assist in informing the public and media, as required.

6.1.3 Level 3 Emergency (Outside Help Required)

For a Level 3 Emergency, the On-Scene Coordinator will follow the same steps as those outlined in the Level 2 Emergency action list above, except that the On-Scene Coordinator will follow a specific protocol for contacting the appropriate external resources.

6.2 OFF-SITE EMERGENCIES

Notification of off-site emergencies will be initiated by calling the 24-hour emergency telephone number **(to be defined in finalized version of ERP)** or by radio on the dedicated emergency channel #2. The persons receiving these calls will be trained to handle emergency calls and will document the details of the emergency using an Incident Reporting Form. The call operator will then contact his or her supervisor, who will in turn contact the On-Scene Coordinator. The On-Scene Coordinator will then follow the procedures outlined above for Level 1, 2, or 3 Emergencies, as required.

6.3 ROAD EMERGENCIES

The proposed 110 km All-Weather Private Access Road will extend from Baker Lake to the mine site. The road will be constructed to accommodate large trucks transporting mine materials and supplies to site throughout the year. Access to the road will be limited to mine vehicles only, for the duration of mine development, operations and closure.

Emergencies occurring on this road outside of the mine site will be handled according to the SCP and HMMP.

SECTION 7 • 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.

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. March 2007a. Final Report Detailed Design of Dewatering Dikes, Meadowbank Gold Project, Volumes 1 to 3.

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 8 • LIST OF ACRONYMS

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
ERP	Emergency Response Plan
ERT	Emergency Response Team
ERTC	Emergency Response Team Coordinator
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
ICC	Incident Command Centre
INAC	Indian and Northern Affairs Canada
MMC	Meadowbank Mining Corporation (Cumberland)
MMER	Metal Mining Effluent Regulations
MSDS	Materials Safety Data Sheets
MSHA	Mine Safety and Health Administration

OHSA	Occupational Health and Safety Administration
OHSP	Occupational Health & Safety Plan
PPE	Personal Protective Equipment
SCP	Spill Contingency Plan
TDG	Transportation of Dangerous Goods
TSF	Tailings Storage Facility
WCB	Worker's Compensation Board
WHMIS	Workplace Hazardous Materials Information System

APPENDIX A

Dike Failure Scenarios

Dewatering Dikes A.1

Central Dike A.2

Saddle Dams A.3

Stormwater Dike A.4

Appendix A.1

Dewatering Dikes

DEWATERING DIKE SYSTEM

The Dewatering Dike System includes the East Dike, Bay Zone Dike and the Goose Island Dike, as shown on the general mine site plan provided at the beginning of this document. The dike construction methodology will involve the advancement of two rockfill berms into open water, followed by infilling the space between the rockfill berms with till, installation of a cutoff wall, and bedrock and bedrock-cutoff contact grouting. The dike section will consist of a downstream rockfill berm that is 20 to 30 m wide at the crest to allow haul truck traffic, a two zone granular filter placed against the upstream face of the downstream rockfill berm, a till core that is a minimum 5 m wide at the lakebed, and an upstream rockfill berm that is 30 m in width at the crest. The total crest width will be on the order of 70 m to 134 m, depending on water depth. A one metre wide cutoff wall extends through the till core and the foundation till to the bedrock surface. The cutoff element is designed against erosion associated with hydraulic gradients, and may be soil-bentonite, soil cement bentonite, or jet grout.

The dewatering dikes are considered high consequence structures, based on Canadian Dam Association (CDA, 1999) 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. The minimum calculated FoS exceed design criteria set out by CDA (1999) for the critical sections along the southeast segment of the Goose Island Dike. The sections examined included the deepest water, and the steepest lakebed slopes, and represent the 'worst case' dike sections. 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 comprehensive quality control and quality assurance program during construction, and an ongoing program of dike surveillance and monitoring during operations, as specified in the design.

East Dike

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 will be 840 m in length through an average water depth of approximately 2 metres, and a maximum water depth of about 6 m. Crest width varies from 77 to 93 metres. Minimum setback from the Portage Pit (distance between dike toe and pit crest) is greater than 180 metres.

Bay Zone Dike

The Bay Zone Dike separates the Portage Pit from Third Portage Lake. The Bay Zone Dike acts as a temporary structure to allow mining of the south end of Portage Pit.

The Bay Zone Dike will be approximately 1.2 km long, and will be constructed in water depths less than 10 metres at the cutoff. Crest width varies between approximately 85 and 100 m. Minimum design setback from the Portage Pit is 70 metres. Setback to the Goose Pit is greater than 100 m. The Bay Zone Dike will include a spur extending to the south, to aid in the construction of the Goose Island Dike.

Goose Island Dike

The Goose Island Dike will extend south from the Bay Zone Dike following the shallowest water where possible, to surround the Goose Island Deposit. The Goose Island Dike will be approximately 1.7 km in length and will be built in an average water depth of near 8 m, with a maximum water depth of 20 m in the south-east portion of the dike. Crest width varies from 82 to 134 metres. Minimum setback from pit crest to dike toe is 70 metres.

The cutoff for the Goose Island Dike will be constructed using slurry trench with soil-bentonite and soil-cement-bentonite backfills, and also by jet grout cutoff wall, with cutoff type depending on hydraulic gradient across the cutoff.

Potential dike failure scenarios are presented in Table A.1, along with consequences and actions.

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 or Second Portage Lake (excessive inflow is a far less likely scenario).	Water spilling over the crest. 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 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 daily 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 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 rockfill 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 available from the mining operation can be placed to raise the dike crest.

Failure Mode	Scenario	Consequence	Monitoring/Action
Internal Erosion	(1) Dike Section: Cutoff wall is defective, allowing high water flow. This defect occurs at a location where the till core allows high flows and where the filters are defective; the combination allows erosion of the till core.	The till core 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 till core near the filter. Will be most likely in deep water sections. Gradients across the till in shallow water may not be high enough to cause piping.
	(2) Dike Section: Cutoff wall loses bentonite because of improper construction.	Same consequences as erosion because of defect, as above.	As above.
	(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 cutoff wall allowing high flows. Seepage would lead to erosion of the cutoff 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.	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 cutoff is important, and most

Failure Mode	Scenario	Consequence	Monitoring/Action
			important for deep water sections. In the worst case, the pit may be deliberately flooded in a controlled manner, the cutoff 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 not 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 cutoff 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 offtake works or other structures extending through the dikes.	Not applicable.	Not applicable.
Slope Instability	(1) Normal Operation: 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 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 till 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.
	(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. 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 Cutoff Wall 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 cutoff 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. 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 cutoff would be done prior to dewatering.
Unexpected Settlements	Unexpected foundation soils consolidate during dike construction. A significant quantity of clay would be required to generate settlement required for a water release event. Settlement of the till core will be limited by surcharge loading.	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 cutoff wall. However, the rockfill has a very high flow-through capacity and will not move unless the foundation is involved. The water will flow through the upstream rockfill first, then through the till, and finally through the downstream rockfill berm. Flow through cracks opening in the foundation may erode the foundation soils and the till 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 a low permeability till core in addition to the cutoff wall 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 the 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 south end of the dike. In this area water depth is as much as 5.8 m at the centreline of 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 will be 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 the Bay Zone Dike, the worst-case scenario breach that could allow the greatest amount of water inflow would be associated with the western portions of the dike through the deepest water prior to the construction of the Goose Island Dike. In this area, the water depth is less than 10 metres at the cutoff wall, and the Portage Pit is as deep as 150 m. This inflow could potentially result in loss of workers caught in flowing water. Breach of the Bay Zone Dike would be unlikely to trap workers in the pit when access ramps are on the west side, to the north of inflows considered in this scenario. Breach of the Bay Zone Dike would result in cessation of mining, either temporarily or permanently. Once the Goose Island Dike is constructed, the effective length of Bay Zone Dike is reduced with a maximum water depth of approximately 7 m at the cutoff wall.

In the case of the Goose Island 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 cutoff, 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 Goose Island Dike would be unlikely to trap workers in the pit when access ramps are on the northwest side, opposite the inflows. Breach of the Goose Island Dike would result in cessation of mining of the Goose Pit, either temporarily or permanently.

In the unlikely even that such a failure of the Bay Zone or Goose Island 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 the lake is 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 Zone or Goose Island 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.

Mitigation, Management, and Monitoring

A major cutoff breach scenario due to pit wall movement, while possible, has a low probability of occurrence. If foundation movement was sufficient to compromise the cutoff wall, then the till core would act as a secondary low permeability element. Water would first need to flow through the rockfill shell, the till core, the damaged cutoff wall, and then through more of the till core, filters, and the downstream rockfill. Provided that the filter elements at the downstream interface of the till core and the rockfill shell are properly constructed, then migration of the till into the rockfill will not occur. Some additional seepage may occur due to failure of the cutoff wall; however this would be noted during regular monitoring. Mitigation could be by jet grouting, freezing, or installation of sheet piling through the cutoff wall. Consolidation of the till between the rockfill berms would also contribute to the integrity of the core material. This will occur naturally due to self-loading and assisted by loading the till core with rockfill during construction.

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 comprehensive quality control and quality assurance program will be undertaken.

Routine visual inspection of the dikes will be conducted on a regular basis to document any changes in the dikes.

During the operation of the dike, 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 cutoff wall would be monitored for pressure changes as the pit is deepened. Increasing pressure would indicate that less head loss is occurring across the seepage cutoff, 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 cutoff 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 cutoff under no-flow conditions, then dewater and resume mining.

Specific monitoring and mitigation strategies will be developed as part of an Operations Plan for the de-watering 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 Goose Island 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 till core could result in 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). 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.

Appendix A.2

Central Dike

CENTRAL DIKE SYSTEM AND TAILINGS STORAGE FACILITY

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 and downstream faces designed at a 1.5H:1V slope;
- An upstream two zone granular filter;
- A bituminous liner on the upstream face;
- An upstream cutoff trench through the foundation soils to bedrock; and
- A grout curtain through the fractured bedrock zone (at this time it has been assumed that the fractured bedrock is up to 20 m deep, based on available geotechnical drilling information along the dike alignment).

The Central Dike is a high consequence structure, based on Dam Safety Guidelines (CDA, 1999). 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.

Table A.2: Meadowbank Central Dike 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 rockfill, 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 deposit. Settlement would occur upon placement of rockfill 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.

Failure Mode	Scenario	Consequence	Monitoring/Action
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 rockfill. This is not a catastrophic failure mode, because the rockfill 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, foundation slopes down towards the tailings, so seepage impounds in the rockfill 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 rockfill. This is not a catastrophic failure mode, because the rockfill of the dike will be stable, and at its worst, would lead to temporary suspension of mining. Accumulation of ponded water within the rockfill 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.

Failure Mode	Scenario	Consequence	Monitoring/Action
Seepage within Embankment	Seepage on its own is not a credible failure scenario. The rockfill is pervious so seepage will not daylight on the downstream face. Flow through the rockfill 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 cutoff 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 build up 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.
Internal Conduit Rupture	There are no water offtake works or other structures extending through the dikes.	Not applicable.	Not applicable.

Failure Mode	Scenario	Consequence	Monitoring/Action
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 rockfill 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, 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 rockfill 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.

Failure Mode	Scenario	Consequence	Monitoring/Action
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. Also, the liner and rockfill can withstand significant deformation, making this an unlikely scenario.	Tailings and water escape into the dike rockfill, 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 rockfill, but this would not cause failure of the rockfill. It could also be readily repaired by placing more end-dumped rockfill, 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.2.1 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 down-stream 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, 1999). 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 will be developed for the operation of the tailings facility, and will include 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 to be installed include:

- Thermistors to monitor the thermal regime in the dike and foundations, and deposited tailings;
- Prisms to monitor deformations within the dike; and
- Piezometers to measure pressure and to infer flow through the dike and foundation materials.

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.2.2 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.

Appendix A.3

Saddle Dams

SADDLE DAMS

Saddle dams will be constructed around the limits of the tailings basin. The saddle dam locations are shown on the general mine site plan provided at the beginning of this document. The North Saddle Dam is not intended to retain tailings or water, but acts as a roadway and berm for the tailings discharge pipe. The South Saddle Dam acts as a road access and pipe berm and is also intended to act as a water retaining structure.

The saddle dams will be constructed by dumping a rockfill berm with a crest width of 30 m to allow haul truck traffic. The South Saddle Dam will be re-sloped, with a minimum 6 m crest width. The downstream face will be angle of repose, or 1.3H:1V (Horizontal:Vertical), and the upstream face will be 3H:1V. The South Saddle Dam will have an upstream two-zone granular filter and either a bituminous liner similar to the Central Dike, or a compacted till upstream impermeable element. The elevation of the South Saddle Dam will vary, with a maximum crest elevation of 148 m.

There is a potential for release of either attenuation water, reclaim water, or tailings to Third Portage Lake in the event of an overtopping or catastrophic failure at two topographically low areas or channels along the South Saddle Dam; one located at the north west end, and the other just south of the intersection of the Stormwater Dike and South Saddle Dam.

A.3.1 Failure Scenario during Operation

Depending upon the phase of operations, breach or complete failure of the South 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 South Saddle Dam to be 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.

In Years 1 to 4, the possibility of these events occurring at the northwest end of the South Saddle Dam is not credible for the expected site conditions as ponded water levels will be below the base of the Saddle Dam. However, there is the possibility that additional attenuation water storage is required resulting in an Attenuation Pond surface elevation higher than currently predicted. In this situation, water would be ponded against the northwest end of the South Saddle Dam; however, the water would consist of mine runoff that is currently predicted to meet discharge requirements. Some particle entrainment may occur from water flowing over or through the breached dike; however the effects caused by this are considered to be minor.

In later years, a tailings beach will be formed at the northwest location. As a result, the Reclaim Pond will be pushed southeast, away from the northwest end of the South Saddle Dam. As the tailings and Saddle Dam are expected to freeze, and freezing will reduce the chance of tailings reaching Third Portage Lake, failure of the South Saddle Dam at the northwest end 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 Dam 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.

Potential Effect

Should an overtopping event or breach occur in the South Saddle Dam just south of the intersection with the Stormwater Dike, 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 Dam 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 Dam 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.

Mitigation, Management, and Monitoring

The dams are designed according to Dam Safety Guidelines (CDA, 1999), and will be constructed under controlled conditions. A comprehensive quality control and quality assurance program 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 the South Saddle Dam by overtopping, full breaching or foundation and slope failure is not considered to be credible.

With respect to slope stability failure, the South 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 design criteria in the Dam Safety Guidelines (CDA, 1999) for static and pseudo-static conditions. Consequently, the probability of such a failure developing is low.

In the case of Saddle Dam failure just south of the intersection with the Stormwater Dike, the risk of loss of tailings or water is limited to the period of operation where the Reclaim Pond is located near the Dam. The tailings are expected to freeze, and freezing will reduce the chance of tailings reaching Third Portage Lake. The distance from Saddle Dam 3 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.

As stated, failure of the South Saddle Dam at the northwest end is not considered to be credible.

A.3.2 Failure Scenario during Closure

At closure Reclaim Pond water will be pumped to the treatment plant, the basin behind the Saddle Dam will be drained and filled with run-of-mine, acid-buffering ultramafic waste rock. The rock is expected to freeze over time. Failure of the South Saddle Dam 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 will be designed meet Dam Safety Guidelines (CDA, 1999). The dams will be constructed under controlled conditions. During the construction of the dams a comprehensive quality control and quality assurance program 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 South 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.

Appendix A.4

Stormwater Dike

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 will separate the tailings basin from the Attenuation Pond until approximately Year 6, at which point the Reclaim and Attenuation ponds will combine. 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 will be constructed using rockfill, with south face slope of 3H:1V, and a north face slope at angle of repose for rockfill. The minimum crest width will be 6 m. The dike will have a filter zone placed on the south face, underlying an impermeable element of either bituminous geomembrane, or compacted till. The maximum height of the dike will be about 13 m with a final crest elevation of 142 m. At the maximum cross section, the width of the base of the dike will be approximately 95 m.

A.4.1 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 South Saddle Dam at the northwest end, releasing tailings and reclaim water to Third Portage Lake.

Potential Effect

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.

Mitigation, Management, and Monitoring

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 will be constructed in the dry under controlled conditions. During the construction of the dike a comprehensive quality control and quality assurance program would be 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.

A.4.2 Failure Scenario during Closure

The Stormwater Dike will be covered by tailings during operations and will not exist at closure.

Potential Effect

There will be no environmental effect on the receiving environment.

Mitigation, Management, and Monitoring

None required.