MEADOWBANK SITE

DEWATERING DIKES

Operation, Maintenance and Surveillance Manual

Prepared by
Agnico Eagle Mines Limited

Version 12
March 2025

DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
(first revision)	February 2012	All	All	
V2	August 27, 2013	All	All	
V3	September 15, 2013	All	All	Updated items mentioned by MDRB and the Mine Inspector in the Annual Geotechnical Inspection in September 2013
V4	January 2015	All	All	Annual Update
V5	January 2016	All	All	Annual Update
V6	February 2017	All	All	Annual Update
V7	February 2018	All	All	Annual Update
V8	February 2019	All	All	Annual Update
V9	November 2021	All	All	Annual Update. Reviewed to comply with MAC Revised OMS Guide (2019)
V10	December 2022	All	All	Updated surveillance procedures
V11	January 2024	All	All	Annual Update
V12	March 2025	1.5 Table 2-1 Table 2-2 Table 3.4 Table 3-7 5.3	4 7 10 17 23 35	Update policies list AEO responsibilities update AEM personnel ED seepage update BGD seepage update Operating levels

Approved by:

2025-03-06
Thomas Lepine
Engineer of Record - Nunavut

Eric Haley
Environment & Critical Infrastructure Superintendent

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

SECTION 1 • INTRODUCTION

1.1 OBJECTIVE OF THE OMS MANUAL

This Operation, Maintenance and Surveillance Manual has been prepared by Agnico Eagle Mines Limited (AEM) and is to be used for the operation, maintenance, and surveillance (OMS) of the Dewatering Dikes at the Meadowbank Site which is part of the Meadowbank Complex.

This manual is intended as a practical document used by the personnel involved with the Dewatering Dikes at the Meadowbank Site. It incorporates Industry Standards as well as the AEM Corporate Standard and Policy on Water Management.

The objectives of this OMS manual are to define and describe:

- Roles, responsibilities, and level of authority of personnel who perform activities related to the Dewatering Dikes at the Meadowbank Site
- The infrastructures covered in the scope of this OMS manual.
- Plans, procedures, and processes for:
  - The operation, maintenance, and surveillance of the Dewatering Dikes at Meadowbank to ensure that they function in accordance with their design, meet performance objectives, and link to emergency response planning
  - Evaluating performance of the structures, and reporting performance results
  - Managing change

This manual contains protocols and information that will assist AEM to operate, maintain, and monitor the Dewatering Dikes in a safe manner and identify early signs of malfunction.

Elements related to design, construction, and closure of the Dewatering Dikes, and infrastructure related to water treatment are out of scope of this manual.

1.2 CONTROL OF DOCUMENTED INFORMATION

This OMS manual is a controlled document. The latest version of this document is available in Intelex. This Operation, Maintenance and Surveillance Manual may not be copied in whole or in part without the written consent of Agnico Eagle Mines Limited.

The Responsible Person (RP) is in charge of the preparation, update, and distribution of this manual. Any change to this OMS manual must be submitted to and approved by the RP who will be responsible to update the OMS manual in Intelex.

It is each user’s responsibility to ensure that they are using the latest version of this document.

The RP is responsible to communicate any change to this manual by e-mail to the distribution list in Table 1-1. They are responsible for maintaining an up-to-date distribution list of this manual.

Table 1-1 : OMS Manual Distribution List

Position	Name
General Manager	Eric Steinmetzer
General Superintendents	Pierre McMullen Mathieu Hotte
Environment & Critical Infrastructure Superintendent	Eric Haley
Engineering Superintendent	Alexandre Lavallée
Maintenance Superintendent	Frederic Dubé
Energy & Infrastructures Superintendent	Trevor Davies
Health & Safety Superintendent	Patrick Goldfinch
Engineer of Record, Nunavut Division	Thomas Lepine
Meadowbank Independent Review Board (MBK-IRB)	Anthony Rattue Kevin Hawton Ron Nicholson

1.3 MANAGEMENT OF CHANGE

This manual will be reviewed on an annual basis and revised as necessary to accommodate changes in the condition and operation of the facilities. The RP will be responsible to coordinate this review process.

In conducting the review and update of the OMS manual the following must be considered:

- Performance of the structures
- Current life cycle of the structures
- Change since the last review (site condition, critical control, risk profile, personnel, methodology, and technology for OMS activities)

In addition to the annually scheduled review, a review may be triggered by a significant event or may need to be updated in response to:

- Planned changes, such as change in surveillance instrumentation or methodologies, or introduction of new instrumentation methodology
- Changes in personnel or roles referred to in the OMS manual
- Other changes that may occur that need to be addressed prior to the next scheduled review of the OMS manual

The update needs to be completed in a timely manner following the document control criteria specified in Section 1.2.

As a good practice, the RP should organize on a yearly basis a session to present the changes in the OMS manual to the persons in its distribution list.

1.4 REQUIRED LEVELS OF KNOWLEDGE

To ensure safe operation of these structures, the personnel involved in the OMS activity must have a good comprehension of this manual and the factors that can impact the performance of these structures.

It is the responsibility of each person in the distribution list of this manual to be familiar with its content. They must also ensure that everyone under their supervision whose duty involves tasks related to the operation, maintenance, or surveillance of any component associated with the Dewatering Dikes have the appropriate level of knowledge and the resources to comply with the protocol presented in this document.

Table 1-2 below indicates a summary of the required level of knowledge of this Manual. General Knowledge refers to having read and understood the information. Detailed Knowledge refers to having sufficient understanding, training, and knowledge of the processes within a section to be able to carry them out as required.

Records that the requirements of this manual have been reviewed and that each person involved in OMS activity understands the processes and procedures relevant to their task should be kept up to date by each department and updated each time a new manual revision is done. This can be done by using a sign-off sheet.

Table 1-2 : Summary of Required Level of Knowledge of this Manual

Position or Task	Level of Knowledge	Objective
In the manual distribution list	General knowledge of All Sections Detailed knowledge of Section 1 and 2	• Understand their R&R related to OMS process • Ensure that the task are delegated to the people directly performing the activity and that they have the proper resources to accomplish them • Ensure that required training is provided
Supervise or perform operation task	Detailed knowledge of Section 5 General knowledge of Section 3, Table 7-3, and Section **Error! Reference source not found.**	• Have an in depth understanding of the Operation Process and their requirement • Be able to recognize visible sign of deficiency and to know how to communicate those
Supervise or perform maintenance task	Detailed knowledge of Section 6 General knowledge of Section 3, Table 7-3, and Section **Error! Reference source not found.**	• Have an in depth understanding of the Maintenance Process and their requirement • Be able to recognize visible sign of deficiency and to know how to communicate those
Supervise or perform surveillance task	General knowledge of All Sections Detailed knowledge of Sections 3, 5, 6, & 7	• Have an in depth understanding of the Surveillance Process and their requirement • Be able to recognise when there is a deficiency in an operation and maintenance process
Work routinely brings them in the vicinity of the structures for task not directly linked to Operation, Maintenance, or Surveillance	General knowledge of Section 3, Table 7-3, and Section **Error! Reference source not found.**	• Understand how their work might impact the structure • Be able to recognize visible sign of deficiency and to know how to communicate those

1.5 ALIGNMENT WITH POLICIES, GUIDELINES, AND REQUIREMENTS

This OMS manual aligns with the following regulator requirements, guidelines, and Standards. These documents can be found on Intelex:

- AEM, Corporate Standard on Water Management (AEM, 2021)
- AEM, Corporate Standard on Tailings Storage and Heap Facilities (AEM, January 2021)
- AEM Governance Policy for Critical Infrastructure (2020)
- AEM, Sustainable Development Policy (AEM, 2024)
- AEM, Tailings Management Policy (AEM, 2025)

- AEM Water Management Policy (AEM, 2025)
- AEM Geochemical Characterization Guide (AEM, 2017)
- International Cyanide Management Code (ICMC, 2021)
- Canadian Dam Association 'Dam Safety Guidelines' (CDA 2013) and 'Application of Dam Safety Guidelines to Mining Dams' (CDA 2019)
- Mining Association of Canada 'Guide to the Management of Tailings Facility' (MAC, Version 3.2 2021)
- Mining Association of Canada 'Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities' (MAC, Version 2.1 2021)
- Mining Association of Canada 'Toward Sustainable Mining Protocol, Water Stewardship' (MAC, November 2018)
- Mining Association of Canada 'Toward Sustainable Mining Protocol, Tailings Management' (MAC, June 2022)
- Nunavut Water Board, Meadowbank Water License (No. 2AMMEA15-30)

1.6 LINKAGE WITH EMERGENCY RESPONSE PLAN

An emergency is a situation that poses an impending or immediate risk to health, life, property, or the environment and which requires urgent intervention to prevent or limit the expected outcome.

This OMS manual addresses conditions related to operation under normal or unusual conditions, as opposed to emergency situations. An Emergency Preparedness Plan and an Emergency Response Plan (EPP/ERP) describes measures the Owner and, in some cases, external parties will take to prepare for an emergency, and to respond if an emergency occurs.

An OMS and ERP manual must be aligned. As a result, this OMS manual contains the following information (refer to Section 4 and 5):

- Performance, occurrences, or observations that would result in an emergency being declared
- Roles and responsibilities of key personnel in transition from normal or unusual conditions to an emergency
- Actions to be taken to transition from normal or unusual conditions to an emergency situation

Once an emergency has been declared, reference must be made to the Emergency Response Plan (reference included in Table 1-3). The most recent version of the ERP can be found on Intelex and in the Emergency Control Room.

Table 1-3 : Emergency Response Reference Documents

Document	Current Revision
Emergency Response Plan	Updated by AEM. Version 18, October 2023. (Intelex)

SECTION 2 • ROLES AND RESPONSIBILITIES

The roles and responsibilities of the key personnel involved in the Dewatering Dikes of the Meadowbank Project are shown in Table 2-1. Contact information for each position is indicated in Table 2-2. Terms of reference for the Accountable Executive Officer, Responsible Person, Engineer of Record, and Independent Reviewer are on Intelex.

2.1. Training and Qualification

Personnel who have tasks directly related to the Dewatering Dikes need to be qualified for the task and receive and maintain sufficient training to ensure they can perform their required roles and responsibilities. Defining the required qualifications and ensuring proper training and qualification of personnel is a responsibility defined in Table 2-1.

Qualification requirements of personnel is managed on a by department basis and are captured in the R&R of each position and are ensured as part of the HR Process to be fulfilled for each position.

Training requirements and records are defined and managed on a by department basis.

Table 2-1 : Responsibilities of Key Members of the OMS Related to Meadowbank Dewatering Dikes

Role	Responsibilities
Accountable Executive Officer (AEO)	As emphasized by MAC (2017), the accountability for decisions related to tailings management rests with the Owner's Board of Directors or Governance Level. The Board of Directors or Governance Level is expected to designate an Accountable Executive Officer (AEO) for tailings management. More specifically, the following responsibilities are assigned to the AEO: • Needs to be aware of key outcomes of water management risk assessment and of how these risks are being managed • Has accountability and responsibility for putting in place appropriate management structure • Assign responsibility and appropriate budgetary authority for water management • Define the personnel duties, responsibility, and reporting relationships, supported by job description and organizational charts to implement the water management system through all stages in the facility life cycles • Provide assurance to AEM and its Community of Interest that water is managed responsibly • Development and implementation of training needed for responsible training management • Ensuring development of any required plans for emergency preparedness
General Manager	• Identify the scope of work and budget requirement for all aspects of water management • Approve budget for OMS related activity • Establish an organizational structure with Roles and Responsibilities that meets the Governance Standard on Critical Infrastructure • Identify and retain a Responsible Person (RP) • Liaise with independent reviewer (MBK-IRB) as required
General Superintendents	• Ensure the OMS responsibilities delegated to the departments they oversee are carried out as described in this section of the OMS Manual
Engineer of Record (EoR)	The function of the EoR is to support AEM in ensuring that mine waste and water management infrastructure are designed and operated properly. The owner, in assuring that these facilities are safe, has the responsibility to identify and retain an EoR, who provides technical direction on behalf of the owner. Having an EoR for mine waste and water infrastructure is recognized as one of the best practices for responsible management of mine waste and water management facilities. • Support and give technical advice to the RP and the AEO on geotechnical and operational challenges • Participate, if possible, in Dam Safety Inspections and associated reports for facilities that include retention structures/dams/dikes • Verify if the TSF, WRSF, and Water Retaining Infrastructures are designed and are operating in accordance with the best standards in the industry and the AEM corporate standards • Verify if the waste and water management plans are developed and followed to ensure safety of the operation and the business • Review and provide agreement on the procedural documents related to waste and water management (including OMS, ERP, and TARP) • Be available for the Independent Review (IR) Panel • Participate in IR meetings and assist the RP in their preparation if required • Participate in the facility's risk assessments

Role	Responsibilities
	• Be available for dam safety reviews • Identify other internal or external professionals (such as hydrogeologists, geologists, hydrologists, etc.) to provide their support when required • Propose a schedule of site visits and required meetings during the course of the year
Responsible Person (RP)	The Responsible Person(s) identifies the scope of work and budget requirements (subject to final approval) for all aspects of water and tailings management, including the Engineer of Record (EoR), and will delegate specific tasks and responsibilities for aspects of water and tailings management to qualified personnel. The RP is directly responsible for the management of critical infrastructure on a specific site with the objective of compliance with the Governance. The management of critical infrastructure includes design, construction, operation, and closure. • Ensure the implementation and sustainability of the Governance model at the site level • Management of critical infrastructure, as well as appurtenant structures that may affect the critical infrastructure • The management of personnel, budget, and external resources for the critical infrastructure (external resources include the Design Engineer (DE), Independent Review Board (IRB) and any other necessary consultants/contactors) • Close collaboration with the EoR and communication with the Design Engineer and Independent Review Board (IRB) • Preparation for, and coordination of, IRB meetings and site visits • Preparation for, and coordination of, annual geotechnical inspections • Responding to, and implementation of, the recommendations of the IRB • Annual review and update of the OMS Manual in collaboration with the EoR • Continued application of the requirements of the OMS • In collaboration with the EoR, preparation of an annual report on the status of the critical infrastructure • Management of all documents and data related to design, construction, operation, closure, surveillance, and monitoring in a secure, accessible, and permanent manner • Revise and update the OMS Manual to reflect as-built conditions and any other changes. Review and update the OMS manual into Intelex. Maintain up to date distribution list of the OMS Manual
Independent Review Board (IRB) – Meadowbank IRB (MBK-IRB)	IR Panels are a mechanism to obtain independent, expert commentary, advice, guidance and where appropriate, recommendations to assist owners/operators in identifying, understanding, and managing risks associated with TSF, WRSF, WSF, HLF, and water-retaining infrastructures. The Independent Reviewer(s) does not have decision-making authority. Accountability and responsibility for decisions rests with AEM. • Review mine waste management strategy (including tailings and waste rock storage facilities) • Review water management infrastructure designs and performance (including water retaining infrastructures) • Review on-going construction works and monitoring data • Comment on implementation progress of proposed mine waste management improvement measures • Provide opinions and guidance to the operation on the physical integrity, safety, behavior, and performance of the confinement systems for mine waste and water retaining infrastructures • Comment on management systems, emergency preparedness, and overall management approach of the different mine waste management facilities and water retaining infrastructures

Role	Responsibilities
Design Engineer	• Advise on contemplated changes to the structure operation • Advise on structure performance and mitigation work as required • Present, as required, during independent review board site visit and meeting to provide input and context on the structure performance
Environment & Critical Infrastructure Superintendent	The Environment Department ensures compliance with Environment Regulations and the Water License and is the owner of the water and tailings management infrastructures outside of the process plant. They ensure reporting and liaison with the NIRB, NWB, NGO's and other government agencies. The Environment & Critical Infrastructure Superintendent is in charge of the Environment & Critical Infrastructure Department and ensures that: • The Environment team has sufficient resources (qualified manpower, material, budget, training) to fulfill the OMS obligation defined in this manual • A structure is in place that defines the R&R, qualification, training requirement and a staffing strategy to fulfill the obligation of the OMS Manual • Environment review of monitoring data for compliance with Water License and regulations and to determine dike performance with respect to design parameters • The Environment team carries out the surveillance of the structures as required in the OMS Manual (visual inspection and instrument monitoring) • The Environment team identifies and performs the maintenance work (predictive, preventive, and corrective) on the earthwork and instrumentation system • The Environment team reviews and analyses the surveillance data to evaluate dike performance with respect to design parameters and that surveillance reporting is distributed • The Environment team ensures that the other OMS tasks related to a dewatering dike component are planned and have an owner (i.e., pump and pipe, access, maintenance)
Energy & Infrastructures Superintendent	The E&I Department has the manpower and equipment to manage roads, electricity, and dewatering at the Meadowbank Site. They fulfill the planning done in collaboration with the Water & Tailings team to ensure the fulfilment of the OMS requirements. The E&I Superintendent is in charge of the E&I Department and ensures that: • The E&I team has sufficient resources (qualified manpower, material, budget, training) to fulfill the OMS obligation defined in this manual • A structure is in place that define the R&R, qualification, training requirement, and a staffing strategy to fulfill the obligation of the OMS Manual • E&I maintains access to the structures and seepage collection systems as per Engineering Planning. This includes making road repairs, controlling dust, and managing snow and water • E&I installs, operates, maintains, and monitors all the components of pumps and piping systems associated with dewatering dikes as defined in the OMS Manual. This work is planned in collaboration with the Environment Department • Update and maintain a list of operational pumping equipment
Maintenance Superintendent	The Maintenance Department has the manpower and equipment to maintain mobile equipment and pumps. They fulfill maintenance of some of the mechanical equipment components of the dewatering dikes as requested by the E&I department. The Maintenance Superintendent is in charge of the Maintenance Department and ensures that: • Preventive, predictive, and corrective maintenance is carried out regularly on pumping equipment as requested by E&I • Records are kept of maintenance performance on pumping equipment

Role	Responsibilities
Health and Safety Superintendent	The Health and Safety Department is responsible to update and manage the site wide emergency response plan. The Health and Safety Superintendent is in charge of the Health and Safety Department and ensures that: • The emergency response plan is updated and is aligned with the OMS manual • The trigger to raise an emergency defined in the OMS manual and the communication pathway to do so is understood and aligned with the ERP

Table 2-2 : Contact Information

Role	Name	Work Contact Info
Environment and Critical Infra VP / Accountable Executive Officer	Michel Julien	michel.julien@agnicoeagle.com 416-947-1212 x4013738 514-244-5876
Engineer of Record (EoR) / Technical Specialist, Environmental Management	Thomas Lepine	thomas.lepine@agnicoeagle.com 416-947-1212 x4013722 418-473-8077
Design Engineer – AtkinsRéalis (former SNC-Lavalin)	Anh-Long Nguyen	anh-long.nguyen@atkinsrealis.com 514-393-8000 x54292 514-236-5422
Independent Reviewer – Meadowbank Independant Review Board (MBK-IRB)	Anthony Rattue Kevin Hawton Ron Nicholson	anthony.rattue@bell.net khawton@knightpiesold.com ron.nicholson@minewatermatters.com
General Manager	Eric Steinmetzer	819-759-3555 x4606896 819-763-0187
General Superintendent (Operations)	Pierre McMullen	819-759-3555 x4606721 819-860-2556
General Superintendent (Maintenance, E&I, Mill)	Mathieu Hotte	819-290-3614
Engineering Superintendent	Alexandre Lavallée	819-759-3555 x4606870 819-860-0804
Environnent & Critical Infrastructures Superintendant / Responsible Person	Eric Haley	819-651-1010 819-759-3555 x4606491
Energy & Infrastructures Superintendent	Trevor Davies	819-759-3555 x4606632 514-912-8508
Maintenance Superintendent	Frederic Dubé	819-759-3555 x4606722 418-961-9895
Health and Safety Superintendent	Patrick Goldfinch	819-759-3555 x4606720 514-231-6912

SECTION 3 • DEWATERING DIKES DESCRIPTION

The Meadowbank Gold Mine is located approximately 80 km north of Baker Lake, Nunavut. The Meadowbank property is located on Inuit Owned Land, in the Kivalliq region of Nunavut. A summary of the physical conditions of the site, as well as a summary of the geological and geotechnical conditions can be found in Section 3.1.

Public access to the site is restricted and safety restrictions have been put in place to restrict access to the dewatering dikes to essential personal who must perform OMS tasks on the structure. Berms, delineators, and signs are some of the methods used to restrict access. Environment is in charge of ensuring that access to the structures are restricted to essential persons.

The Meadowbank Gold Mine required the construction of a series of Dewatering Dikes as described in Table 3-1. Appendix A provides the site layout. Appendix B of this document provides a summary of the design criteria and risk profile of the structures and Appendix C details their operation criteria.

Table 3-1 : Description of the Dewatering Dikes of the Meadowbank Project

Infrastructure	Function	Status
East Dike	Non-contact water retention and dewatering structure. ED isolates the Portage pit tailings deposition activities from Second Portage Lake. A seepage collection and pumping system is associated with this infrastructure	Operation
Bay-Goose Dike	Non-contact water retention and dewatering structure. Isolates the Portage and Goose pit tailings deposition activities from Third Portage Lake	Operation
South Camp Dike	Non-contact water retention structure. Isolates the Portage and Goose pit tailings deposition activities from Third Portage Lake	Operation
Vault Dike	Non-contact water retention and dewatering structure. Isolates the Vault pit from Wally Lake	Operation
West Channel Dike	Used to isolate the Portage pit mining from Second Portage Lake. Dismantled in 2012 as part of the Portage Pit mining operation.	Dismantled

3.1 SITE CONDITIONS

The Meadowbank mine is located within a low Arctic Eco climate described as one of the coldest and driest regions of Canada. Arctic winter conditions occur from October through May, with temperatures ranging from +5°C to -40°C. Summer temperatures range from -5°C to +25°C with isolated rainfall increasing through September. The long-term mean annual air temperature for Meadowbank is estimated to be approximately -11.3°C.

The prevailing winds at Meadowbank for both the winter and summer months are from the northwest. A maximum daily wind gust of 119 km/h was recorded on December 2024. August is the wettest month, with a total precipitation of 43.4 mm, and February is the driest month, with a total precipitation of 6.1 mm. During an average year, the total precipitation is 249.6 mm, split between 147.5 mm of rainfall and 102.1 mm of snowfall precipitation.

Two main faults are inferred in the Portage deposit area and are the Bay Zone Fault and the Second Portage Fault. The Second Portage fault trends to the northwest under Central Dike and the Tailings Storage Facilities (TSF), roughly parallel to the orientation of Second Portage Lake. The Bay Zone Fault trends from South to North and crosses Third Portage Lake, Goose Pit and Portage Pit.

Meadowbank is in an area of continuous permafrost. Lake ice thicknesses of between 1.5 m and 2.5 m have been encountered during mid to late spring. Taliks (areas of permanently unfrozen ground) could be expected where water depth is and/or has been greater than about 2 to 2.5 m. The depth of permafrost at site is estimated to be in the order of 450 to 550 m, depending on proximity to lakes. The depth of the active layer ranges from about 1 to 1.5 m.

The site area consists of low, rolling hills with numerous small lakes. It is covered by laterally extensive deposits of glacial till with a thickness from 0 to 5 m. The glacial till is variable but generally is made up of sand and gravel with cobbles and boulders and a fines content between 15% and 40%. Lakebed sediment consisting of sand, silt, and clay sized particles overlies the till in the lakes.

The site is underlain by a sequence of Archaean greenstone (ultramafic and mafic flow sequences) and metasedimentary rocks that have undergone polyphase deformation resulting in the superposition of at least two major structural events. Within the greenstone are volcaniclastic sediments, felsic-to-intermediate flows and tuffs, sediments (greywackes), and oxide iron formations. Ultramafic rocks are variably altered, and the ore is hosted in the iron formation rocks. The four main rock types are iron formation, intermediate volcanic, ultramafic volcanic, and quartzite.

3.2 ACCESS

The Meadowbank site is a remote site that is only accessible from the all-weather access road from the town of Baker Lake (with entry gates at the mine and at Baker Lake), or by aerial link with AEM hubs in Quebec. As such, access from unauthorized members of the public is very unlikely.

The crest of Bay-Goose Dike is a restricted area and access is prohibited. The crest of this structure can only be accessed by authorization from the Geotechnical Coordinator.

3.3 EAST DIKE

East Dike isolates the northwest arm of Second Portage Lake. It isolates the Portage pit and the tailings storage facility from Second Portage Lake. In closure, East Dike will separate Third Portage Lake from Second Portage Lake. There are no spillways or water diversion works associated with the East Dike.

East Dike was constructed in the summer of 2008 and grouting of the foundation and bedrock occurred in 2008 and during the first quarter of 2009.In July 2009, during dewatering, a sinkhole cavity (18 m^3) was identified in the general vicinity of a leak identified at Sta.60+472. This was caused by erosion of the soil bentonite material in the cut-off wall. Additional grouting was performed to mitigate this occurrence. The dike has been performing adequately since then.

It is approximately 800 m in length and was constructed within Second Portage Lake prior to dewatering. It consists of a wide rockfill shell, with downstream filters and a soil-bentonite cutoff wall that extends to bedrock. The cutoff wall extends up to 8 m below lake level.

References to key documents for the design and construction of East Dike are presented in Table 3-2. Table 3-3 summarizes the main highlights of East Dike.

Table 3-2 : Reference Documents for East Dike Design and Construction

Dike	Type of Information	Reference Document	Link to retrieve document
East Dike	Design Report	• Detailed Design of Dewatering Dikes (Golder 2007) 06-1413-081/6000 Doc. No. 342 Ver. 0 • East Dike Design Report (Golder, 2008) 07-1413-0074/2500/1000 Doc. No. 572 Ver. 0	• \\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\1-East Dike\1- Engineering\1- Detailled Engineering\2- Deliverable\1- Design Report \342 13Mar_07 Detailed Design of Dewatering Dikes Ver 0 (3 volumes) • \\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\1-East Dike\1- Engineering\1- Detailled Engineering\2- Deliverable\1- Design Report \Doc 572 1031_08 RPT-East Dike Design Report-Meadowbank Ver 0.pdf
	Drawings	Appendix VIII of East Dike Design Report (Golder, 2008) 07-1413-0074/2500/1000 Doc. No. 572 Ver. 0	\\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\1- East Dike\1- Engineering\1- Detailled Engineering\2- Deliverable\1- Design Report \Doc 572 1031_08 RPT-East Dike Design Report-Meadowbank Ver 0.pdf
	Technical Specifications	Appendix VII East Dike Design Report (Golder, 2008) 07-1413-0074/2500/1000 Doc. No. 572 Ver. 0	\\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\1- East Dike\1- Engineering\1- Detailled Engineering\2- Deliverable\1- Design Report \Doc 572 1031_08 RPT-East Dike Design Report-Meadowbank Ver 0.pdf
	As-Built	• East Dike Construction As-Built Report (Golder, 2009) 07-1413-0074; 09-1428-5007 Doc. No. 900 Ver. 0 • East Dike Grouting As-Built Report (Golder, 2009) 07-1413-0074 Doc. No. 916 Ver. 0	• \\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\1-East Dike\2- Construction\4-Deliverable\1- As-Built Report\1-Dike\Doc 900 1202_09 Rpt-East Dike Construction As-Built Report - Meadowbank Ver 0.pdf • \\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\1-East Dike\2- Construction\4-Deliverable\1- As-Built Report\1-Dike\Doc 916 0714_09 TM Meadowbank East Dike Grouting Response Plan-Completed Works Ver 0.pdf

Table 3-3 : East Dike Summary

<table>
<tr><th colspan="8">EAST DIKE</th></tr>
<tr><td colspan="8">Designer : Golder - WSP
Construction Period : 2008 – 2009
Operation Period : 2009 - 2028
Planned Closure Period : 2028-2036</td></tr>
<tr><th colspan="8">Design Criteria</th></tr>
<tr><th rowspan="2">Use</th><th rowspan="2">Water type</th><th rowspan="2">Classification (CDA, 2007)</th><th rowspan="2">Inflow Design Flood</th><th colspan="2">Water Level (m)</th><th rowspan="2" colspan="2">Crest Elevation (m) (max height)</th></tr>
<tr><th>Normal</th><th>Design Flood</th></tr>
<tr><td>Water Retention / Dewatering</td><td>Non-contact</td><td>High</td><td>1/3 between 1000-year and PMF[1]</td><td>133.1</td><td>135.1</td><td colspan="2">137.1 (10 m)</td></tr>
<tr><td colspan="8">Built to dewater 2nd Portage Arm Lake. 800 m long rockfill embankment with soil-bentonite cutoff wall with filter system +5 m deep injection curtain. The structure has been built to operate Portage Pit and is still in operation due to ongoing tailings deposition in Portage Pit</td></tr>
<tr><td colspan="8">Operation Highlight
• Sinkhole cavity due to SB erosion observed in 2009 and repaired with grouting. Stable since then (refer to Section 4.1)
• Seepage managed by 2 pumping stations (slower rate)</td></tr>
<tr><td colspan="8">Risk assessment performed on water management infrastructure in 2022.
Annual Probability of Failure and design Factor of Safety in Appendix B</td></tr>
</table>

Figure 3-1 : Aerial View of East Dike

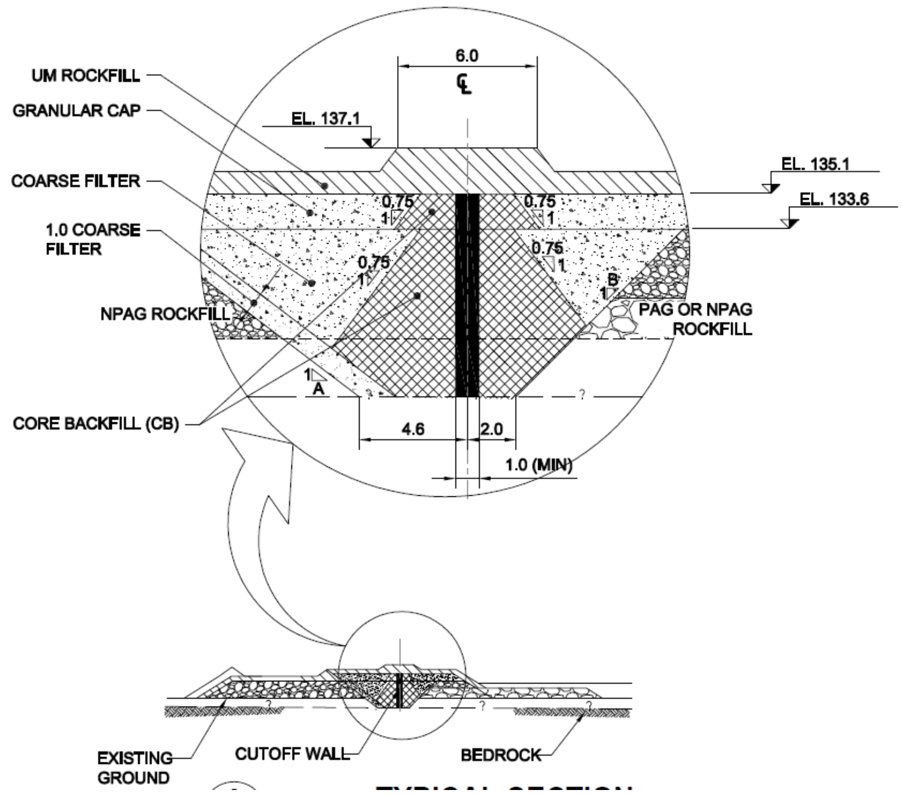


Figure 3-2 : Typical Cross-Section of East Dike

Dike construction occurred in the following manner:

<u>Rockfill Embankment:</u>

- A rockfill platform approximately 50 m wide was advanced from the south abutment to the north. The rockfill platform provided construction access and support for the core materials.
- The width of the rockfill platform (embankment) was subsequently increased by placement of additional rockfill on the downstream side, to provide an adequate road width to accommodate two-way haul traffic.

<u>Initial Trench Excavation:</u>

- Rockfill and lakebed soils were excavated from the crest of the rockfill platform to expose bedrock along the cutoff centreline. Loose blocks or slabs from the bedrock surface were removed, as practical.

<u>Backfilling of the Initial Trench:</u>

- A coarse granular filter (150 mm minus) was placed using the bucket of the excavator on the downstream slope of the excavation.
- Then the remaining portion of the excavation was backfilled with core backfill (19 mm minus) material in the central portion along the cutoff wall centreline and coarse filter (150 mm minus) material on the upstream and downstream sides of the core backfill. Backfilling of the trench with the core backfill and coarse filter materials was a simultaneous activity and occurred progressively as the excavation front advanced.
- At the bedrock surface, a minimum of 5 m of core backfill material was to be placed.

<u>Compaction of core backfill:</u>

- Core backfill and coarse filter were placed to an elevation of 2 m above the water level to form a platform from which densification could occur.
- The core backfill was densified using multiple passes of dynamic compaction. Craters produced by the dropped weight were backfilled to level the working platform between passes.

<u>Cutoff:</u>

- A 1 m wide trench was excavated through the core backfill material and extended to the bedrock surface along the cutoff wall centreline. Bentonite slurry was used to support the trench.
- The trench was backfilled with soil-bentonite.

<u>Grouting:</u>

- Grouting of the bedrock foundation and "contact area" identified as the zone between the base of the cutoff wall and bedrock surface was performed through the centerline of the cutoff wall.

3.3.1 East Dike – Seepage Collection System

After commissioning of the dike, three seepage zones were identified along the toe of the East Dike at approximately Sta. 60+480, Sta. 60+225, and Sta. 60+550.

The purpose of the seepage collection system is to collect and convey seepage and runoff away from the downstream toe area; and allow measurement of seepage through the dike.

The installation of the seepage collection system downstream of East Dike to capture and pump the seepage water was completed in 2012. The confirmed seepage zones at about Sta. 60+247 and Sta. 60+498 each had a collection sump with pump connected to a year-round pumping and piping system.

Since the installation of the seepage collection system, all seepage is being captured within the sumps and no sign of additional seepage on the ground surface or downstream in the Portage Pit was observed. Table 3-4 sums up the seepage observations at East Dike in currently active seepage areas.

Water collected in the seepage collection system is pumped to Second Portage Lake if the water quality meets the criteria for environmental discharge (usually over the winter) or to Portage Pit if turbidity exceeds the threshold (15 mg/L).

Table 3-4 : Summary of East Dike Seepage Areas

Seepage area	Dike Station	Average[1] seepage rate (flowmeter)	Water quality
North Shallow	60+700	Not measured	Clear (no turbidity)
North Channel	60+500	± 275 m^3/day	Usually clear in winter and turbid from freshet
South Channel	60+250		Usually clear in winter and turbid from freshet

[1]: average measured between 2018 and 2020

3.4 BAY-GOOSE DIKE

The Bay-Goose Dike together with the South Camp Dike isolates the Bay-Goose Basin from Third Portage Lake, which permits mining of the Goose pit and the southern portion of Portage pit. No spillways or water diversion works are associated with the Bay-Goose Dike.

The Bay-Goose Dike is approximately 2,200 m in length and was constructed “in the wet”, prior to dewatering. The earthworks component of the Bay-Goose Dike construction occurred over two summer construction seasons. The north portion of the Bay-Goose Dike was constructed in 2009 and the south portion in 2010. Grouting and jet grouting works commenced in 2010 and were completed by mid-July 2011.

The crest of Bay-Goose Dike is a restricted area and access is prohibited. The crest of this structure can only be accessed by authorization from the Geotechnical Coordinator.

References to key documents for the design and construction of Bay-Goose Dike are presented in Table 3-5. Table 3-6 summarizes the highlights of Bay-Goose Dike.

Table 3-5 : Reference Documents for Bay-Goose Dike Design and Construction

Dike	Type of Information	Document Reference	Link to Retrieve Document
Bay-Goose Dike	Design Report	• Detailed Design of Dewatering Dikes (Golder 2007) 06-1413-081/6000 Doc. No. 342 Ver. 0 • Bay-Goose Dike and South Camp Dike Designs (Golder, 2009) 08-1428-0028 Doc. No. 802 Ver. 0	• \\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\2-Bay-Goose Dike\1- Engineering\1-Detailed Engineering\3-Deliverable\1- Design Report\342 13Mar_07 Detailed Design of Dewatering Dikes Ver 0 (3 volumes) • \\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\2-Bay-Goose Dike\1- Engineering\1-Detailed Engineering\3-Deliverable\1- Design Report\Doc 802 0202_09-Let-Bay Goose Dike South Camp Dike Designs-Ver 0.pdf
	Drawings	Appendix A of Bay-Goose Dike and South Camp Dike Designs (Golder, 2009) 08-1428-0028 Doc. No. 802 Ver. 0	\\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\2-Bay-Goose Dike\1- Engineering\1-Detailed Engineering\3- Deliverable\1-Design Report\Doc 802 0202_09-Let-Bay Goose Dike South Camp Dike Designs-Ver 0.pdf
	Technical Specifications	Appendix B of Bay-Goose Dike and South Camp Dike Designs (Golder, 2009) 08-1428-0028 Doc. No. 802 Ver. 0	\\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\2-Bay-Goose Dike\1- Engineering\1-Detailed Engineering\3- Deliverable\1-Design Report\Doc 802 0202_09-Let-Bay Goose Dike South Camp Dike Designs-Ver 0.pdf
	As-Built	Bay-Goose Dike Construction As-Built Report (Golder, 2013) 09-1428-5007 1328 Ver. 0	\\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\2-Bay-Goose Dike\2- Construction\4-Deliverable\1- As-Built Report\Final\Doc 1328-0914285007 0419_13 Text & Figures - Ver. 0.pdf

Table 3-6 : Bay-Goose Dike Summary

<table>
<tr><th colspan="7">Bay-Goose Dike</th></tr>
<tr><td colspan="7">Designer : Golder - WSP
Construction Period : 2009 – 2011
Operation Period : 2011 - 2028
Planned Closure Period : 2028-2036</td></tr>
<tr><th colspan="7">Design Criteria</th></tr>
<tr><th rowspan="2">Use</th><th rowspan="2">Water type</th><th rowspan="2">Classification (CDA, 2007)</th><th rowspan="2">Inflow Design Flood</th><th colspan="2">Water Level (m)</th><th rowspan="2">Crest Elevation (m) (max height)</th></tr>
<tr><th>Normal</th><th>Design Flood</th></tr>
<tr><td>Water Retention/Dewatering</td><td>Non-contact</td><td>High</td><td>1/3 between 1000-year and PMF</td><td>134.1</td><td>135.1</td><td>137.1 (15 m)</td></tr>
<tr><td colspan="7">2.2 km long rockfill embankment with cement-soil-bentonite cutoff wall with filter system. To reach bedrock depths – used injection jet-grouting to create the full cutoff wall. After cutoff wall, a 5 m deep injection curtain into the bedrock</td></tr>
<tr><td colspan="7">Operation Highlight
• Settlement and tension cracks observed in the thermal capping of the structure
• Small seepage observed at the toe of the structure. Naturally report to Goose Pit
• Crest settlement resurfaced in 2023.</td></tr>
<tr><td colspan="7">Risk assessment performed on water management infrastructure in 2022.
Annual Probability of Failure and design Factor of Safety in Appendix B.</td></tr>
</table>

Figure 3-3 : Aerial View of Bay-Goose Dike

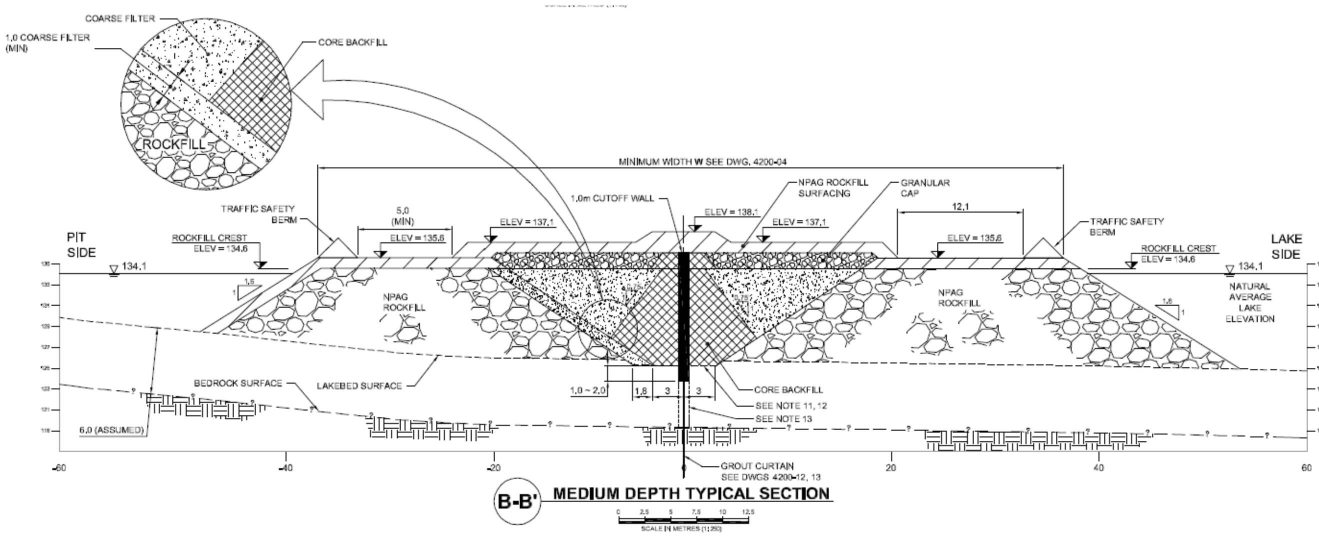


Figure 3-4 : Typical Cross-Section of Bay-Goose Dike

Dike construction occurred in the following general manner:

<u>Rockfill Platform / Embankment:</u>

- A rockfill platform of varying width (approximately 60 to 90 m) was advanced from the north abutment to Goose Island, between July and September 2009 to an elevation of about 134 m.
- A rockfill causeway about 25 m wide was advanced from Goose Island to the south abutment between February and June 2010 while ice cover existed on Third Portage Lake. Ice was broken and removed, as practical, in front of the advancing rockfill platform.
- Following ice breakup from the lake in July 2010, additional rockfill was placed to widen the causeway to the full design width of the rockfill platform (approximately 55 to 100 m).
- The rockfill platforms surface elevation was about 134 m and was used to provide a working surface for the subsequent construction activities. The rockfill also provides lateral support for the granular core materials.

<u>Initial Trench Excavation:</u>

- Rockfill and lakebed soils were excavated from the rockfill platform surface to bedrock or competent lakebed soils along the cutoff centreline. As much as practical, loose blocks or slabs from the bedrock surface were removed.
- Ice rich soils beneath the cutoff wall were removed except for at the south abutment where beyond Sta. 32+112 some ice-rich soils remain beneath the base of the initial trench excavation and cutoff wall.
- The required bottom width of the excavation varied based on its depth and varied between 8 and 11 m.

<u>Backfilling of the Initial Trench:</u>

North Portion of Dike

- A layer of core backfill (19 mm minus) material was placed along the downstream slope of the excavation such that core backfill material would be in contact with the lakebed soils.
- Then the remaining portion of the excavation was backfilled with core backfill (19 mm minus) material in the central portion along the cutoff wall centerline, with coarse filter (150 mm minus) material simultaneously placed on either side of the core backfill. Backfilling of the excavated trench occurred progressively as the excavation front advanced.

South Portion of Dike

- In very limited areas along the alignment, a layer of core backfill (19 mm minus) material was placed along the downstream slope of the excavation prior to the primary backfilling of the trench.
- The excavation was backfilled with core backfill (19 mm minus) material in the central portion along the cutoff wall centerline, with coarse filter (150 mm minus) material simultaneously placed on the downstream side of the core backfill and a "fine rockfill" material placed on the upstream side. Backfilling of the excavated trench occurred progressively as the excavation front advanced.
- In areas to be compacted using the vibratory-densification method, the width of Core backfill material was required to be 8 m. Therefore, once the initial backfilling had been completed relatively small V-shaped excavations were made at the surface on either side of the initially placed core backfill. These excavations were then refilled with Core backfill material to provide the required 8 m width of core backfill.

<u>Compaction of core backfill:</u>

- For all of the North Portion of the dike and a majority of the South Portion of the dike, a 2 m layer of core backfill, coarse filter, and rockfill was placed to increase the elevation of the platform to provide a working surface for the dynamic compaction.
- The core backfill was densified using multiple passes of dynamic compaction. Craters produced by the dropped weight were backfilled to the level of the working platform between passes.
- For the South Portion of the dike, in zones where the initial excavation was not extended to bedrock, termed "partial cutoff" zones, compaction of the core backfill material was done using two methods: vibratory-densification and dynamic-compaction. Vibratory densification of the core backfill material was conducted from the initial rockfill platform working surface (134 m). Vibro-densification was utilized to treat the core backfill material at the base of the excavation up to an elevation of about.128 m (i.e. 6 m below the water level). Then the 2 m of additional core backfill, coarse filter, and rockfill materials were placed to increase the elevation of the platform to about 136 m creating the working surface for the dynamic compaction. The upper portion of the core backfill material was then treated using multiple passes of dynamic compaction. Craters produced by the dropped weight were backfilled to the level of the working platform between passes.

Cutoff:

- A 1 m wide trench was excavated through the core backfill material and extended to bedrock or competent till surface along the cutoff wall centreline. Bentonite slurry was used to support the trench.
- The trench was backfilled with:
  - Soil-Bentonite (SB);
  - Cement Soil-Bentonite (CSB); or
  - A combination of SB and CSB.
- Then a capping layer about 0.5 m thick of SB was placed above the trench to an approximate elevation of 136.5 m.

Jet Grouted Wall

- Jet grouting has been used to extend the low permeability element (cutoff wall) of the dike to the bedrock surface. A double jet system was used with a cement water ratio of 1:1 to construct the jet grouted columns. Jet grouting was completed from a working platform elevation of approximately 137 m.
- Jet grouting beneath the cutoff wall to the bedrock surface was conducted in the "partial cutoff" areas where the cutoff wall was not excavated to bedrock. This occurred in Channel 1 (Sta. 32+007 to 32+110), Channel 2 (Sta. 31+820 to 31+928), and Channel 3 (Sta. 31+575 to 31+611). Jet grouted columns were constructed with a centre to centre spacing of 1.2 m with an overlap with the cutoff wall and extended into the bedrock surface. Columns were constructed in two passes, primary columns at a spacing of 2.4 m with secondary columns subsequently constructed between the primary columns.
- Jet grouting was also conducted in two additional areas of the dike where significant silt accumulated at the base of the initial excavation and prevented the cutoff wall from being successfully constructed to bedrock. These two areas are the North Channel (Sta. 30+361 to 30+435) and between Channel 1 and Channel 2 (Sta. 31+928 to 32+007). Jet grouted columns were constructed with a centre to centre spacing generally of 1.5 m, except for the portion between Sta. 31+928 and Sta. 31+966.4 where a spacing of 1.2 m was utilized, following a primary and secondary sequence for installation.

Grouting:

- The working platform along the cutoff wall centerline was raised with coarse filter material to an elevation of 137 m, from which grouting work was conducted.
- Grouting of the bedrock foundation and "contact area" identified as the zone between the base of the cutoff wall or jet grout columns and bedrock surface was performed through the centerline of the cutoff wall.

3.4.1 Bay-Goose Dike – Seepage Collection System

Starting in 2012, four small seepage areas were identified with a total of 9 seepage channels along the dike. The number of active seepage channels is decreasing over the years, as some channels stop flowing. No flowmeter is installed due to low flow rates. Flow rates are measured manually during summer in seepage stations equipped with a pipe to collect the flow. Table 3-7 sums up the seepage observations at Bay-Goose Dike in currently active seepage areas.

The total flow coming from these seepages each year has been decreasing. The flow of the seepages is directed toward Goose Pit as part of natural reflooding. The overall seepage is much less than anticipated and is not a concern. The area will continue to be monitored to follow the evolution of the seepage in these areas.

No seepage collection has been implemented so far as the seepage is not affecting site operations or the integrity of the dike. The condition of the dike will continually be monitored and if the condition of the dike is judged to be deteriorating then remediation would be reassessed.

Table 3-7 : Summary of Bay-Goose Dike Seepage Areas

Seepage area	Dike Station	Average[1] seepage rate (measured manually in summer)	Water quality
6 (Channel 3)	31+550	5.8 m^3/day	Clear (no turbidity)
Central Channel (no seepage station)	31+150	Not measured	Clear (no turbidity)
7 (Central Shallow)	30+650	5.8 m^3/day	Clear (no turbidity)
8 (North Channel)	30+400	dry	Clear (no turbidity)
9&9A (North Channel)	30+350	dry	Clear (no turbidity)

[1]: average measured between 2020 and 2024

3.5 SOUTH CAMP DIKE

The South Camp Dike covers a narrow channel within Third Portage Lake and in conjunction with the Bay-Goose Dike isolates the Bay-Goose Basin from Third Portage Lake. No spillways or water diversion works are associated with the South Camp Dike. It is located south of the plant site area and is used to connect the mainland to South Camp Island. It covers a narrow channel, approximately 60 m in width, where water depths were between 0.5 and 1 m.

The South Camp Dike was primarily constructed between April and June of 2009, prior to ice breakup. During the winter of 2009-2010 additional thermal capping material and rockfill for the haul road was added to the dike. The South Camp Dike has a broad rockfill shell with a bituminous geomembrane liner installed on the upstream side of the shell. The liner was founded on native frozen (permafrost) till material, in a trench approximately 3 to 5 m below the lakebed surface. Compacted granular material mixed with bentonite was placed above the toe of the liner. The haul road is located on the downstream side of the dike.

The dike design includes the following components: a rockfill shell, a bituminous geomembrane liner, and granular material mixed with bentonite.

References to key documents for the design and construction of South Camp Dike are presented in Table 3-8. Table 3-9 summarizes the main design criteria of South Camp Dike.

Table 3-8 : Reference Documents for South Camp Dike Design and Construction

Dike	Type of Information	Document Reference	Link to Retrieve Document
South Camp Dike	Design Report	• Detailed Design of Dewatering Dikes (Golder 2007) 06-1413-081/6000 Doc. No. 342 Ver. 0 • Bay-Goose Dike and South Camp Dike Designs (Golder, 2009) 08-1428-0028 Doc. No. 802 Ver. 0	• \\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\3-South Camp Dike\1- Engineering\3-Deliverable\1- Design Report\342 13Mar_07 Detailed Design of Dewatering Dikes Ver 0 (3 volumes) • \\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\3-South Camp Dike\1- Engineering\3-Deliverable\1- Design Report\Doc 802 0202_09-Let-Bay Goose Dike South Camp Dike Designs-Ver 0.pdf
	Drawings	Appendix A of Bay-Goose Dike and South Camp Dike Designs (Golder, 2009) 08-1428-0028 Doc. No. 802 Ver. 0	\\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\3-South Camp Dike\1- Engineering\3-Deliverable\1- Design Report\Doc 802 0202_09-Let-Bay Goose Dike South Camp Dike Designs-Ver 0.pdf
	Technical Specifications	Appendix B of Bay-Goose Dike and South Camp Dike Designs (Golder, 2009) 08-1428-0028 Doc. No. 802 Ver. 0	\\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\3-South Camp Dike\1- Engineering\3-Deliverable\1- Design Report\Doc 802 0202_09-Let-Bay Goose Dike South Camp Dike Designs-Ver 0.pdf
	As-Built	South Camp Dike Construction Summary Report (AEM, 2012)	\\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\3-South Camp Dike\2- Construction\4-Deliverable\1- As-Built Report\South Camp Dike Construction Summary VER 0_stamp.pdf

Table 3-9 : South Camp Dike Summary

SOUTH CAMP DIKE						
Designer : Golder **Construction Period :** 2009 **Operation Period :** 2009 - 2028 **Planned Closure Period :** 2028-2036						
Design Criteria						
Use	**Water type**	**Classification (CDA, 2007)**	**Inflow Design Flood**	**Water Level (m)**		**Crest Elevation (m) (max height)**
				Normal	**Design Flood**	
Water Retention	Non-contact	Significant	-	134.1	136.3	137.6 (3 m)
Rockfill embankment with bituminous liner, and shear key about 1/3 distance from upstream face. Liner ties into fine filter amended with bentonite. Built on permafrost foundation.						
Operation Highlight • -						
Risk assessment performed on water management infrastructure in 2022. Annual Probability of Failure and design Factor of Safety in Appendix B.						

Figure 3-5 : Aerial View of South Camp Dike

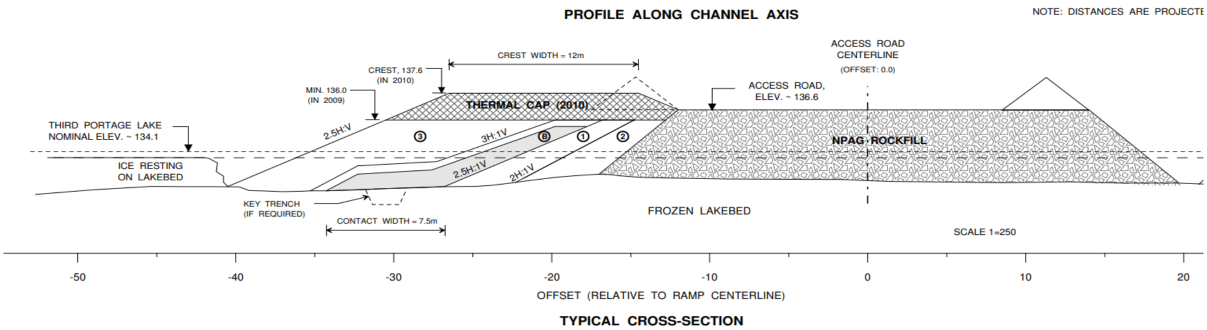


Figure 3-6 : Typical Cross-Section of South Camp Dike

3.6 VAULT DIKE

Vault Dike is located across a shallow creek which connects Wally Lake and Vault Lake, at the Vault pit area approximately 8 km north of the main Meadowbank site. Vault Dike is essential to allow the dewatering of Vault Lake and to isolate Vault pit during mining activities from Wally Lake.

The construction of the Vault Dike at Meadowbank was conducted from February 2013 to March 2013. Vault Dike is designed and constructed as a zoned rockfill dam with filter zones, an impervious upstream liner consisting of a bituminous membrane, and an upstream key trench made of aggregate mixed with bentonite. The filter zones minimize seepage and internal erosion and facilitate seepage collection. Vault Dike includes a key trench at the base of the upstream side filled with a 0-25 mm fill amended with bentonite surrounding the liner. Coarse and fine filter material was placed on the upstream slope as geomembrane bedding. The bulk part of the dike consists of coarse rockfill material. The embankment crest is at El. 142.4 m and the upstream toe is at approximately El. 139.4 m. The downstream toe is at approximately El. 139.6 m and the bottom of the key trench ranges from El. 135.6m to El. 142.3m, with an average height of El. 137.0m. The upstream and downstream fill slopes of the dam are 1.5H:1V.

References to key documents for the design and construction of Vault Dike are presented in Table 3-10. Table 3-11 summarizes the main design criteria of Vault Dike.

Table 3-10 : Reference Documents for Vault Dike Design and Construction

Dike	Type of Information	Document Reference	Link to Retrieve Document
Vault Dike	Design Report	Construction of Vault Dike (SNC, 2013) 610548-2020-4GER-0001_00	\\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\4- Vault Dike\1- Engineering\3- Deliverable\1- Design Report\610548-2020-4GER-0001_00.pdf
	Drawings	Appendix 1 of Construction of Vault Dike (SNC, 2013) 610548-2020-4GER-0001_00	\\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\4- Vault Dike\1- Engineering\3- Deliverable\1- Design Report\610548-2020-4GER-0001_00.pdf
	Technical Specifications	Construction of Vault Dike (SNC, 2013) 610548-2020-4GER-0001_00	\\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\4- Vault Dike\1- Engineering\3- Deliverable\1- Design Report\610548-2020-4GER-0001_00.pdf
	As-Built	Construction Summary Report Vault Dike (AEM, 2013)	\\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\4- Vault Dike\2- Construction\4- Deliverable\1- As-Built Report\Vault Dike Construction Report Final with Appendices.pdf

Table 3-11 : Vault Dike Summary

<table>
<tr><th colspan="8">Vault Dike</th></tr>
<tr><td colspan="8">Designer : Golder
Construction Period : 2013
Operation Period : 2013 - 2028
Planned Closure Period : 2028-2036</td></tr>
<tr><th colspan="8">Design Criteria</th></tr>
<tr><th rowspan="2">Use</th><th rowspan="2">Water type</th><th rowspan="2">Classification (CDA, 2007)</th><th rowspan="2">Inflow Design Flood</th><th colspan="2">Water Level (m)</th><th rowspan="2">Crest Elevation (m) (max height)</th></tr>
<tr><th>Normal</th><th>Design Flood</th></tr>
<tr><td>Water Retention/Dewatering</td><td>Non-contact</td><td>Low</td><td>1-100 year snow melt + 1-100 year rainfall</td><td>139.52</td><td>141</td><td>142.5 (3 m)</td></tr>
<tr><td colspan="8">Rockfill embankment with filtering system and bituminous liner. Sitting on permafrost condition. Allowed dewatering of Vault Lake</td></tr>
<tr><td colspan="8">Operation Highlight
• -</td></tr>
<tr><td colspan="8">Risk assessment performed on water management infrastructure in 2022.
Annual Probability of Failure and design Factor of Safety in Appendix B.</td></tr>
</table>

Figure 3-7 : Aerial View of Vault Dike

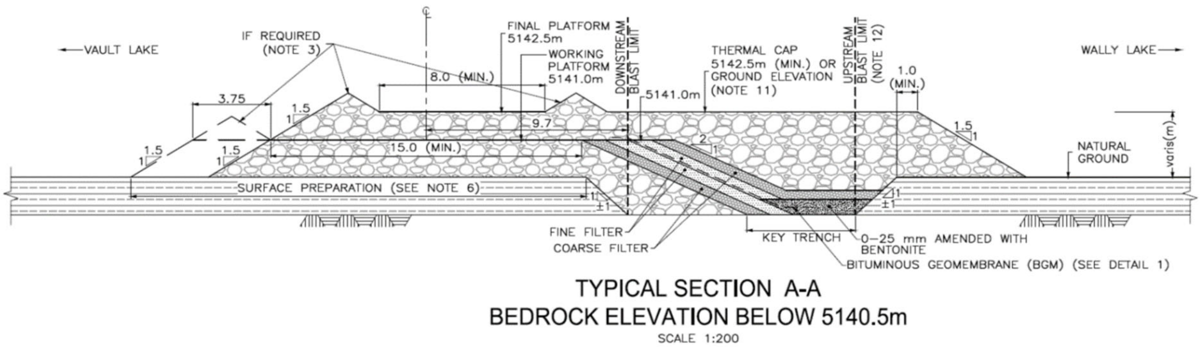


Figure 3-8 : Typical Cross-Section of Vault Dike

3.7 INSTRUMENTATION

The Dewatering Dikes are instrumented to continuously monitor performance. In-situ instruments are installed within the structures and their foundations (piezometers, thermistors, inclinometers).

Water levels in the ponds are monitored by piezometers, and periodic water surveys.

Reference documents for the instrumentation installed on the Dewatering Dikes is summarized in Table 3-12. The summary of the instruments installed is summarized in
Table 3-13.

Table 3-12 : Reference Documents for Instrumentation

Type of Information	Information Location
Instrumentation Campaign As-Builts	ED: Refer to Table 3-2 BGD: Refer to Table 3-5 SCD: Refer to Table 3-8 VD: Refer to Table 3-10
Instruments Database	\\Cambfs01\groups\Engineering\05-Geotechnic\11-Instrumentation\1-Instruments\ALL Instruments Databases
Instrument Maps and Typical Cross-Sections	Instruments summary folder for each structure on the network

Table 3-13 : Instrumentation Summary for the Water Management Infrastructure

Structure	Piezometer	Thermistors	Inclinometer	Survey Monument
East Dike	41	8	3	-
Bay-Goose Dike	141	30	8	-
South Camp Dike	-	2	-	-
Vault Dike	-	5	-	-

SECTION 4 • DEWATERING

The Dewatering Dikes isolate the open pit mining and tailings deposition activities from Second Portage Lake, Third Portage Lake, and Wally Lake. All the dewatering dikes are now in the operation phase as dewatering is complete.

4.1 SECOND PORTAGE NORTHWEST ARM DEWATERING - EAST DIKE PERFORMANCE

The dewatering of the northwest arm of Second Portage Lake started in March 2009. A total of 6.7 Mm^3 was pumped from the Second Portage Arm.

4.2 BAY-GOOSE BASIN DEWATERING

The Bay-Goose Dike together with the South Camp Dike isolates the Bay-Goose Basin from Third Portage Lake. Dewatering of the Bay-Goose Basin commenced on July 25, 2011, and was completed on November 14, 2011. The approximate pool volume dewatered was 3 Mm^3.

4.3 VAULT LAKE DEWATERING

The dewatering of Vault Lake started on June 27^{th}, 2013, and was completed in the summer of 2014. The approximate pool volume to be dewatered was 2 Mm^3. During dewatering, water from the Vault Basin was pumped and directly discharged to Wally Lake through a diffuser or processed through the Water Treatment Plant (WTP) to reduce Total Suspended Solids (TSS).

SECTION 5 • OPERATIONS

The following section outlines the key operational procedures that need to be observed and followed during operation of the Dewatering Dikes at Meadowbank in accordance with their performance objectives.

5.1 REFERENCES

References to key documents for the operation of the Dewatering Dikes are presented in Table 5-1.

Table 5-1 : Key Reference Documents for Operation of the Dewatering Dikes at Meadowbank

Type of Information	Reference	Link to Retrieve Document
Meadowbank Water Management Plan	V14 AEM 2024	\\Cambfs01\groups\Engineering\12- Annual Report\2024\1- Annual Report 2024\7- Water Management Plan Update\1- Mdbk\Meadowbank Water Management Plan Version 14.pdf
Meadowbank Annual Water Balance	AEM (2024)	\\Cambfs01\groups\Engineering\12- Annual Report\2022\1- Annual Report 2024\7- Water Management Plan Update\1- Mdbk\Appendix A & B\Appendix A 2024 Water Balance.pdf
Power BI Dashboard on Water Management	-	https://app.powerbi.com/groups/me/apps/e2b8b538-784c-43d5-9ed2-3b213d5f1d3b/reports/4284becf-d88d-479d-b81b-eb133449a879/ReportSection81fc7fbdeaab99c7dc96

5.2 SUMMARY OF PERFORMANCE OBJECTIVES AND OPERATIONAL CONTROL

The performance objectives with respect to the failure modes are summarized in Table 5-2. The operational controls for the Dewatering Dikes at Meadowbank during operation are summarized in Table 5-3 and described further in this Section.

Table 5-2 : Performance Objectives in Terms of Failure Modes of the Dewatering Dikes at Meadowbank

Failure mode	Inferred mechanism	Causes	Consequences	Performance objective and indicator
Overtopping of low-permeability element (cut-off wall or liner)	Reservoir level exceeds low-permeability element elevation	• Poor management of reservoir level • Subsidence of low-permeability element	Uncontrolled inflow into site	• Adequate reservoir level (monitoring by survey and PZ) • No subsidence of the crest (visual inspections)
Internal erosion of dike or foundation	• Erosion of engineered fill leading to deformation of cut-off wall or liner • Erosion of cut-off wall • Damage in liner (hole or tear) • Erosion of foundation soils	• Excessive hydraulic gradient • Pre-existing seepage channels • Inadequate construction materials or foundation soils (unlikely due to appropriate design and QA/QC) • Damage to liner due to operations around the dike (unlikely because liner is protected)	Seepage, partial loss of containment, inflow into site. Possible progressive degradation of dike and later risk of destabilization.	• Good, stable condition of fill and foundation at the toe (visual inspections) • Stable, manageable seepage (visual inspections, flowmeter monitoring) • Stable thermal and piezometric regime in foundation (piezometers and thermistors monitoring, refer to TARP in Section 5.6)
Instability due to foundation failure	Failure of foundation soils against shear stress	• Inadequate foundation shear strength • Excessive pore-water pressure • Erosion of soils (refer to previous failure mode)	Dam breach, uncontrolled inflow into site, partial or total loss of containment	• Good, stable condition of foundation at the toe (visual inspections) • Stable thermal and piezometric regime in foundation, acceptable pore-pressure levels (piezometers and thermistors monitoring refer to TARP in Section 5.6)
Instability due to deformation of dike and slope failure	Failure of construction material against shear stress	• Excessive deformation of engineering fill, cut-off wall or liner • Erosion of soils (refer to previous failure mode)	Dam breach, uncontrolled inflow into site, partial or total loss of containment	• Good, stable condition of all elements of the dike (visual inspections) • Acceptable levels of deformation (inclinometers monitoring, refer to TARP in Section 5.6)
Unmanageable seepage to site / uncontrolled discharge to Env	Seepage through the structure higher than design intent that can't be managed by a collection system	• Excessive hydraulic gradient • Pre-existing seepage channels • Inadequate seepage collection system • Damage to liner • Permafrost degradation	Unmanageable inflow / uncontrolled outflow	• Manageable seepage (visual inspections, flowmeter monitoring, pumping capacity) • Stable thermal and piezometric regime in foundation (piezometers and thermistors monitoring refer to TARP in Section 5.6)

Table 5-3 : Operational Control of the Dewatering Dikes at Meadowbank

Water Management
• Operational freeboard (Section 5.3) • Water balance calibration (Section 5.4) • Water discharge, volume, and quality (Section 5.4) • Seepage control and collection (Section 5.5)
Surveillance
• Surveillance requirements for operational performance indicators (Section 5.6) • Threshold for performance criteria to trigger pre-defined actions (Section 5.6)

5.3 OPERATING LEVEL AND FREEBOARD

Operating level and freeboard are monitored by water level survey and piezometric monitoring. The design criteria for minimum freeboard and operational criteria for the Dewatering Dikes are presented in Table 5-4. The TARP category associated with each water level range are a summary of the response and are included in the same table. Refer to Section 5.7 for the communication protocol and Appendix C for the list of specific action to take (Operational Guideline). The freeboard may change due to fluctuations in lake levels or due to settlement of the dikes. Maintenance may be required to restore loss of freeboard due to settlement. The Dewatering dikes will also be impacted by the In-Pit tailings deposition operational levels on the downstream side of the infrastructures. As tailings will be deposited in the Goose and Portage pits, the water level will increase to a point it will reach the toe of the Dewatering dikes. At the moment, an interim elevation of 125masl was set as the maximum elevation at which the process water would be allowed on the downstream of the dewatering dike, this number will be revised by the Designer in 2025.

Table 5-4 : Freeboard and Operational Levels

Structure	Freeboard		Operation water level (m)		Critical water level (m)	Emergency water level (m)
	To the Dike Crest (m)	To the Dike Cut-off Wall or Liner (m)	Normal	Maximum		
East Dike	3.0	1.0	<134.1	134.1-134.8	134.8-135.6	>135.6
Bay-Goose Dike	4.0	1.0	<135.1	135.1-135.8	135.8-136.1	>136.1
South Camp Dike	3.0	1.0	<135.6	135.6-136.3	136.3-136.6	>136.6
Vault Dike	3.0	1.5	<141.5	141.5-142.2	142.2-142.5	>142.5
TARP Level	N/A		Green	Yellow	Orange (risk of overtopping)	Red (overtopping and uncontrolled inflow)
Response	N/A		Standard operations.	Inform stakeholders (Section 5.7)	Immediately take action to stop increase	Trigger ERP (Section 5.7)

Structure	Freeboard		Operation water level (m)		Critical water level (m)	Emergency water level (m)
	To the Dike Crest (m)	To the Dike Cut-off Wall or Liner (m)	Normal	Maximum		
				Refer to Appendix C for specific action	Inform stakeholders (Section 5.7) Refer to Appendix C for specific action	

5.4 WATER MANAGEMENT

Water management activity includes the movement of water and the respect of it's quality. Water is moved around site using pumps and pipes. The main source of water to manage related to the dewatering dikes is seepage water. The movement of water on site is monitored using flowmeters and are recorded in the site wide water balance. The water balance is calibrated monthly. Water quality is monitored to ensure that any discharge to the environment respects the water license criteria. Information on water management at the Meadowbank Site is documented in the Meadowbank Water Management Plan which is reviewed on a yearly basis.

5.5 SEEPAGE MANAGEMENT

Seepage through a dewatering dike must be managed in a controlled fashion. This is attained by using a system of collection ditches and sumps at the downstream toe of the structure to capture the seepage into a contact water retention pond. The water quality is monitored, and it will be directed to an approved discharge point. Table 5-5 summarizes the current seepage control measures in place. More details on these systems can be found in Section 3.

The amount of seepage that can be tolerated is dependent on the structure design intent and the capacity of the collection system in place. These values are considered to determine the seepage indicator in the TARP level presented in Section 5.6.

Table 5-5 : Summary of Seepage Management

Structure	Seepage Expected from Design	Performance Indicator	Status	Water Collection System	Seepage Quality
East Dike	Yes, talik. (900 m^3/day from design report)	Seepage rate measured	463 m^3/day with a maximum of 650 m^3/day at freshet in seepage station	2 pumping station (culvert). Can pump to Portage Lake or to the Pit based on water quality. Capacity of 1,440 m^3/h	Turbid at freshet. Clear rest of the year

Bay-Goose Dike	Yes, talik.(3,350 m^3/day from design report)	Seepage rate measured	Less than 25 m^3/day at dike toe	None, reporting to Bay-Goose Pit	Historically clear
South Camp Dike	No – foundation in permafrost	Thermal regime of foundation	No seepage. Permafrost condition. No degradation	-	-
Vault Camp Dike	No – foundation in permafrost	Thermal regime of foundation	No seepage. Permafrost condition. No degradation	-	-

5.6 OPERATING PROCEDURE DURING OPERATION OF THE DEWATERING DIKES AT MEADOWBANK

Table 5-6 to Table 5-8 below present performance indicators for each of the Dewatering Dikes at Meadowbank and the Trigger Action Response Plan (TARP) if the associated performance criteria deviate from the defined range.

Table 5-6 : Threshold Criteria and Pre-Defined Action During Operation of East Dike

	Failure mode	Observation	Threshold Criteria During Operation			
			Green Acceptable Situation	Yellow Areas of concern	Orange High Risk Situation	Red Emergency Situation
Criteria	Overtopping of cut-off wall because of excessive reservoir level, leading to uncontrolled outflow	Lake elevation (survey and piezometer reading)	< 134.1 masl	> 134.1 and < 134.8 masl	> 134.8 and < 135.6 masl	> 135.6 masl
	Internal erosion of dike or foundation, leading to partial loss of containment (seepage through wall or foundation)	Sinkhole on crest	Not visible	> 5 m outside from centreline, localised depression	Within 5 m from centreline, sinkhole identified	Within 5 m from centreline and associated with seepage increase. Continued event
		Temperature variation along centreline (based on thermistors and piezometers)	Temperature measurement stable and similar variation at surface from previous years.	Increasing trend in temperature below the active layer (permafrost degradation)	-	-
	Unmanageable seepage to site (can also be indicative of internal erosion failure mode depending on seepage flowpath)	Seepage through dike (flowmeter data in pumping station) Turbidity observation	Within historical flow < 650 m^3/ day and managed by pumping	Inflow higher than historical flow but manageable with available pumping capacity < 720m^3/day (FOS > 2) or Sudden or cumulative increase > 25 % in over 3 days (not related to freshet) turbidity in the water (not related to freshet)	Inflow higher than design parameter but manageable with available pumping capacity > 720 m^3/day (FOS < 2) or turbidity in the water (not related to freshet)	Inflow is unmanageable with pumping capacity (FOS < 1)
	Instability due to foundation failure, leading to dam breach and total or partial loss of containment	Downstream toe displacement, sloughing or bulging	None visible / inactive	Visible displacement or bulging	Toe displacement related to a sloughing slide from near downstream crest to 5 m from centreline Bulging > 1 m in height	Toe displacement related to a sloughing slide reaching 5 m from centreline Bulging greater than 4m in height. Continued event
		Pore water pressure (based on piezometers)	Pore water pressure measurements stable or seasonal	Unexplained trend in pore water pressure downstream of cut-off wall.	Anomalous trends (sharp increase) in pore water pressure downstream of cut-off wall. Trend explained and demonstrates an upset condition	-
	Instability due to deformation and slope failure, leading to dam breach and total or partial loss of containment	Tension crack along downstream or upstream rockfill embankment (more than 3 m from centreline)	Within 7 m of the downstream crest edge and < 0.1 m deep and < 3 m length along the dike	Within 10 m of the downstream crest edge and > 0.1 m and < 1.0 m deep < 0.1 m wide	> 0.1 m and < 0.2 m wide & > 5 m and < 10 m length along the dike > 1.0 m deep	> 0.2 m wide > 10 m length along the dike > 2.0 m deep
		Tension crack within 3 m each side of the cutoff wall at crest (upstream or downstream)	None visible / inactive	< 0.1 m deep or < 0.1 m wide	> 0.1 m wide and < 0.2 m wide > 0.1 m and < 0.3 m deep	or > 0.2 m wide > 0.3 m deep
		Cumulative vertical crest movement	< 0.2 m	> 0.2 and < 1 m or Stable trend	> 1 m with increasing rate of settlement	> 2 m with increasing rate of settlement
		Cut-off wall lateral cumulative deformation (based on settlement survey and inclinometer reading)	None	<0.05 m	> 0.05 and 0.10 m	-
Action Required			Continue operation, maintenance, surveillance, and monitoring as per OMS procedure	. • If event is related to water level refer to Appendix C • If event is referring to seepage rate increase pumping capacity or repair system • Document location, photograph, survey, and increase inspection and instrument monitoring in area of concern (refer to Section 7) • Implement engineering review. • Implement communication plan (section 5.7)	• If event is related to water level refer to Appendix C • Suspend activities on dike crest and immediate downstream area • Implement communication plan (section 5.7) • Document location, photograph, survey, and increase inspection and instrument monitoring in area of concern. • Plan and take appropriate mitigation measures with engineering review. • Reassess thresholds and conditions for red category (emergency situation) taking into account the changing conditions presently observed and interactions of various items.	• Evacuation of personnel and equipment from downstream area. • Close access to dike crest • Implement Emergency Response Plan (Section 5.7)

Table 5-6 : Threshold Criteria and Pre-Defined Action During Operation of Bay-Goose Dike

	Failure mode	Observation	Threshold Criteria During Operation			
			Green **Acceptable Situation**	**Yellow** **Areas of concern**	**Orange** **High Risk Situation**	**Red** **Emergency Situation**
Criteria	Overtopping of cut-off wall because of excessive reservoir level, leading to uncontrolled inflow into site	Lake elevation (survey and piezometer reading)	< 135.1 masl	> 135.1 and < 135.8 masl	> 135.8 and < 136.1 masl	> 136.1 masl
	Internal erosion of dike or foundation, leading to partial loss of containment (seepage through wall or foundation)	Sinkhole on crest	Not visible	> 5 m outside from centreline, localised depression	Within 5 m from centreline, sinkhole identified	Within 5 m from centreline and associated with seepage increase. Continued event
		Temperature variation along centreline (based on thermistors and piezometers)	Temperature measurement stable and similar variation at surface from previous years.	Increasing trend in temperature below the active layer (permafrost degradation)	-	-
	Unmanageable seepage to site (can also be indicative of internal erosion failure mode depending on seepage flowpath	Seepage through dike at toe (excluding freshet water)	Within design parameter < 3,350 m^3/day global Within historical value at the toe < 50 m^3/day	Inflow higher than design parameter but manageable with available in-pit infrastructure according to water balance turbidity in the water (not related to freshet)	Inflow higher than design parameter and is not manageable with available in-pit infrastructure (run out of capacity in more than 1 year) turbidity in the water (not related to freshet)	Inflow higher than design parameter and is not manageable with available in-pit infrastructure (run out of capacity in less than 1 year)
	Instability due to foundation failure, leading to dam breach and total or partial loss of containment	Downstream toe displacement, sloughing or bulging	None visible / inactive	Visible displacement or bulging	Toe displacement related to a sloughing slide from near downstream crest to 5 m from centreline Bulging > 1 m in height	Toe displacement related to a sloughing slide reaching 5 m from centreline Bulging greater than 4m in height. Continued event
		Pore water pressure (based on piezometers)	Pore water pressure measurements stable or seasonal	Unexplained trend in pore water pressure downstream of cut-off wall.	Anomalous trends (sharp increase) in pore water pressure downstream of cut-off wall. Trend explained and demonstrates an upset condition	-
	Instability due to deformation and slope failure, leading to dam breach and total or partial loss of containment	Tension crack along downstream or upstream rockfill embankment (more than 3 m from centreline)	Within 7 m of the downstream crest edge and < 0.1 m deep and < 3 m length along the dike	Within 10 m of the downstream crest edge and > 0.1 m and < 1.0 m deep < 0.1 m wide	> 0.1 m and < 0.2 m wide & > 5 m and < 10 m length along the dike > 1.0 m deep	> 0.2 m wide > 10 m length along the dike > 2.0 m deep
		Tension crack within 3 m each side of the cutoff wall at crest (upstream or downstream)	None visible / inactive	< 0.1 m deep or < 0.1 m wide	> 0.1 m wide and < 0.2 m wide > 0.1 m and < 0.3 m deep	or > 0.2 m wide > 0.3 m deep
		Cumulative vertical crest movement	< 0.2 m	> 0.2 and < 1 m or Stable trend	> 1 m with increasing rate of settlement	> 2 m with increasing rate of settlement
		Cut-off wall lateral cumulative deformation (based on inclinometer)	None	< 0.05 m	> 0.05 m and < 0.10 m	> 0.10 m
Action Required			• Continue operation, maintenance, surveillance, and monitoring as per OMS procedure	. • If event is related to water level refer to Appendix C • If event is referring to seepage rate increase pumping capacity or repair system • Document location, photograph, survey, and increase inspection and instrument monitoring in area of concern (refer to Section 7) • Implement engineering review. • Implement communication plan (section 5.7)	• If event is related to water level refer to Appendix C • Suspend activities on dike crest and immediate downstream area • Implement communication plan (section 5.7) • Document location, photograph, survey, and increase inspection and instrument monitoring in area of concern. • Plan and take appropriate mitigation measures with engineering review. • Reassess thresholds and conditions for red category (emergency situation) taking into account the changing conditions presently observed and interactions of various items.	• Evacuation of personnel and equipment from downstream area. • Close access to dike crest • Implement Emergency Response Plan (Section 5.7)

Table 5-7 : Threshold Criteria and Pre-Defined Action During Operation of South Camp Dike

	Failure mode	Observation	Threshold Criteria During Operation			
			Green **Acceptable Situation**	**Yellow** **Areas of concern**	**Orange** **High Risk Situation**	**Red** **Emergency Situation**
Criteria	Overtopping of cut-off wall because of excessive reservoir level, leading to uncontrolled inflow into site	Lake elevation (survey and piezometer reading)	< 135.6 masl	> 135.6 and < 136.3 masl	> 136.3 and < 136.6 masl	> 136.6 masl
	Internal erosion of dike or foundation, leading to partial loss of containment (seepage through wall or foundation)	Sinkhole on crest	Not visible	> 5 m outside from centreline, localised depression	Within 5 m from centreline, sinkhole identified	Within 5 m from centreline and associated with seepage increase. Continued event
		Temperature variation along centreline (based on thermistors and piezometers)	Temperature measurement stable and similar variation at surface from previous years.	Warming trend in the permafrost or increase in active layer (permafrost degradation)	Thawing of the dike key trench	-
	Unmanageable seepage to site (can also be indicative of internal erosion failure mode depending on seepage flowpath	Seepage through dike at toe (excluding freshet water)	None	Inflow < 300 m^3/day and managed by pumping (FOS >2) turbidity in the water (not related to freshet)	Inflow > 300 m^3/day and managed by pumping (FOS >2) turbidity in the water (not related to freshet)	Inflow is unmanageable with pumping capacity (FOS < 1)
	Instability due to foundation failure, leading to dam breach and total or partial loss of containment	Downstream toe displacement, sloughing or bulging	None visible / inactive	Visible displacement or bulging	Toe displacement related to a sloughing slide from near downstream crest to 5 m from centreline Bulging > 1 m in height	Toe displacement related to a sloughing slide reaching 5 m from centreline Bulging greater than 4 m in height. Continued event
	Instability due to deformation and slope failure, leading to dam breach and total or partial loss of containment	Tension crack on crest	None visible / inactive	< 0.1 m wide & < 5 m length < 1.0 m deep	> 0.1 m and < 0.2 m wide & > 5 m and < 10 m length along the dike > 1.0 m deep	> 0.2 m wide > 10 m length along the dike > 2.0 m deep Dike stability is compromised
		Cumulative vertical crest movement	< 0.2 m	> 0.2 and < 1 m or Stable trend	> 1 m with increasing rate of settlement	> 2 m with increasing rate of settlement
Action Required			• Continue operation, maintenance, surveillance, and monitoring as per OMS procedure	. • If event is related to water level refer to Appendix C • If event is referring to seepage rate increase pumping capacity or repair system • Document location, photograph, survey, and increase inspection and instrument monitoring in area of concern (refer to Section 7) • Implement engineering review. • Implement communication plan (section 5.7)	• If event is related to water level refer to Appendix C • Suspend activities on dike crest and immediate downstream area • Implement communication plan (section 5.7) • Document location, photograph, survey, and increase inspection and instrument monitoring in area of concern. • Plan and take appropriate mitigation measures with engineering review. • Reassess thresholds and conditions for red category (emergency situation) taking into account the changing conditions presently observed and interactions of various items.	• Evacuation of personnel and equipment from downstream area. • Close access to dike crest • Implement Emergency Response Plan (Section 5.7)

Table 5-8 : Threshold Criteria and Pre-Defined Action During Operation of Vault Dike

	Failure mode	Observation	Threshold Criteria During Operation			
			Green Acceptable Situation	**Yellow Areas of concern**	**Orange High Risk Situation**	**Red Emergency Situation**
Criteria	Overtopping of cut-off wall because of excessive reservoir level, leading to uncontrolled inflow into site	Lake elevation (survey and piezometer reading)	< 141.5 masl	> 141.5 and < 142.2 masl	> 142.2 and < 142.5 masl	> 142.5 masl
	Internal erosion of dike or foundation, leading to partial loss of containment (seepage through wall or foundation)	Sinkhole on crest	Not visible	> 5 m outside from centreline, localised depression	Within 5 m from centreline, sinkhole identified	Within 5 m from centreline and associated with seepage increase. Continued event
	Unmanageable seepage to site (can also be indicative of internal erosion failure mode depending on seepage flowpath	Seepage through dike at toe (excluding freshet water)	None	Inflow < 300 m^3/day and managed by pumping (FOS >2) turbidity in the water (not related to freshet)	Inflow > 300 m^3/day and managed by pumping (FOS >2) turbidity in the water (not related to freshet)	Inflow is unmanageable with pumping capacity (FOS < 1)
	Instability due to foundation failure, leading to dam breach and total or partial loss of containment	Downstream toe displacement, sloughing or bulging	None visible / inactive	Visible displacement or bulging	Toe displacement related to a sloughing slide from near downstream crest to 5 m from centreline Bulging > 1 m in height	Toe displacement related to a sloughing slide reaching 5 m from centreline Bulging greater than 4m in height. Continued event
		Temperature variation along centreline (based on thermistors and piezometers)	Temperature measurement stable and similar variation at surface from previous years.	Warming trend in the permafrost or increase in active layer (permafrost degradation)	Thawing of the dike key trench	-
	Instability due to deformation and slope failure, leading to dam breach and total or partial loss of containment	Tension crack on crest	None visible / inactive	< 0.1 m wide & < 5 m length < 1.0 m deep	> 0.1 m and < 0.2 m wide & > 5 m and < 10 m length along the dike > 1.0 m deep	> 0.2 m wide > 10 m length along the dike > 2.0 m deep Dike stability is compromised
		Cumulative vertical crest movement	< 0.2 m	> 0.2 and < 1 m or Stable trend	> 1 m with increasing rate of settlement	> 2 m with increasing rate of settlement
Action Required			• Continue operation, maintenance, surveillance, and monitoring as per OMS procedure	. • If event is related to water level refer to Appendix C • If event is referring to seepage rate increase pumping capacity or repair system • Document location, photograph, survey, and increase inspection and instrument monitoring in area of concern (refer to Section 7) • Implement engineering review. • Implement communication plan (section 5.7)	• If event is related to water level refer to Appendix C • Suspend activities on dike crest and immediate downstream area • Implement communication plan (section 5.7) • Document location, photograph, survey, and increase inspection and instrument monitoring in area of concern. • Plan and take appropriate mitigation measures with engineering review. • Reassess thresholds and conditions for red category (emergency situation) taking into account the changing conditions presently observed and interactions of various items.	• Evacuation of personnel and equipment from downstream area. • Close access to dike crest • Implement Emergency Response Plan (Section 5.7)

5.7 COMMUNICATION AND DECISION MAKING

Figure 5-1 indicates the communication and decision processes when the threshold criteria are met and when pre-defined actions need to be implemented. Table 5-9 indicates the communication procedure to follow when changing the TARP level.

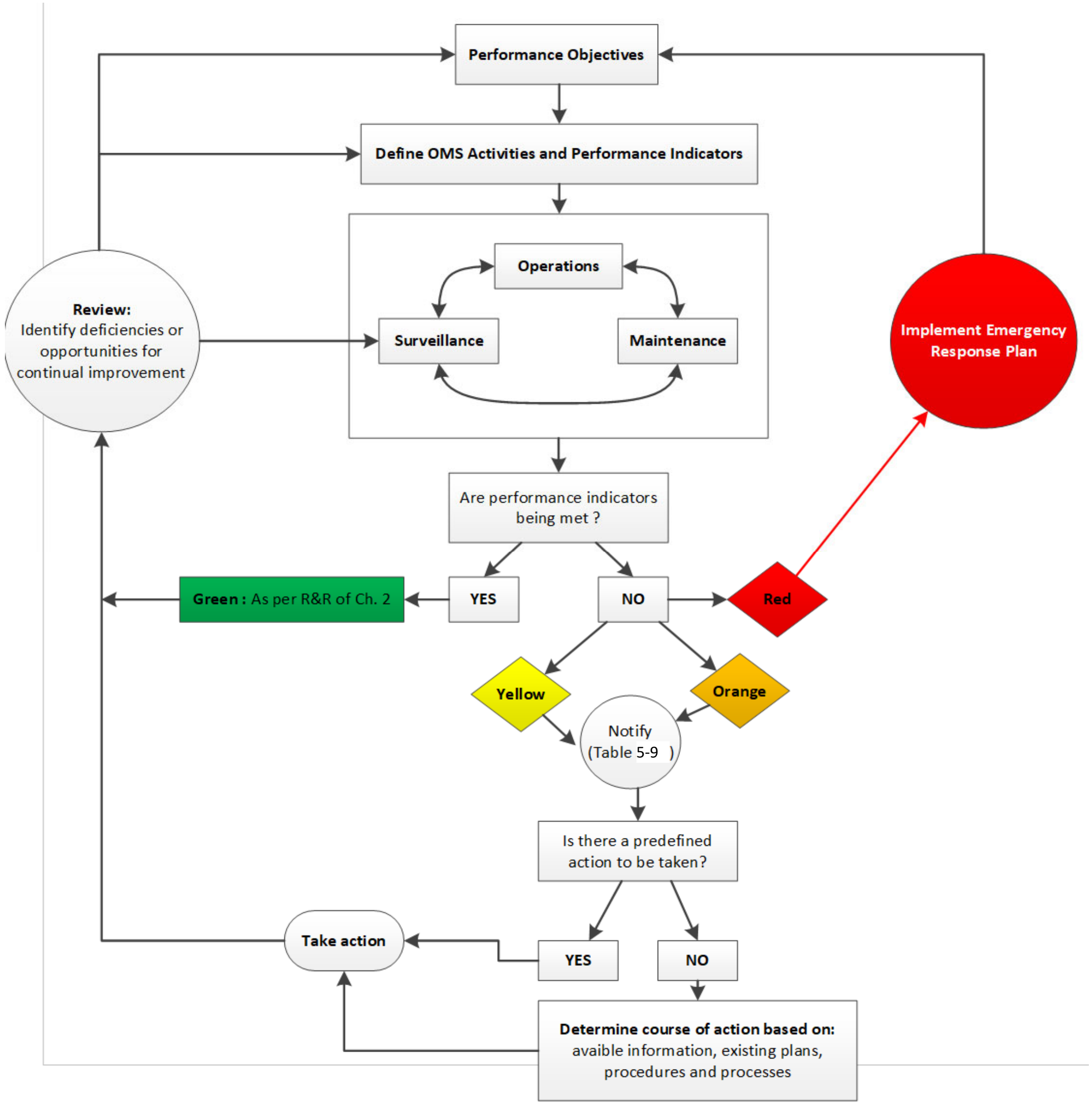


Figure 5-1 : Communication and Decision Process for Water Management Infrastructure TARP

Table 5-9 : Communication Procedure to Change TARP Level

Category	Notify	Timeline	Method of Communication
Green	On-Site team → Responsible person → • Independent Review Board • Designer • General Manager • EOR • AEO	The triggers are back to green for more than 2 weeks	Phone Call and E-mail to inform on status change. RP and EOR must agree to change status Brief memo sent by e-mail to officialise TARP change
Yellow	On-Site team → Responsible person → • Environment Superintendent • Critical Infrastructure General Supervisor • EOR	Within 24 hours of the TARP level condition being met	Phone Call and E-mail to inform on status change. RP and EOR must agree to change status. If RP can't be joined the on-site team will try to contact these people in this order: Critical Infrastructure GS, EOR, AEO
	Responsible person → • Independent Review Board • Designer • General Manager • EOR	Within 72 hours of the TARP level change	Brief memo sent by e-mail to officialise TARP change Meeting to be set to explain situation if required
	EOR → • AEO	Within 1 week of TARP level change	Left to the EOR discretion
Orange	On-Site team → Responsible person → • Environment Superintendent • Critical Infrastructure General Supervisor • EOR	Immediately upon discovering TARP level triggers change	Phone Call, E-mail, and meeting to inform on status change. If RP can't be joined the on-site team will try to contact these people in this order: Critical Infrastructure GS, EOR, AEO
	Responsible person → • Independent Review Board • Environment Superintendent • Critical Infrastructure General Supervisor • Designer • General Manager • EOR • AEO • Health & Safety Superintendent	Within 24 hours of the TARP level change	Brief memo sent by e-mail to officialise TARP change Meeting to be set to explain situation
RED	On-Site team → Emergencies Response Team Once an emergency is declared refer to the ERP. Emergency response is out of scope of this document	Immediately when the emergency is discovered. If there is currently a risk to Env or Health and Safety	Code 1 – Code 1 – Code 1 in all pit operation and road channel Or at Emergencies 460-6911
		Immediately when the emergency is discovered. If there is imminent risk to Env or Health and Safety	Phone call to Emergency Measure Counselor (460-6809) & Health and Safety Superintendent

SECTION 6 • MAINTENANCE

This section identifies all infrastructures within the scope of this manual that have maintenance requirements and identifies all preventative, predictive, and corrective maintenance activities.

6.1 PREVENTATIVE, PREDICTIVE, AND CORRECTIVE MAINTENANCE

Maintenance is divided into preventative (planned), predictive, and corrective.

Preventative maintenances are planned, recurring, maintenance activities conducted at a fixed or approximate frequency and not typically arising from results of surveillance activities. Examples of such maintenance includes calibration and maintenance of surveillance equipment or regularly changing oil on a pump as per the manufacturer's requirement.

Predictive maintenances are pre-defined maintenances conducted in response to results of surveillance activities that measure the condition of a specific component against performance criteria.

Corrective maintenance of a component of the water management system is to prevent further deterioration and ensure their performance in conformance with performance objectives. The need for corrective maintenance is based on surveillance activities, with surveillance results identifying the need and urgency of maintenance.

6.2 REFERENCES

References to key documents for the maintenance of the Dewatering Dikes at Meadowbank are presented in Table 6-1.

Table 6-1 : Reference Documents for Maintenance of Dewatering Dikes at Meadowbank

Type of information	Link to Retrieve Information
Maintenance log of water management infrastructure	Located in the Maintenance folder for each structure
Maintenance log of pumping equipment	I:\MAINTENANCE\G dore SECTION\PWA-COM-LGT hrs reading.xlsx P:\EnergyInfra\08-PowerHouse\2 EQUIPMENT\2 GENERATORS
Maintenance log of geotechnical instrumentation	Located in the Instrument Analysis Log for each structure. \\Cambfs01\groups\Engineering\05-Geotechnic\11-Instrumentation\12- Instrumentation_Analysis
Pump allocation tool	\\Cambfs01\groups\Engineering\05-Geotechnic\14-Amaruq\04- Water Management\3- Operation\11-Planning\4- Freshet\4 - Freshet 2023\2-Technical\Pump Allocation\PumpAllocation_Vs1_2023_CP_JG.xlsx
Godwin pump parts and schematics site	https://xylem.sysonline.com/Login.aspx
Geotechnical instrument and data logger inventory	\\Cambfs01\groups\Engineering\05-Geotechnic\11-Instrumentation\1- Instruments\ALL Instruments Databases

6.3 COMPONENTS OF THE WATER MANAGEMENT INFRASTRUCTURES REQUIRING MAINTENANCE

Table 6-2 indicates all the components of the Meadowbank water management infrastructures that require maintenance.

Table 6-2 : Components of the Water Management Infrastructures Requiring Maintenance

Water Management
• Dike embankment (i.e., repair erosion) • Dike crest (i.e., fill inactive tension cracks, repair crest settlement) • Seepage collection sump (i.e., reprofile slope, increase sump volume) • Ditches and diversions (i.e., snow removal, repair erosion) • Pumps and pipes at East Dike stations
Surveillance
• Geotechnical instruments (thermistors, piezometers, inclinometers, survey monuments) • Data acquisition system • Flowmeter
Other
• Dike crest access roads • Access to sumps

6.3.1 Maintenance Components Outside the Scope of this OMS Manual

The following component maintenance activities are outside of the scope of this OMS manual. For more information, the superintendent of the department responsible for this maintenance can be contacted:

- Electrical systems and supply – E&I
- Maintenance of heavy equipment and light vehicles – Maintenance
- Communication infrastructures – IT
- Road used to access the infrastructures – Mine

6.4 DESCRIPTION OF MAINTENANCE ACTIVITIES

Table 6-3 summarizes the description of maintenance activities for each component of the Meadowbank water management infrastructure. Each component has activities as well as a trigger for that maintenance and a person in charge of this activity. It is the duty of the person responsible for the maintenance activity to ensure that the person doing the maintenance has the qualifications and competencies required to conduct the maintenance and is following the proper safety procedure. The person in charge of the activity must also ensure that the proper documentation and reporting requirements are followed.

Table 6-3 : Description of Maintenance Activities for Components of Water Management Infrastructure

Component	Type of Maintenance	Nature of the Activity	Frequency of Maintenance (preventative) OR Trigger of Maintenance (predictive and corrective)	Accountable for the activity→ Responsible for the Activity	Documentation Required	Reporting Requirement
Water Management						
Dike embankment – repair erosion	Corrective	Gullies and depressions to be filled with rockfill and re-sloped	Following a visual inspection showing erosion	Environment & Critical Infrastructure Superintendent → Water & Geotechnical Coordinator	Photo & survey of corrective work	Geotechnical Coordinator to update the maintenance log of the structure. Survey of work to be added to structure layout
Dike crest – fill inactive tension cracks	Corrective	Inactive tension cracks to be filled with bentonite to prevent widening due to water infiltration	Following consecutive visual inspection showing inactive tension cracks (more than 1 month)	Environment & Critical Infrastructure Superintendent → Water & Geotechnical Coordinator	Photo & survey of corrective work	Geotechnical Coordinator to update the maintenance log of the structure. Survey of work to be added to structure layout
Dike crest – compensate settlement	Corrective	Add rockfill to increase the height of the dike following observation of settlement	Following a visual inspection showing settlement that needs to be compensated (i.e., loss of freeboard)	Environment & Critical Infrastructure Superintendent → Water & Geotechnical Coordinator	Photo & survey of corrective work	Geotechnical Coordinator to update the maintenance log of the structure. Survey of work to be added to structure layout
Seepage collection sump – increase volume	Predictive	Excavate an additional sump or increase the capacity of an existing sump	Following a re-assessment of the required sump capacity	Environment & Critical Infrastructure Superintendent → Water & Geotechnical Coordinator	Photo & surveying of predictive work	Geotechnical Coordinator to ask for update of status map. Survey of work to be added to structure layout
Seepage collection sump – broken culvert / frozen sump	Corrective	Unfreeze culvert, repair culvert, or install a new sump	Following a visual inspection showing problem with the collection culvert	Environment & Critical Infrastructure Superintendent → Water & Geotechnical Coordinator	Photo of corrective work	Geotechnical Coordinator to update the maintenance log of the structure
Seepage collection sump – reprofile sump	Corrective	Excavate flatter slope for the sump or add material against the slope to reprofile them	Following a visual inspection showing instable sump slope	Environment & Critical Infrastructure Superintendent → Water & Geotechnical Coordinator	Photo of corrective work	Geotechnical Coordinator to update the maintenance log of the structure
Pumps and Genset – maintenance as per manufacturer specification (i.e., change oil, look for wear and tear, calibration)	Preventative	Do PM on the pumping unit as per manufacturer recommendation	As per manufacturer specification	Maintenance Superintendent → Pump mechanics	Equipment log Maintenance record	Maintenance to update the pump maintenance log or Genset maintenance log
Pumps and Genset – maintenance when deficiency are observed (cavitation, breakdown, electrical trouble)	Corrective	Troubleshoot the pump problem so that it is once again operational	Following a visual inspection of deficiency	Maintenance Superintendent → Pump mechanics	Equipment log Maintenance record	Maintenance to update the pump maintenance log or Genset maintenance log
Pumps – winterization of unit used in winter	Preventative	Ensure that pumps used in winter have been winterized	Once a new pump is received on site that will be used in winter. During initial reception of pump	Maintenance Superintendent → Pump mechanics	Maintenance record	Maintenance to update the pump maintenance log
Pipe – drain the line	Preventative	Ensure that the line is empty of water when it is stopped in winter	Every time pumping is interrupted in winter	E&I Superintendent → E&I Operation G.S	Pigging radius notice	-
Pipe – unfreezing a line	Corrective	Steaming the line to unfreeze it in winter	Following visual inspection of a frozen line	E&I Superintendent → E&I Operation G.S	-	-
Pipe – maintenance when deficiency is observed (leak, pipe burst)	Corrective	Replacing a deficient part of a line with new pipe	Following visual inspection of pipe deficiency	E&I Superintendent → E&I Operation G.S	How much pipe was replaced, what was installed and where it came from	Update of pipe inventory
Surveillance						
Geotechnical instrument – loss of reading	Corrective	Investigate the status of an instrument that no longer gave data	When an instrument no longer gave data for an unknown reason	Environment & Critical Infrastructure Superintendent → Water & Geotechnical Coordinator	Update status in instrument database	Update of the Instrument Analysis Log by the Project Tech
Geotechnical instrument – unusual reading	Corrective	Investigate the status of an instrument that gave unusual data	When an instrument gave unusual data	Environment & Critical Infrastructure Superintendent → Water & Geotechnical Coordinator	Update status in instrument database	Update of the Instrument Analysis Log by the Project Tech
Geotechnical instrument – replacement	Corrective	Replace an instrument that no longer works	Following an assessment that an instrument needs to be replaced to ensure proper coverage of the surveillance system	Environment & Critical Infrastructure Superintendent → Water & Geotechnical Coordinator	Instrument installation as-built report Update spare inventory Calibration sheet Initial instrument reading	Update of the Instrument Analysis Log by the Project Tech
Survey Instrument – repair of equipment (drone, survey rod, scanner)	Corrective	Fix a problem with the survey equipment (could require sending it for repair)	Following an assessment that there is an issue with the equipment	Engineering Superintendent → Survey Leader	-	-
Survey Instrument – Calibration of drone data	Preventative	Confirm the accuracy of the drone survey with rod or scan survey	Once a year per structure	Environment & Critical Infrastructure Superintendent →	Survey data and drone data	Both data in the survey file

Component	Type of Maintenance	Nature of the Activity	Frequency of Maintenance (preventative) OR Trigger of Maintenance (predictive and corrective)	Accountable for the activity→ Responsible for the Activity	Documentation Required	Reporting Requirement
				Water & Geotechnical Coordinator		
Geotechnical instrument – calibration of inclinometer probe	Preventative	Send the inclinometer probe to be calibrated	Yearly	Environment & Critical Infrastructure Superintendent → Water & Geotechnical Coordinator	Calibration sheet	Update of the Instrument Analysis Log by the Project Tech
Data acquisition system – maintenance	Preventative	Do maintenance of datalogger (i.e., battery, solar panel, shack)	Yearly	Environment & Critical Infrastructure Superintendent → Water & Geotechnical Coordinator	List of items maintained	Update of the Instrument Analysis Log by the Project Tech
Datalogger – battery change	Predictive	Change battery when the battery level alarm gets triggered	When the battery alarm is triggered in VDV	Environment & Critical Infrastructure Superintendent → Water & Geotechnical Coordinator	Update status in instrument database	Update of the Instrument Analysis Log by the Project Tech
Datalogger – troubleshooting	Corrective	Repair of a datalogger deficiency	When a datalogger is suspected of being deficient	Environment & Critical Infrastructure Superintendent → Water & Geotechnical Coordinator	Update status in instrument database	Update of the Instrument Analysis Log by the Project Tech
Flowmeter – calibration	Preventative	Calibrate the flowmeter as per License requirement	Yearly	E&I Superintendent → E&I Operation G.S	Calibration sheet	WO records
Flowmeter – deficient reading	Corrective	Repair of a flowmeter deficiency	When a flowmeter is suspected of providing anomalous data	E&I Superintendent → E&I Operation G.S	Maintenance report	WO records
Other						
Dike crest access, sump access, access road	Predictive	Snow clearing, maintaining roadway, grading access as per snow management map	As required to maintain access	E&I Superintendent → E&I Operation G.S	-	-

SECTION 7 • SURVEILLANCE

Surveillance involves the inspection and monitoring (i.e., collection of qualitative and quantitative observations and data) of the Dewatering Dikes. Surveillance also includes the timely documentation, analysis, and communication of surveillance results, to inform decision making and verify whether performance objectives including critical controls are being met.

There are two types of surveillance activities which are further discussed in this section:

- Site observation and inspection
- Instrument monitoring

7.1 REFERENCE

References to key documents for site observation and inspection of the Dewatering Dikes at Meadowbank are presented in Table 7-1. References to key documents for instrument monitoring are presented in Table 7-2.

Table 7-1 : Key Reference Documents for Inspection of the Dewatering Dikes at Meadowbank

Type of information	Document #	Document Title and Link
Inspection form templates	-	\\Cambfs01\groups\Engineering\05-Geotechnic\10-Inspection\8- Inspection Form Template
East Dike inspection report	ED-VIR	..\..\..\..\04-DewateringDikes\1- East Dike\4-Operation\1- Inspection
Bay-Goose Dike inspection report	BG-VIR	..\..\..\..\04-DewateringDikes\2- Bay-Goose Dike\4- Operation\1- Inspection
South Camp Dike inspection report	SCD-VIR	..\..\..\..\04-DewateringDikes\3- South Camp Dike\4- Operation\1- Inspection
Vault Dike inspection report	VD-VIR	..\..\..\..\04-DewateringDikes\4- Vault Dike\4-Operation\1- Inspection
Annual geotechnical inspection	-	..\..\..\..\10-Inspection\Annual Geotechnical Inspection
Freshet Inspection	-	\\Cambfs01\groups\Engineering\05-Geotechnic\05-WaterManagement\2024\04 - Freshet Inspections
Minute of MBK-IRB Meeting	MDRB #32 (most recent)	\\Cambfs01\groups\Engineering\05-Geotechnic\13-MDRB
Inspection Recommendation Implementation Log	-	https://agnicoeagle.sharepoint.com/:x:/r/sites/GRP_CAMB_ENVIRONEMENT/Shared%20Documents/General/Geotech/Inspection%20Recommendation%20Implementation%20Plan.xlsx?d=w23331bcb9a124aaf88978a570dd1b6c0&csf=1&web=1&e=nR9CVi

Table 7-2 : Reference Documents for Instrument Monitoring of the Dewatering Dikes at Meadowbank

Type of information	Link to Retrieve Information
Access to Instrument Data	VDV (http://cambeng2:8080/)
Geotechnical Instruments Map	Instrument Summary folder for each structure on the network
Instrument Analysis Log	\\Cambfs01\groups\Engineering\05-Geotechnic\11-Instrumentation\12-Instrumentation_Analysis
Instrument alert trigger and review frequency (Instrumentation compilation and trigger)	P:\Engineering\05-Geotechnic\11-Instrumentation\12-Instrumentation_Analysis
Blast Vibration Log	\\CAMBFS01\Groups\Engineering\05-Geotechnic\99-Archive\Blast Monitoring\Events\k_factor(to update).xls
Environment Calendar	Tracks field activities P:\Environment\INSPECTIONS AND FORMS\2022
Water Quality Result Database	https://equis/equis7/Default.aspx?d=251&redirect=user
Inclinometer Reading	\\CAMBFS01\Groups\Engineering\05-Geotechnic\04-DewateringDikes\1-East Dike\6- Instruments\2- Instrument Data\Displacement\Inclinometers \\CAMBFS01\Groups\Engineering\05-Geotechnic\04-DewateringDikes\2-Bay-Goose Dike\6- Instruments\2- Instrument Data\Displacement\Inclinometers\PDF
Bay-Goose V-Notch Reading	\\Cambfs01\groups\Engineering\05-Geotechnic\04-DewateringDikes\2-Bay-Goose Dike\6- Instruments\2- Instrument Data\Seepage
Manual Water Level Survey File	\\Cambfs01\groups \\CAMBFS01\Groups\\Environment\INSPECTIONS AND FORMS\Water Levels

7.2 PRIORITY LISTING

Any recommendation or action to be taken following a surveillance activity must be assigned a priority and an Owner and be followed up on according to its priority. The priority scale of Table 7-3 must be used for this. These recommendations must also be tracked using the Inspection Recommendation Implementation Log.

Table 7-3 : Surveillance Activity Recommendation Priority Listing

Priority #	Description	Timeline to Address
P-1	A high priority or actual structure safety issue considered immediately dangerous to life, health, or the environment; or a significant risk of regulatory enforcement	Immediately to 1 week
P-2	If not corrected could likely result in structure safety issues leading to injury, environmental impact, or significant regulatory enforcement; or a repetitive deficiency that demonstrates a systematic breakdown of procedures	1 week to 3 months
P-3	Single occurrences or deficiencies or non-conformance that alone would not be expected to result in structure safety issues	3 months to 6 months
P-4	Best Management Practice – further improvements are necessary to meet industry best practices or reduce potential risks	>6 months

7.3 SITE OBSERVATIONS AND INSPECTIONS

The purpose of site observations and inspections is to identify warning signs of the development of potentially adverse conditions that could lead to a failure or some other form of loss of control. Site observations and inspections include direct observations by personnel on or adjacent to the Dewatering Dikes and may also include observations from helicopter or photos taken from an unmanned airborne vehicle (UAV, satellites).

Site observations and inspections are used to identify and track visible changes in the condition of the Dewatering Dikes. Changes that may be observed throughout site observations and inspections are included in Table 7-4.

Table 7-4 : Changes Possibly Observed Through Site Observation and Inspection of the Dewatering Dikes at Meadowbank

Changes related to physical risk of dike, road, ramp
• Change in freeboard. • Deformation or change in condition at the crest, slopes, and toes (i.e., bulges, cracks, sinkholes, sloughing, settlement) • Newly formed or expanding areas of erosion • Evidence of piping or unexpected water movement through water containment structures • Changes in the seepage quantity (pumping rate) and quality (turbidity)
Changes related to physical risk of ditch
• Newly formed or expanding areas of erosion • Newly formed obstructions to flow (i.e., boulder, sediments, snow) • Newly formed slope instability
Changes related to water storage and transport
• Change in sump level.

• Discovering using a staff gauge (when applicable) that the pond is not being operated within its normal operating conditions. • Changes in the seepage quantity (pumping rate) and quality (turbidity) • Change in the condition of the piping for water transport. • Sign of leaks from water line • Change in the condition of pumps
Changes related to surveillance instrumentation
• Change in the condition of surveillance instruments and associated protection around instruments (i.e., cover, barriers to prevent vehicle damage) • Change in condition of power supplies for instruments (i.e., solar panel) • Change in condition of communication infrastructures associated with instruments (i.e., antenna, datalogger)

7.3.1 Site Observation

Site observation is conducted by personnel working on or adjacent to the Dewatering Dikes as part of their daily activities, maintaining awareness of the facility while performing their duties. Trained personnel such as geotechnical engineers or technicians should be on the lookout for signs of changing conditions as indicated in Table 7-4 since adverse conditions can develop rapidly between inspections. It is recommended that training be provided once a year to crews working around the structures, such as during a toolbox meeting around the start of freshet. Photos to show examples of cracks, sinkholes, and other signs of changing conditions can be presented to ensure workers know what to look out for during their activities. Any new observation should be documented by photograph and reported to the geotechnical team. Observation of new observation during a site observation could trigger a special inspection.

7.3.2 Inspection Program

Inspections are conducted by the geotechnical team or other personnel with appropriate training and competency and are more rigorous than site observations.

The inspection program consists of several types of inspections such as routine and special visual inspections, dike safety inspections, and dam safety reviews. The following sub-sections describe in more detail the scope, frequency, and person responsible for each type of inspection.

7.3.2.1 Routine Visual Inspection and Reporting

Routine visual inspections are conducted on a pre-defined schedule and may target specific activities. Their objective is to identify any conditions that might indicate change in the Dewatering Dikes performance and therefore require follow-up. The inspections need to cover the changes described in Table 7-4. Of significance are new occurrences or noted changes in seepage, erosion, sinkholes, boils, slope slumping, settlement, displacement, or cracking of structure components. These inspections are conducted during dewatering and operation.

The approved inspection forms for inspection include:

- The integrated inspection form used for weekly inspection during freshet (during period of flow) or when required to document an ad-hoc inspection.
- The detailed inspection form used for monthly inspection.

These forms can be found at the location indicated in Table 7-1. All areas of the form must be filled.

Table 7-5 summarizes the inspection documentation and the responsibilities of those involved with creating them and reviewing them. Table 7-6 summarizes the routine visual inspection roles and responsibilities, suggested frequency, and scope in function of the alert level of the structure.

The frequency for inspection of a structure will vary based on its TARP level and needs to be updated in the Instrument Analysis Log if it changes.

For the structures that have an orange TARP level, the weekly update report needs to be written with the following information:

- Context on why the structure is at the orange level.
- Change in condition since the last weekly report.
- Description of the mitigation plan and what actions have been taken since the last update report.
- Discussion on the results of the instrumentation data.

Table 7-5 : Summary of Inspection Documentation & Responsibilities

Routine Visual inspection type	Documentation to be generated	Documentation content	Inspection officer responsibilities	Reviewing officer responsibilities
Monthly visual inspection	Visual inspection report Photographs	- Summary of visual observations during the inspection (including inactive features) - Discussion on the progress of former inspection observations - Documentation of the performance indicator versus the threshold criteria (water level, seepage rate, visual observation) - Map of where the visual observations are located (including past observation with date) - Representative photos with caption and a clear way of locating where they are taken. - Action items to be taken following the inspection (operation, maintenance, or surveillance) with a Priority listing as well as an Owner.	- Perform the inspection as per the OMS frequency. All components of the structure must be accessed on foot and the performance visually assessed (access, earthwork, sump, pumping system, instruments). - Immediately report adverse conditions to the Water & Geotech Coordinator - Take pictures to supplement the inspection. As much as possible, these are to be taken from the same vantage points during each inspection so that changes in conditions can be readily identified. All areas having abnormal condition (active or inactive or no longer visible) must be photographed. Photos must be annotated or captioned and must include a date stamp. - Store electronically all photos and the inspection form (even those not included in the report) - Fill all information in the proper inspection form. - Update the surveillance activity tracking tool. - Sign the inspection form as the person having done the inspection and ensure that the reviewer is aware that the document is ready to be reviewed.	- Ensure that all required information is present as per requirement. - Ensure that the indicators do not trigger a change in alert level. - Review and approve the action items and ensure that they are assigned an Owner. - Ensure the inspection recommendation tracking tool is updated accordingly. - If there is a change in recommendation status, ensure that the recommendations are distributed to the appropriate stakeholder based on R&R defined in Section 2. - Sign the inspection form as a reviewer. - Ensure the surveillance activity tracking tool is updated. - Distribute the inspection results to the EOR, the Meadowbank Geotechnical Engineering e-mail list and to responsible of action item.
Weekly Yellow TARP inspection	Weekly structure-specific inspection report Photographs	- Summary of visual observations during the inspection (including inactive features) - Discussion on the progress of former inspection observations - Discussion on the progress of the conditions that are related to the yellow TARP level change. - Documentation of the performance indicator versus the threshold criteria (water level, seepage rate, visual observation) - Representative photos with caption and a clear way of locating where they are taken. - Action items to be taken following the inspection (operation, maintenance, or surveillance) with a Priority listing as well as an Owner.	- Perform the inspection as per the OMS frequency. All components of the structure must be accessed on foot and the performance visually assessed (access, earthwork, sump, pumping system, instruments). - Pay a special attention to the conditions in relation to what triggered the change in TARP level. - Immediately report adverse conditions to the Water & Geotech Coordinator - Take pictures to supplement the inspection. As much as possible, these are to be taken from the same vantage points during each inspection so that changes in conditions can be readily identified. All areas having abnormal condition (active or inactive or no longer visible) must be photographed. Photos must be annotated or captioned and must include a date stamp. - Store electronically all photos and the inspection form (even those not included in the report) - Fill all information in the proper inspection form. - Update the surveillance activity tracking tool. - Sign the inspection form as the person having done the inspection and ensure that the reviewer is aware that the document is ready to be reviewed.	- Ensure that all required information is present as per requirement. - Ensure that the indicators do not trigger a change in alert level. - Review and approve the action items and ensure that they are assigned an Owner. - Ensure the inspection recommendation tracking tool is updated accordingly. - If there is a change in recommendation status, ensure that the recommendations are distributed to the appropriate stakeholder based on R&R defined in Section 2. - Sign the inspection form as a reviewer. - Ensure the surveillance activity tracking tool is updated. - Distribute the inspection results to the EOR, the Meadowbank Geotechnical Engineering e-mail list and to responsible of action item
Weekly inspection (freshet)	Integrated freshet inspection checklist Photographs	- Summary of visual observations during the inspection	- Perform the inspection as per the OMS frequency. All components of the structure must be accessed on foot and the performance visually assessed (access, earthwork, sump, pumping system, instruments). - Use and fill in the integrated freshet inspection checklist. - Immediately report adverse conditions to the Water & Geotech Coordinator - Take pictures to supplement the inspection. - Store electronically all photos in full resolution. - Record an observations summary in the Environment freshet inspection file. - Notify the Water & Geotech Coordinator if actions or further investigation are required. - Update the surveillance activity tracking tool.	- Update the inspection recommendation tracking tool if required. - Ensure that the indicators do not trigger a change in alert level. - Ensure a special visual inspection is conducted if change in conditions is noted as detailed in section 6.3.2.2

Table 7-6 : Summary of Routine Inspection Requirements (frequency, reporting, distribution)

TARP Level	Person Responsible	Inspection Frequency	Reporting	Inspection Reviewer	Distribution List
Green	Geotechnical engineer or delegate	Monthly from Mid-May to Mid-October East Dike and Bay-Goose Dike: Monthly	Visual inspection form	Geotechnical Engineer and/or Water & Geotechnical Coordinator	Meadowbank Geotechnical Eng e-mail list, recommendation Owner
		Weekly during period of flow (from May to October)	Integrated Inspection form for each component (pond, dike, channel)		
Yellow		Monthly	Visual inspection form		
		Weekly	Specific simplified inspection form		
Orange	Water & Geotechnical Coordinator	Weekly	Report on summary of surveillance activity + status of mitigation action	Environment Superintendent and/or EOR (left at EOR discretion)	Meadowbank Geotechnical Eng e-mail list, EOR, recommendation Owner + Weekly update sent to: Designer, MBK-IRB, General Superintendent Technical Services
		Monthly	Visual inspection form		
		Daily	Integrated Inspection form		

7.3.2.2 Special Visual Inspection

Special inspections are conducted during and after unusual or extreme events that may impact the facility or after a site observation noticed a change in condition that is deemed significant to the Water & Geotechnical Coordinator. Special inspections are conducted by qualified personnel from the Geotechnical Team. The Engineer of Record or the Independent Review Board or the Designer could be asked to join these inspections based on the circumstance of the event (left at the RP and EOR discretion). This inspection will be recorded using the inspection form using the same procedure for review and documentation. A memo might also accompany these inspections based on the circumstances of the event (left at the EOR and RP discretion).

Special visual inspections must be done on each structure after each of these events:

- At the end of dewatering once the downstream toe is exposed
- Following a blast that exceeds the vibration limits of the structure.
- After an earthquake
- After a high intensity rainfall event (higher than a 1:2 years recurrence (25 mm in 24 hrs)

7.3.2.3 Annual Geotechnical Inspection

The Annual Geotechnical Inspection is a requirement of the Water License. It is a more comprehensive technical inspection, integrating inspections and results of monitoring instruments. This inspection is conducted annually by an external geotechnical engineer to have a more complete understanding of the facility performance and to identify deficiencies in performance or opportunity for improvement. This will also provide information to be used to revise the OMS manual.

For the Dewatering Dikes at Meadowbank, such inspection must occur on an annual basis by the end of the flow period (July to September). The following components need to be inspected during this review:

- All components of East Dike, Bay-Goose Dike, South Camp Dike and Vault Dike

In addition to field inspection the following points should be addressed during the review:

- Review of inspection reports performed since the last review
- Review of instruments data
- Identify deficiencies in performance or opportunity for improvement
- Review performance indicator, operational control, and operational threshold criteria
- Review and provide recommendations regarding the OMS for the following year

After each annual inspection, a report must be submitted to the Responsible Person which includes the results of the inspection and addresses all points above. These reports will be stored electronically. The recommendation must respect the priority nomenclature. The Responsible Person will ensure that an action plan is developed to address the recommendations and will transmit the report and the action plan to the EOR.

7.3.2.4 EOR Inspection

As per AEM Governance on Critical Infrastructure, on an annual basis the EOR will perform a site visit to inspect the infrastructure and review the various components of the water and tailings management system. The results of this inspection will be summarized in an annual report transmitted to the RP and the AEO. The RP will ensure that an action plan is developed to address the recommendations of the EOR inspection.

7.3.2.5 Independent Review Board Meeting (MBK-IRB)

The name of the Independent Review Board for the Meadowbank Complex is the *Meadowbank Independent Review Board* (MBK-IRB).

An annual IRB meeting will be held every year. The following topics are part of the annual IRB scope of work:

- Site visit (between June and October) of all infrastructure covered by the scope of the IRB
- Review of mine waste management strategy (including tailings and waste rock storage facilities)
- Review water management infrastructure designs and performance (including water retaining infrastructures)
- Review of on-going construction works and monitoring data
- Comment on implementation progress of proposed mine waste management improvement measures
- Provide opinions and guidance to the operation on the physical integrity, safety, behavior, and performance of the confinement systems for mine waste and water retaining infrastructures
- Comment on management systems, emergency preparedness, and overall management approach of the different mine waste management facilities and water retaining infrastructures

Other events that could trigger a IRB meeting are:

- Presentation of design of new critical infrastructure
- Major modifications to the design or design criteria
- Discovery of unusual conditions that can compromise the integrity of the Dewatering Dikes
- After extreme hydrological or seismic events
- Decommissioning

The IRB will submit a report outlining their observations and recommendations following each meeting. The RP will ensure that an action plan is developed to address the recommendations and will transmit the report and the action plan to the EOR.

7.3.2.6 Independent Dike Safety Review (DSR)

Independent dike safety reviews (DSR) are carried out by an independent third party with the EOR to review all aspects of the design, construction, operation, maintenance, processes, and other systems affecting dike safety, including the dike safety management system. The DSR defines and encompasses all components of the "dike system" under evaluation including the dikes, foundations, abutments, instrumentation, and seepage collection works.

A DSR will be organized as per the MAC proposed frequency by the Responsible Person and will be done according to the Dam Safety Guideline (CDA, 2019). The first DSR for the Meadowbank Dewatering Dikes was done in August 2023.

7.4 INSTRUMENT MONITORING PROGRAM – DATA ACQUISTION

Instrument monitoring provides information on parameters or characteristics that cannot be detected through site observation or inspections, cannot be observed with sufficient precision and accuracy, or need to be monitored at high frequency or continuously.

The objective of instrument monitoring is to collect data to be used to assess the performance of the infrastructures against the performance objectives and indicators and the critical controls (refer to Table 5-2). Instrument monitoring and inspections work together as a comprehensive data set to enable assessment of the Dewatering Dikes performance and to provide a basis for informed decision making. All are essential, and none of these forms of surveillance can be neglected if performance objectives are to be met and risks are to be managed.

More information on the type of in-situ instruments installed on each structure, how they were installed, and their location can be found in Section 3.7 of this OMS manual.

Table 7-7 indicates the type of information collected through instrument monitoring and how it is collected. Table 7-8 summarizes the data acquisition programs related to instrument monitoring. Table 7-8 also goes over the required water level surveys at Meadowbank; this information is used by the Water & Tailings Engineer to update the water movement log and water balance and is vital information for ensuring the freeboard of the Dewatering Dikes is respected.

Table 7-7 : Information Collected Using Instrument Monitoring

Direct collection of information
• In-situ thermistors to measure temperature profile within the structure and its foundation • In-situ piezometer to measure pore-water pressure providing information about flow of water through the structure and foundation stability • Manual inclinometer reading to provide information on deformation within the cut-off wall • Airborne survey to monitor vertical settlement and deformation • Survey of dike crest to provide validation on settlement and deformation • Blast monitor to inform on potential impact of blasting vibration on the structure • Flow meters and seepage monitoring stations to inform on volume of water movement • Surveys conducted to measure ice cover, water level, and update height and slope of containment structure
Collection of information from remote sensing
• Data acquired from airborne survey to generate detailed topographic map
Collection of information based on laboratory analyses
• Water quality analysis of seepage and surface runoff reporting to sump • Water quality analysis of water stored in the various ponds on site to inform on water movement decisions
Collection of information related to the conduct of OMS activities
• Automatic data collection and transmission system for in-situ instruments (datalogger, solar panel, antenna, battery)

Table 7-8 : Summaries of Data Acquisition Programs Related to Instrument Monitoring of the Dewatering Dikes at Meadowbank

Instrument Monitoring	Location of Monitoring (3)	Parameter Measured	Acquisition Methodology	Standard Acquisition Frequency	Acquisition Responsible	Documentation Methodology (1)	Documentation Responsible
Thermistor	East Dike, Bay-Goose Dike, South Camp Dike, Vault Dike	Temperature (^{0}C) point for each bead on the chain	In-situ instrument connected to automatic data acquisition and transmission system	New data are acquired and transmitted to VDV every 3 hrs	Environment Superintendent → Water & Geotechnical Coordinator	Data are documented in VDV (2)	Water & Geotechnical Coordinator
Piezometer	East Dike, Bay-Goose Dike, 2nd and 3rd Portage Lakes	Pressure (kPa) point for each instrument	In-situ instrument connected to automatic data acquisition and transmission system	New data are acquired and transmitted to VDV every 3 hrs	Environment Superintendent → Water & Geotechnical Coordinator	Data are documented in VDV (2)	Water & Geotechnical Coordinator
Manual Inclinometer Reading	East Dike, Bay-Goose Dike	Displacement in mm	Manual data acquisition using inclinometer probe	Quarterly	Environment Superintendent → Water & Geotechnical Coordinator	Data are documented on Inclinometer reading file	Water & Geotechnical Coordinator
Blast Monitor	-	Peak particle velocity (PPV) measured by the blast monitor (mm/s)	Placement of blast monitor at a predetermined area on the dike	Before each blast in the blast radius of the dike	Environment Superintendent → Water & Geotechnical Coordinator	Update the blast vibration log.	Water & Geotechnical Coordinator
Flow Meter	East Dike Seepage Station	Volume of water pumped (m^3)	Flowmeter connected to HMI system (remote data acquisition)	Continuously if connected to HMI	E&I Superintendent→ E&I Operation G.S	Historian (if connected to HMI)	E&I Operation G.S
Seepage Monitoring Station (manual reading with a V notch)	Bay-Goose Dike	Seepage flow (m^3/s)	Using a bucket and a stopwatch	Weekly during period of flow	Water & Tailings Superintendent → Water & Geotechnical Coordinator	Documented within measurement spreadsheet	Water & Geotechnical Coordinator
Survey Shot	Pits: Vault Pit, Phaser Lake, BBPhaser Pit Other ponds: Tear Drop Lake, Vault Attenuation Pond 2nd and 3rd Portage Lakes, Wally Lake, Turn Lake	Elevation of the water level (minimum precision of 3 mm required)	Take a water/ice level at a predetermined area	From May to September; once per week for all water bodies, (except Vault Pit, Vault Attenuation Pond, 2nd and 3rd Portage Lakes, Wally Lake, (monthly)) From October to April: monthly to confirm PZ reading	Environment Superintendent → Water & Geotechnical Coordinator	Water Level Survey file	Water & Geotechnical Coordinator
Airborne Survey	All water management infrastructure	Topographic aerial survey made using drone. Measurement of structure settlement	Take a drone survey	Once in June and once in September at ED and BGD	Environment Superintendent → Water & Geotechnical Coordinator	Within drone survey database	Water & Geotechnical Coordinator
Water Quality (4)	Refer to Water Management Plan	Parameters indicated within water management plan	Water quality sample taken and sent for laboratory analyses	Acquisition frequency within water management plan	Environment General Supervisor	Within Env water quality database	Environment General Supervisor

(1) Refer to section 7.7 for more information on reporting methodology and the frequency of reporting
(2) Refer to section 7.7 on how to present instrumentation data from VDV in a report
(3) Exact location of each instrument can be found in the instrumentation database
(4) Location of water quality sampling points can be found in the water management plan

7.5 ADDING INSTRUMENTS TO THE MONITORING PROGRAM

Any addition to the monitoring program must be validated by the acquisition responsible. The addition of a new type of monitoring needs to be validated by the Environment Superintendent. In-situ instrument installation must be recorded in an as-built document and added to the instrumentation database and map. After each installation of instrumentation, the following must be done:

- Document the calibration sheet and initial data reading
- Document instrument specification (manufacturer sheet)
- Document information to which datalogger the instrument is connected
- Survey instrument coordinates (x,y,z)
- If the instrument is drilled, a schematic view of the depth of the instrument versus the stratigraphy must be produced
- Photo of installation must be documented
- Update the structure layout with the location of the new instruments
- Update the instrument database of the structure

7.6 ANALYSIS OF SURVEILLANCE RESULTS

For the effective use of surveillance results in decision making, results must be collated, examined, analyzed, and reported in a timely and effective manner.

For visual inspections, the process of analyzing the data and communicating the results is described in Section 7.4 and happens while the inspection is done, and the report is sent. The information gained from the analysis of these results is then compared during the inspection and reviewed against the TARP criteria which will then indicate the action to take if performance indicators are not met.

For the instrumentation monitoring to be effective, the data must be reviewed, analyzed, and reported at the proper frequency. Table 7-9 summarizes the requirements for review, analyses, and reporting of instrumentation data.

The person performing an instrumentation data review needs to update the Instrument Analysis Log each time an instrument result has been analyzed and reviewed.

7.6.1 Procedure to Review Piezometer and Thermistor Data

While the use of an automatic data acquisition system eases the collection and review of instruments data there are certain pitfalls that need to be avoided to ensure a proper analysis. When doing a formal instrument review according to Table 7-9 it is important to fill in the instrumentation analysis tool and to ensure the following:

Piezometer (PZ):

- When reviewing PZ data it is important to look at the associated temperature of the instrument. A PZ which ever recorded data below 0 degrees should be considered unreliable. A frozen piezometer's data should not be relied upon
- When reviewing PZ data it is important to understand the piezometric regime of the instrument and what is the expected pressure profile. PZ data should be analyzed in context of where the instruments are installed and on the expected reading. It is not recommended to

only look at the variation of the reading and all piezometers should have readings associated with a trigger. If there is no trigger for the instrument and only a differential reading is examined (fall and rise) then the following must be considered in the review and analysis:
  - Ensure that the vertical scale is adequate. The scale used must allow to notice change at the scale of a decimeter. A 1 m change rise or fall is a very significant event that must be examined. If the vertical scale is too big a significant increase can easily be masked
  - Ensure that the data are reviewed at various timescales. When reviewing instrument data, the data should be looked at a multi-year scale (to see cyclical trends), a monthly scale and a weekly scale
  - Try to correlate increases and decreases in piezometric readings with change in the environment (change in water level, change in pumping activity, freezing of the ground, nearby blasting, progression of a nearby excavation)
- Piezometers must be analyzed in groups and arrays, rather than only one by one. It is important to compare a piezometer to others in the same section or in the same area, to understand how stable or evolving is the flow regime. One should make sure that all gradients (across the structure, vertical and lateral) are stable over time. Changes in gradient magnitude or direction are indicators of flow regime changes that can result in internal erosion processes.

Thermistor (TH):

To effectively review TH data, it is important to understand what the purpose is. Displacement graphs showing a TH profile at a set time in function of the elevation should not solely be used for such review. It is important to also consider the time series graphs to detect subtle trends and the thermal profile (colour map) for long term behavior.

- When reviewing a TH installed in a structure that must maintain a key trench in permafrost to perform (South Camp Dike, Vault Dike) the objective of the TH is to ensure that the design intent is met. The TH review needs to focus on the active layer depth and behavior of the permafrost (aggradation, degradation, stable). It is especially important to look at the thermal profile located in the low permeability element of the design (key trench). If a permafrost degradation trend beyond the active layer is observed progressing toward the key trench it must be raised as a concern. To review the performance of these structures, time series and thermal graphs are effective and displacement graphs should not be relied on alone.
- When reviewing a TH installed in talik or in a structure that does not require permafrost condition to perform (East Dike, Bay-Goose Dike) the objective of the TH is to identify potential seepage pathways (correlation between lake temperature and TH reading) as well as to monitor the evolution of the thermal condition (as some PZ behavior can be explained by change in thermal profile). The review of the instrument must focus on the link between the lake temperature and the TH temperature (as well as the delay in correlation) as well as the general progression of the thermal profile over multiple years. To do this review a combination of displacement graph, time series and thermal profile should be used. Trends of permafrost aggradation should be looked for while reviewing such instruments.

Table 7-9 : Requirements for Review, Analysis, and Reporting of Instrument Data

Instrumentation	TARP Level	Expected Range of Observation	Responsible for Review & Analysis	Frequency of Review	Responsible for Documentation	Documentation Frequency	Reporting Strategy
Piezometer, Thermistor	Green	Defined in TARP of each structure	Geotechnical Engineer	Bi-Weekly, monthly, quarterly, or yearly. As defined in instrument alert level and review frequency document	Geotechnical Engineer	As defined in instrument alert level and review frequency document	Annual Geotechnical Report and MBK-IRB Presentation
	Yellow	Defined in TARP of each structure	Geotechnical Engineer	Weekly (for instrument related to the TARP increase failure mode)	Geotechnical Engineer	Weekly (for instrument related to the TARP increase failure mode)	
	Orange	Defined in TARP of each structure	Water & Geotechnical Coordinator (can't be delegated)	Daily (for instrument related to the TARP increase failure mode)	Water & Geotechnical Coordinator (can't be delegated)	Daily (for instrument related to the TARP increase failure mode)	
Water Level	Any	Defined in TARP of each structure and in Appendix C	Geotechnical Engineer or Water & Geotechnical Coordinator	Daily	Geotechnical Engineer	Monthly water level updated in inspection report of each structure in relation to trigger level	Annual Geotechnical Report and MBK-IRB Presentation
Manual Inclinometer Reading	Any	Defined in TARP of each structure	Geotechnical Engineer	After each reading (quarterly)	Geotechnical Engineer	Documented in the Annual Geotechnical Report	Annual Geotechnical Report
Blast Monitor	Any	PPV> 50 mm/s	Geotechnical Engineer	After retrieving a blast monitor on a water management structure	Geotechnical Engineer	Documented in the Annual Geotechnical Report	Annual Geotechnical Report
Flow Meter / Seepage Monitoring	Green	Defined in TARP of each structure	Geotechnical Engineer	Weekly	Geotechnical Engineer	Documented in each inspection form	Annual Geotechnical Report and MBK-IRB Presentation
	Yellow	Defined in TARP of each structure	Geotechnical Engineer	Weekly	Geotechnical Engineer	Documented in each inspection form	
	Orange	Defined in TARP of each structure	Water & Geotechnical Coordinator (can't be delegated)	Daily	Water & Geotechnical Coordinator (can't be delegated)	Included within weekly update report	
Water Quality	Any	Defined in Water Management Plan	Environment Coordinator	As per water management plan	Environment General Supervisor	As per water management plan	As per water management plan
Settlement / Deformation	Any	Defined in TARP of each structure	Geotechnical Engineer	After each survey	Geotechnical Engineer	Included within inspection report of the period	Annual Geotechnical Report and MBK-IRB Presentation

7.6.2 Procedure If Data Exceeds Expected Range of Observation

If data exceeding the expected range of observation or anomalous data readings are observed or an instrument alert is triggered, the following actions need to be taken by the person reviewing the instrument:

Anomalous instrumentation data examples are presented in Table 7-10. These anomalies could happen without triggering a TARP level change and need to be investigated and recorded in the instrumentation analysis tool:

- Re-read to check the reading (if the reading is from VDV, take a manual reading in the field)
- If the instrument is connected to a datalogger ask the Project technician to check readout equipment to verify that it is functioning correctly and to verify calibration
- If instrument has stopped functioning, notify the Water & Geotechnical Coordinator immediately. If considered critical, a replacement instrument should be installed
- If an anomalous reading is confirmed, a detailed review of the effects of the reading should be carried out and design or remedial actions should be implemented if determined necessary by the Water & Geotechnical Coordinator. Any malfunctioning instrument or frozen piezometer must be documented
- In the case of valid data that would exceed the TARP level perform a special inspection if possible
- If the triggered alert is judged to be within normal range the alert threshold should be increased and documented. Modified alert level review needs to be approved by the Water & Geotechnical Coordinator and is to be included in the scope of the external geotechnical inspection.

Before modifying the TARP level due to in-situ instrumentation or readings that cannot be confirmed by visual observation, the EOR must be consulted for further guidance.

7.6.2.1 Blast Monitoring

If a reading exceeding the PPV limit for a water management structure (50 mm/s) is observed, this event must be communicated to the drill and blast engineer who will need to ensure that the blasting pattern is modified to avoid re-occurrence of this event. Afterward a special inspection will need to be done on the structure to look for changes in condition. If more than one occurrence of blast vibration exceeding the limit is observed within a 2-week period, the Environment Superintendent needs to be notified of the situation.

Table 7-10 : Examples of Anomalous Data and Some Common Causes

Thermistors
• Increase or decrease in measurements (over two or more readings) that cannot be explained by seasonal temperature variations • Progressive loss of data (starting from the bottom and progressing). This is usually a sign of water infiltration • Observation of a spike in temperature in one bead. This is usually due to a capacitive effect • Loss of data (could be a transmission error, faulty hardware, a sheared cable, or no more battery power)
Piezometer
• Increase or decrease in pore water pressure measurements that cannot be explained by seasonal lake level variations (verify that the instrument has not been installed in a casing). Also verify if the trend is seasonal. This sometimes can be observed in the winter in instruments installed in a former talik area that are freezing back • Sharp increase in reading. Verify that the instrument is not frozen. If multiple instruments are impacted at the same time verify the barometer reading • Loss of data (could be a transmission error, faulty hardware, a sheared cable, or no more battery power). Especially true if several instruments are lost at the same time or if it is the winter
Inclinometer
• Cumulative increases in displacement (greater than 3 cm) • Erratic movement. This is usually a sign of water infiltration
Survey Monument
• Accelerating displacement rate of the survey monuments (x, y, z directions) (over two or more readings) (could be due to a prism shooting error or problem with the total station) • Widespread difference in settlement between two drone reading. This is probably a reading error and ask for a manual check of the reading
Blast Monitor
• Vibrations during a blast are not observed (the blast was cancelled, the blast monitor was not properly installed, or vibrations were too weak to be recorded)
Flowmeter, Survey Shot, and Staff Gauge
• Sudden change in staff gauge reading or reading that seems not to reflect the probable water elevation. This could be due to a settlement or displacement of the staff gauge • Increase or decrease of a flowmeter reading that are inconsistent with pumping rate or rainfall or observed water level • Survey elevation that has a sharp fluctuation from last reading. This can be caused by the reading not being taken at the right location, wave actions, or daily variances in GPS signal

7.7 INSTRUMENTATION MONITORING DOCUMENTATION AND REPORTING

Instrumentation monitoring results and analysis are documented in the Instrumentation Analysis Log of each structure.

Instrumentation data reporting is done through the Annual Inspection Report Process and during the MBK-IRB annual presentation. Instrumentation reports might also be requested for specific structures by the RP or EOR following changes in observed condition or before/after a change in TARP Level.

The goal of instrumentation reporting is to present a summary of the instrument monitoring done for the period as well as the item of interest for the performance of the structure. It is not required in an instrumentation report to present all instrumentation graphs in a structure but the summary of the instrumentation analysis and monitoring trends for the period need to be summarized. Graphs should only be presented if they are there to support the analysis (show cyclical trend, show trend being closely followed, show example of a type of trend that can be observed in several instruments). Table 7-11 describes how instrumentation graphs should be reported when they are included in the report.

Instrumentation reports need to include the following information:

- Layout of each structure covered by the report showing all the instruments installed on the structure
- Table presenting all the instruments installed on each structure, their status, and pertinent installation information
- Summary of the monitoring done on the structure for the period and if surveillance objectives were met for the period
- Indicator on the instrumentation system on the structure (how many instruments installed and how many are operational). The report must include a discussion on whether the coverage is sufficient or whether it is recommended to replace instruments to maintain coverage in some areas
- Analysis of each type of instruments trend (PZ, TH, inclinometer, water level, seepage) and how the data relate to the performance objective and indicator of the structure
- Discussion on anomalous trends and their potential cause.
- Graph relevant to the analysis. The graph needs to be presented in a way that allows for data interpretation without referring to other documents. The graph also needs to follow the guidelines of Table 7-11. In general, it is expected to present one graph per type of trend observed for operational instruments. Non-operational instrument graphs should not be presented
- Actionable recommendation having priority, owner, and due date
- The graph needs to present data for a minimum period of 1 year. Higher recurrence should be presented if clarity of the presented information allows it

Table 7-11 : Data Presentation for Instrumentation Monitoring Report

Thermistor
• Temperature vs. depth plots over time presented as colour maps should be the main way to present thermal data if the goal is to present general thermal trends • The plot needs to indicate relevant stratigraphy and their depth • In vertical displacement plots the thermistor string reference number and date of each measurement presented should be included. The number of readings presented need to be minimized so that it is easy to understand why this plot is presented. Otherwise use a colour map plot. This plot is best used when looking at a sudden thermal change over a small period of time • Historical plot needs to be presented with a cross-section of the installation (if on a structure) as well as a plan view showing the instrument location. These plots are best used to present the potential seepage location and should be accompanied with the lake temperature data
Piezometer
• Plots of total head as elevation versus time: These plots are very scale sensitive and are generally not the best to show several instruments having different scales of readings • When presenting PZ reading to assess the effectiveness of a cut-off wall it is important to present the various PZ reading for a horizontal cross-section through the cut-off wall • Plot needs to be presented with a cross-section of the installation showing lithology with depth as well as a plan view showing the instrument location • The plot needs to indicate the instrument number, the dates of each measurement, and mention if the temperature read by the instrument is less than 0 degrees
Inclinometer
• Cumulative displacement plots (to view total displacement) • Incremental displacement plots (to present increasing or accelerating movements between readings) • Cumulative displacement at crest versus time • Time plots at zones of identified displacement • The plot needs to indicate the SAA number, what is considered positive and negative displacement, and the dates of each measurement • Both elevations and depths should be presented together with the lithology • A plan view needs to be included showing the instruments locations
Settlement Map

• It is recommended to provide a plan view colour map of the settlement using a calibrated drone survey
• If presenting settlement monument survey the following info must be included:
  o Total net movement plots (to present total displacement)
  o Vertical displacement plots
  o Lateral displacement plots parallel and perpendicular to the dike axis
  o The plot needs to indicate the survey monument number, what is considered positive and negative displacement, and the dates of each measurement
  o A plan view needs to be included showing the instruments locations

7.8 DATA MANAGEMENT

An electronic library or database, which is easily accessible, shall be set up to catalogue and store inspection documents, maintenance reports, and instrumentation measurements. Section 7.1 indicates where each of these items must be stored.

Appendix A

SITE LAYOUT

AGNICO EAGLE
MEADOWBANK

DRAWN BY P.GAGNON	DATE 2024-02-02	MODIFIED BY	DATE
SURVEY CHECK	DATE		
GEOLOGY CHECK	DATE		
ENGINEERING CHECK	DATE		

MEADOWBANK DIVISION

ENVIRONMENT

Water Management Critical Infrastructure

SCALE N.T.S. | DATE | FILE .DWG

Appendix B

DESIGN CRITERIA AND ANNUAL PROBABILITY OF FAILURE

Minimal design Factors of Safety (FoS) against slope failure were based on CDA (2013) criteria for the dikes, as summarized in Table B-1 below from Golder (2009).

Loading Conditions	Minimum Factor-of-Safety	Slope
End of Construction before Reservoir Filling	1.3	Downstream and Upstream
Long-term (Steady-state Seepage, Normal Reservoir Level)	1.5	Downstream
Full or Partial Rapid Drawdown	1.2 to 1.3	Downstream

Loading Conditions	Minimum Factor-of-Safety
Pseudo-static	1.0
Post-earthquake	1.2-1.3

Table B-1: Design minimal FoS according to CDA guidelines (Golder, 2009)

The FoS obtained in the detailed design of the structures are illustrated in Figures B-1 and B-2 as well as Table B-2 below for different analyzed conditions. Detailed stability results are available in the detailed design report for the dewatering dikes (Golder, 2007, for Bay-Goose Dike, East Dike and South Camp Dike; SNC, 2013, for Vault Dike).

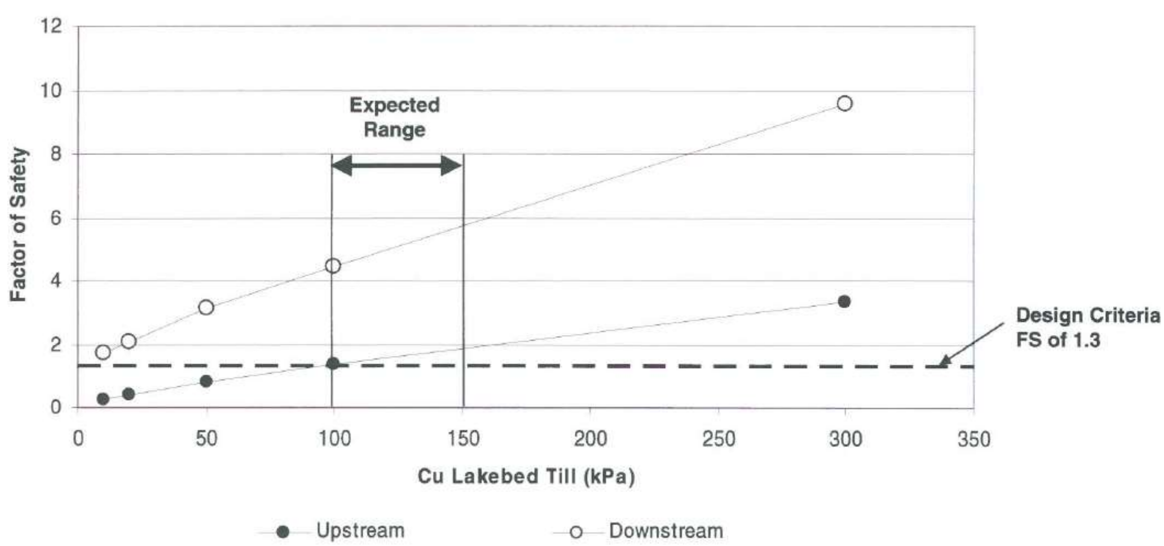


Figure B-1: Factor of safety VS foundation undrained strength (rapid drawdown condition with undrained foundation) (Golder, 2007)

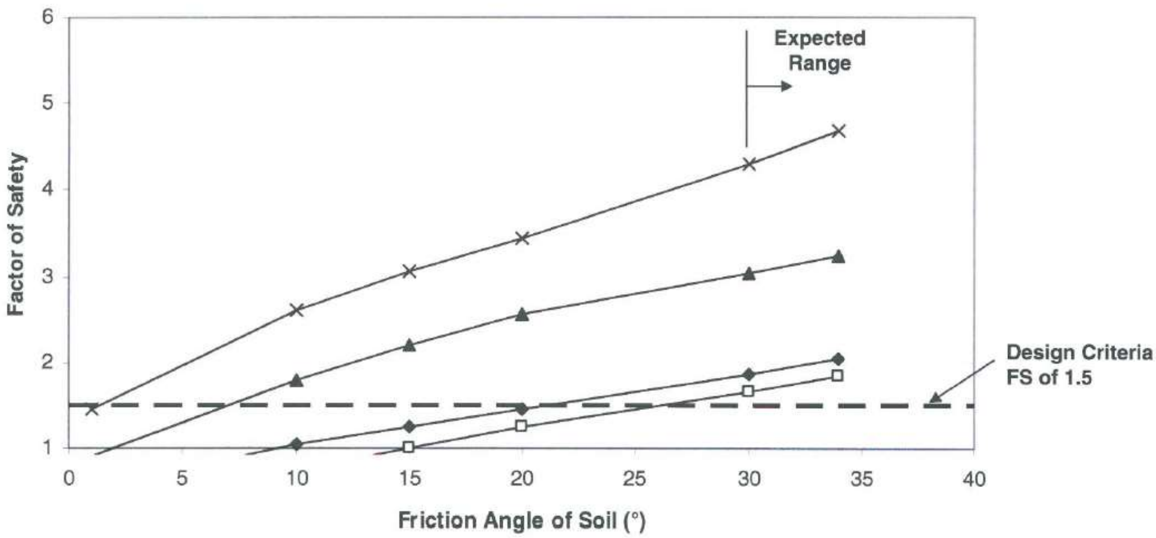


Figure B-2: Factor of safety VS foundation friction angle (normal operation condition with drained foundation) (Golder, 2007)

Loading Condition	Obtained FoS	
	Upstream (Wally Lake side)	Downstream (Vault Lake side)
Static	1.495 (shallow slip surface) 2.163 (deep slip surface)	1.533 (shallow slip surface) 2.680 (deep slip surface)
Pseudo-static	1.392 (shallow slip surface) 1.991 (deep slip surface)	1.421 (shallow slip surface) 2.416 (deep slip surface

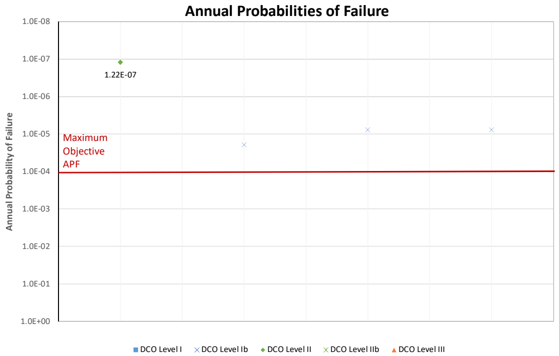
Table B-2: Factors of safety (shallow and deep slope failures) (SNC, 2013)

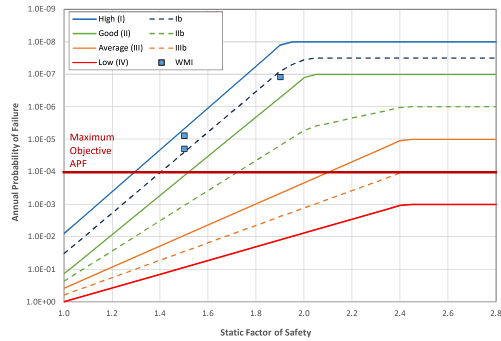
Following the recommendations from the Mining Assoication of Canada (MAC, 2019), the annual probability of failure for all dewatering dikes was determined from a probabilistic failure risk assessment in 2020 and presented below. The source files are available at the following link: **\\Cambfs01\groups\Engineering\05-Geotechnic\21- OMS Manual\Reference\Global Risk Profile**

Meadowbank Comparisons on WMIs

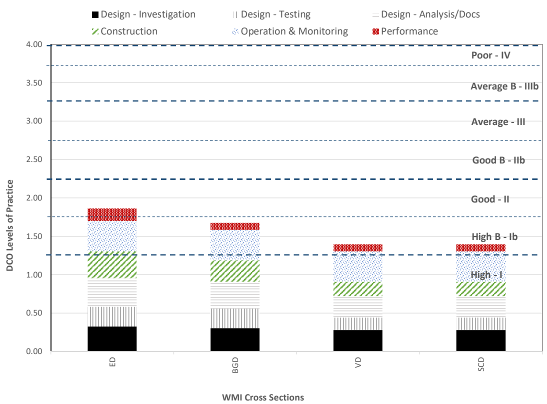
Infrastructures	ED	BGD	VD	SCD
FOS Static (Average conditions)	1.90	1.50	1.50	1.50
Design - Investigation	0.33	0.30	0.28	0.28
Design - Testing	0.26	0.26	0.16	0.16
Design - Analysis/Docs	0.37	0.35	0.28	0.28
Construction	0.35	0.28	0.19	0.19
Operation & Monitoring	0.40	0.40	0.40	0.40
Performance	0.16	0.09	0.09	0.09
DCO Level	**1.86**	**1.67**	**1.40**	**1.40**
PoF	**1.22E-07**	**1.95E-05**	**7.70E-06**	**7.70E-06**
Low PoF	7.15E-08	1.45E-05	2.70E-06	2.70E-06
High PoF	1.72E-07	2.45E-05	1.27E-05	1.27E-05
Health & Safety Consequence Rating	5	5	1	2
Material Damage Consequence Rating	4	4	2	3
Environment Consequence Rating	3	3	3	3
Community Consequence Rating	5	5	3	3
Consequence Rating	**5**	**5**	**3**	**3**

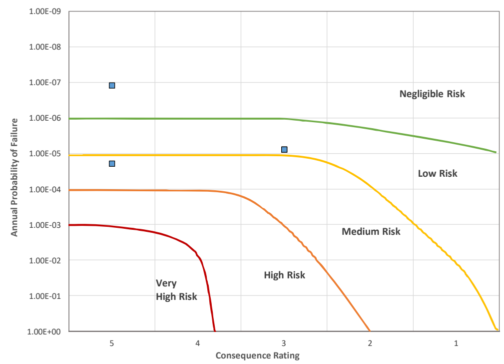
Items 1 and 2	Items 1 and 2	Item 9	Item 10		Item 1	Item 3	Item 4	Item 5		Item 7	Item 8	Item 11		Item 11	Item 12	Item 13	Item 14	Item 15	Item 16	Item 17	Item 18	Item 19	Item 20
Mine Site	**Facility Names**	**Current tailings volume (m^3)**	**Tailings volume (m^3) in 5 years (2023)**	**Type of tailings**	**Infrastructure identifier**	**Ownership**	**Status**	**Year(s) of construction**	**Type of Construction**	**Type of Raise Construction (if applicable)**	**Current Max Dam/Dyke Height (m)**	**External Review Process in place (see note 1)**	**Engineer of Record (see note 2)**	**Latest External Inspection (See note 3)**	**Relevant engineering records (see note 4)**	**Potential consequence level after a failure (see note 5)**	**Guidelines used (see note 6)**	**Have remedial actions been carried out over time (see note 7)**	**Internal and external engineering support (see note 8)**	**Formal analysis of the downstream impacts (see note 9)**	**Closure plan and long term monitoring (see note 10)**	**Impact of climate change considered (see note 11)**	**Additional notes**
Meadowbank NU, Canada 65°01'25"N 96°04'28"W (Meadowbank manages the taillings from Amaruq)	**South Cell TSF - Max Capacity = 16.3 Mm^3**	10,420,000	10,800,000	Slurry	Saddle Dam 1	wned and operated by AEM	Active	2009/2010	Tailings retaining infrastructure: Rockfill shell with liner tie-in key trench with transition	Downstream Raise	15.0	Yes	Yes	2018 (Golder)	Yes	Moderate to high	CDA	Yes	Both	On-going	Yes	Yes - being considered	
					Saddle Dam 2	wned and operated by AEM	Active	2010/	Tailings retaining infrastructure: Rockfill shell with liner tie-in key trench with transition	Downstream Raise	10.0	Yes	Yes	2018 (Golder)	Yes	Moderate to high	CDA	No	Both	On-going	Yes	Yes - being considered	
					Stormwater Dyke	wned and operated by AEM	Active	2010	Tailings retaining infrastructure: Rockfill shell with liner tie-in key trench with transition	Downstream Raise	31.0	Yes	Yes	2018 (Golder)	Yes	Moderate to high	CDA	Yes	Both	On-going	Yes	Yes - being considered	
					RF1	wned and operated by AEM	Active	2010	Tailings retaining infrastructure: Rockfill embankment with transition	Not raised	12.0	Yes	Yes	2018 (Golder)	Yes	Moderate to high	CDA	No	Both	On-going	Yes	Yes - being considered	
					RF2	wned and operated by AEM	Active	2010	Tailings retaining infrastructure: Rockfill embankment with transition	Not raised	9.0	Yes	Yes	2018 (Golder)	Yes	Moderate to high	CDA	No	Both	On-going	Yes	Yes - being considered	
	North Cell TSF - Max Capacity = 14.4 Mm^3	14,400,000	14,400,000	Slurry	Saddle Dam 3	wned and operated by AEM	Active	2016/2017	Tailings retaining infrastructure: Rockfill shell with liner tie-in key trench with transition	Downstream Raise	10.0	Yes	Yes	2018 (Golder)	Yes	Moderate to high	CDA	No	Both	On-going	Yes	Yes - being considered	
					Saddle Dam 4	wned and operated by AEM	Active	2016/2017	Tailings retaining infrastructure: Rockfill shell with liner tie-in key trench with transition	Downstream Raise	8.0	Yes	Yes	2018 (Golder)	Yes	Moderate to high	CDA	No	Both	On-going	Yes	Yes - being considered	
					Saddle Dam 5	wned and operated by AEM	Active	2016/2017	Tailings retaining infrastructure: Rockfill shell with liner tie-in key trench with transition	Downstream Raise	10.0	Yes	Yes	2018 (Golder)	Yes	Moderate to high	CDA	No	Both	On-going	Yes	Yes - being considered	
					Central Dyke	wned and operated by AEM	Active	2012/2013/2014/2015/2016/2017/2018	Tailings retaining infrastructure: Rockfill shell with liner tie-in key trench with transition	Downstream Raise	49.0	Yes	Yes	2018 (Golder)	Yes	Moderate to high	CDA	Yes	Both	On-going	Yes	Yes - being considered	
					North Cell Internal Structure	wned and operated by AEM	Active	2018	Tailings retaining infrastructure: Rockfill embankment with transition	Upstream raise	4.0	Yes	Yes	2018 (Golder)	Yes	Moderate to high	CDA	No	Both	On-going	Yes	Yes - being considered	
	Tailings in pit disposal	0	12,500,000	Slurry	Goose and Portage Pit	wned and operated by AEM	Active	2009 to 2019	Tailings deposited in an open pit	N/A	N/A	Yes	Yes	N/A	Yes	Low to moderate	N/A	No	Both	On-going	Yes	Yes - being considered	
	Dewatering dike	N/A	N/A	N/A	East Dyke	wned and operated by AEM	Active	2008/2009	Water retaining infrastructure: Rockfill shell with SB and CSB Cut-off wall and transition	Not raised	10.0	Yes	Yes	2018 (Golder)	Yes	Moderate to high	CDA	Yes	Both	On-going	Yes	N/A	
	Dewatering dike				Bay Goose Dyke	wned and operated by AEM	Active	2009/2010/2011	Water retaining infrastructure: Rockfill shell with SB and CSB Cut-off wall and transition	Not raised	15.0	Yes	Yes	2018 (Golder)	Yes	Moderate to high	CDA	No	Both	On-going	Yes	N/A	
	Dewatering dike				Vault Dyke	wned and operated by AEM	Active	2013	Water retaining infrastructure: Rockfill shell with liner tie-in key trench with transition	Not raised	3.0	Yes	Yes	2018 (Golder)	Yes	Moderate to high	CDA	No	Both	On-going	Yes	N/A	
	Dewatering dike				South Camp Dyke	wned and operated by AEM	Active	2009	Water retaining infrastructure: Rockfill shell with liner tie-in key trench with transition	Not raised	3.0	Yes	Yes	2018 (Golder)	Yes	Moderate to high	CDA	No	Both	On-going	Yes	N/A	





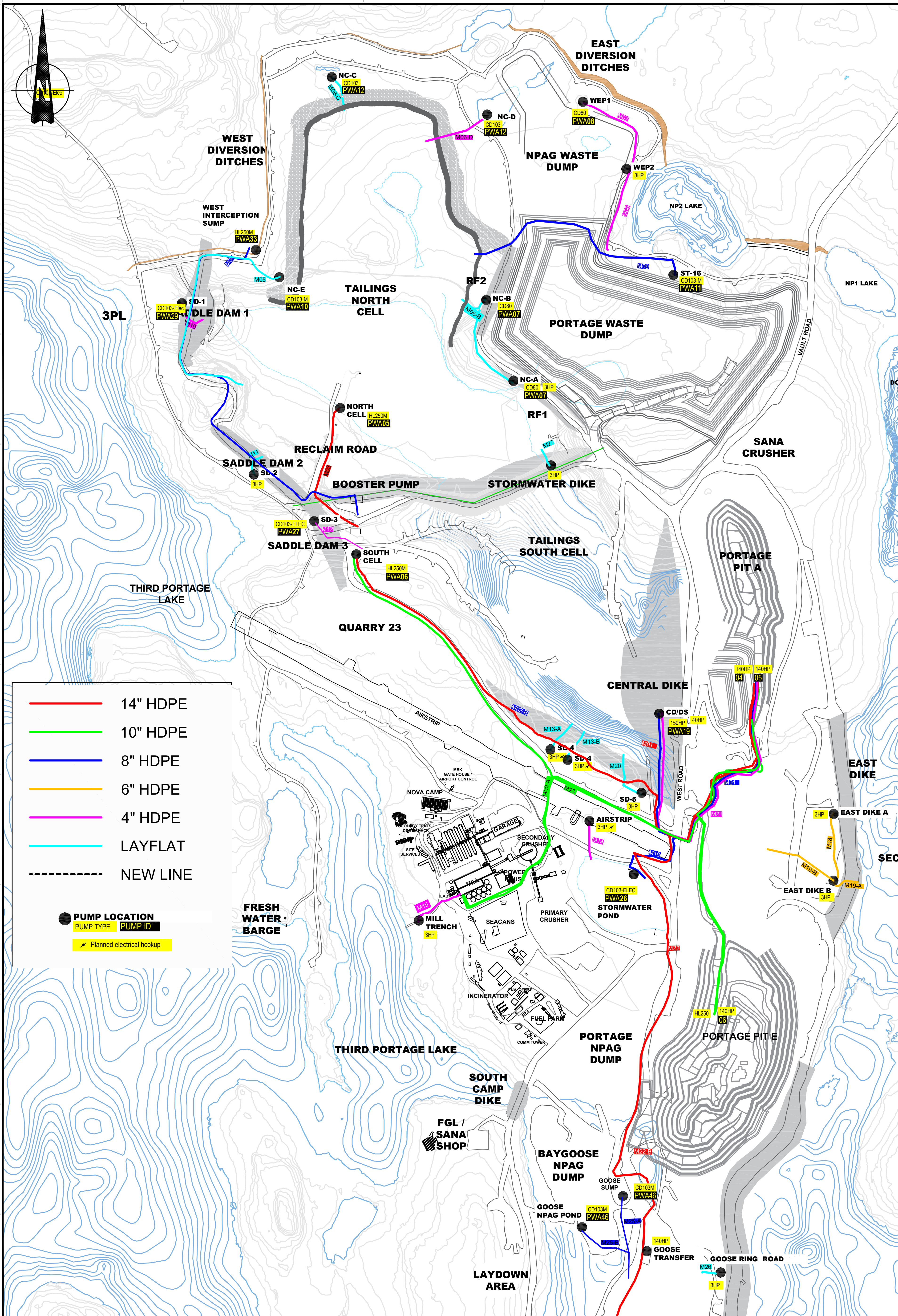
	ED	BGD	VD	SCD		
Level I	1.86	1.67	1.40	1.40		
PoF						
Level Ib	1.86	1.67	1.40	1.40		
PoF		1.95E-05	7.70E-06	7.70E-06		
Level II	1.86	1.67	1.40	1.40		
PoF	1.22E-07					
Level IIb	1.86	1.67	1.40	1.40		
PoF						
Level III	1.86	1.67	1.40	1.40		
PoF						





Appendix C

WATER MANAGEMENT OPERATIONAL GUIDELINES



TECHNICAL SPECIFICATION
None

AGNICO EAGLE
MEADOWBANK

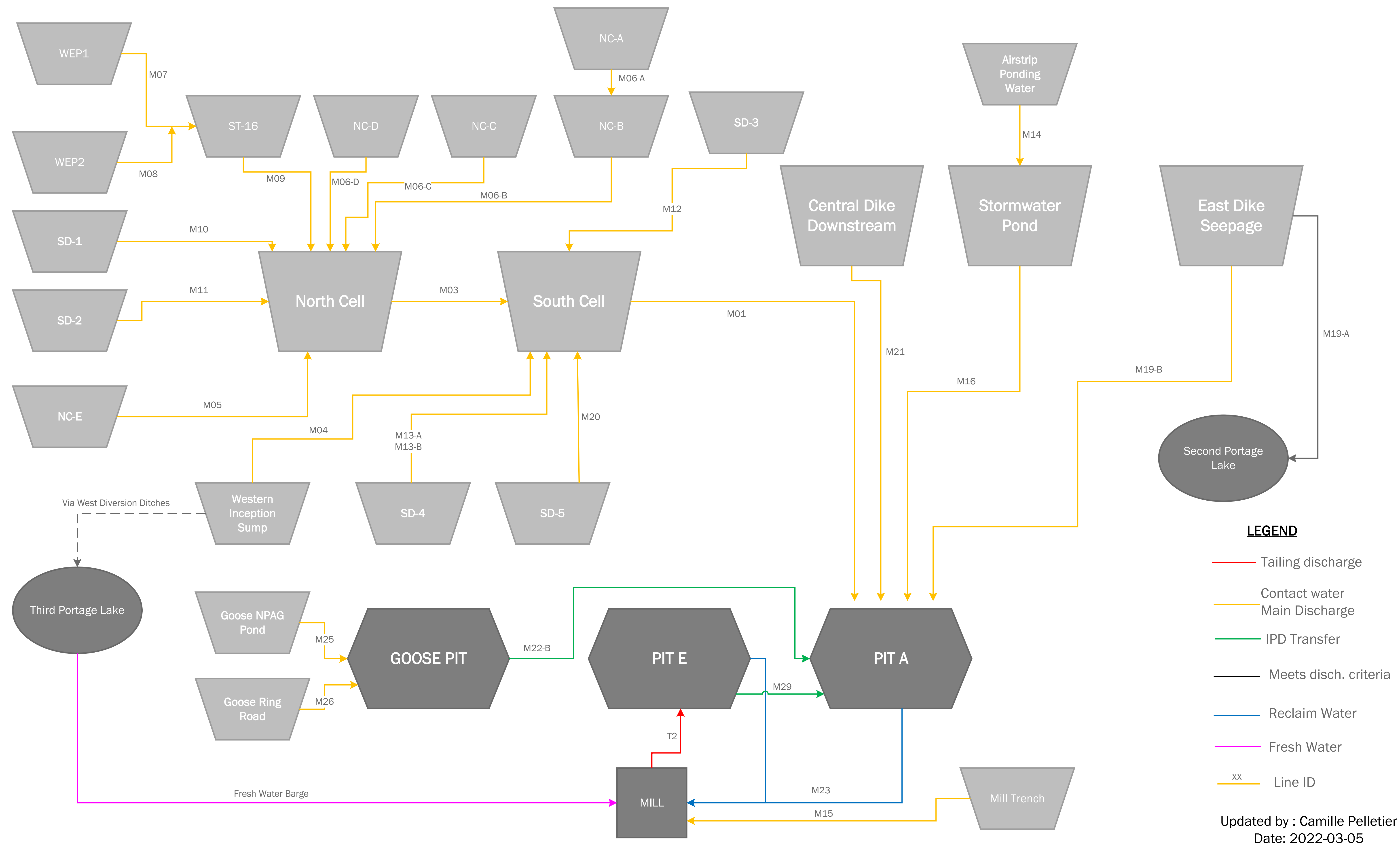
DRAWN BY	DATE
SURVEY CHECK	DATE
GEOLOGY CHECK	DATE
ENGINEERING CHECK	DATE

MODIFIED BY	DATE
Nicole Brisson	2022-03-07

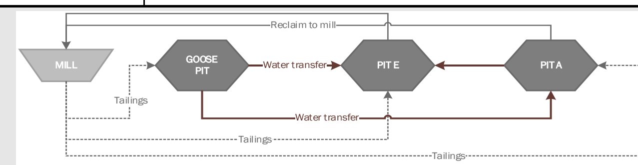
MEADOWBANK DIVISION
ENGINEERING - GEOTECH
MBK DEWATERING MAPS
FRESHET 2022
Revision1

SCALE 1:12500 | DATE | FILE .DWG

Meadowbank 2022 Detailed Freshet Flowsheet



MEADOWBANK

WATER BODY	OPERATIONAL LEVELS	DISCHARGE – STANDARD OPERATION	DISCHARGE – ALTERNATE SCENARIOS	RESPONSE – WITHIN OP. LEVELS	RESPONSE – ABOVE MAX	RESPONSE – ABOVE CRITICAL	RESPONSE – OTHER CRITICAL LEVELS
Central Dike D/S pond	WEST ROAD 116 CRITICAL 115.5 MAX 115.1 MIN 114.8 APPROX BOTTOM 107.0	Pit A	A) Pit E B) South Cell	Resume or maintain standard operations.	* Lower water level to operational level within 3 days. * Increase pumping using current infrastucture or implement mitigation plan. * Inform stakeholder as per communication chart. * E&I and Env to develop path forward with Environment & Critical Infrastructure Superintendent.	Risk of flooding of the pump pad. Immediately lower water to operational levels. * Inform stakeholder as per communication chart. * Environment & Critical Infrastructure Superintendent to develop action plan.	**BASE OF WEST ROAD** Flooding of pump pad and potential for West Road instability and uncontrolled flow into Portage Pit A. * Deploy measure to ensure infrastructure integrity.
South Cell	DIKE LINER ELEVATION 145 CRITICAL 144.0 MAX 143.0 APPROX BOTTOM 136.5	Central Dike D/S pond	Pit A	Resume or maintain standard operations.	* Lower water level to operational level within 30 days. * Increase pumping using current infrastucture or reduce inflows or implement mitigation plan. * Inform stakeholder as per communication chart. * E&I and Env to develop path forward with Environment & Critical Infrastructure	Non-respect of freeboard with potential for structure overtopping and spill. * Immediately lower water to operational levels. * Inform stakeholder as per communication chart. * Environment & Critical Infrastructure Superintendent to develop action plan.	**South Cell Dike Liner Elevation** Dike crest overtopping, spill into site. * Deploy mesure to contain spill, ensure structure integrity and ensure worker safety.
North Cell	DIKE LINER ELEVATION 150 CRITICAL 149.0 MAX 148.0 APPROX BOTTOM 136.5	South Cell	None	Resume or maintain standard operations.	* Lower water level to operational level within 30 days. * Increase pumping using current infrastucture or reduce inflows or implement mitigation plan. * Inform stakeholder as per communication chart. * E&I and Env to develop path forward with Environment & Critical Infrastructure	Non-respect of freeboard with potential for structure overtopping and spill. * Immediately lower water to operational levels. * Inform stakeholder as per communication chart. * Environment & Critical Infrastructure Superintendent to develop action plan.	**North Cell Dike Liner Elevation** Dike crest overtopping, spill into site. * Deploy mesure to contain spill, ensure structure integrity and ensure worker safety.
In-pit Tailings Ponds	EAST DIKE CORE 135.6 EAST DIKE CRITICAL LEVEL 133.5 CRITICAL 133.0 MAX 132.7 Goose & Portage pits connection 131 West Road Low point 126.4 Central Dike D/S Zone 116 Pit E & Pit A connection 87 APPROX BOTTOM -24			Resume or maintain standard operations. * West Road needs to be raised to maintain a 4m freeboard. Lowest point is at El. 126.4 (needs to be raised prior to El. 122.4). * Pit A & E connect at El. 87. * Portage & Goose Pit connect at El. 131. * Need to raise other accesses prior to reaching El. 131. * Need to re-assess CD D/S prior to El. 116 m.	* Lower water level to operational level within 30 days. *Increase pumping using available infrastucture or modify deposition strategy. *If Second Portage Lake is lower than the pond level, take lake samples daily to monitor water quality. * Inform stakeholder as per communication chart. * E&I and Env to develop path forward with Environment & Critical Infrastructure Superintendent.	* Increased risk of contaminant release in Second Portage Laike. * Immediately take action to stop water level raise. * Take samples daily to monitor water quality until pond level is below lake level. * Inform stakeholder as per communication chart. * Environment & Critical Infrastructure Superintendent to develop action plan.	**East Dike Critical level** Increased risk of East Dike overtopping. * Immediately take action to stop increase. * Inform stakeholder as per communication chart. * Environment & Critical Infrastructure Superintendent to develop action plan. **East Dike Core** Overtopping of dike core: Release of contaminant out of the site. * Deploy measure to ensure structure integrity and protect Environment
Second Portage Lake	EAST DIKE CORE 135.6 CRITICAL 134.8 MAX 134.1 APPROX BOTTOM 120	None		Resume or maintain standard operations.	* Investigate cause. * Inform stakeholder as per communication chart. * Engineering, E&I and Env to develop path forward with Water & Tailings Superintendent.	Increase risk of East Dike overtopping. * Immediately take action to stop increase. * Inform stakeholder as per communication chart. * Environment & Critical Infrastructure Superintendent to develop action plan.	**EAST DIKE CORE** Overtopping of East Dike core. Uncontrolled inflow into site. * Deploy measure to ensure structure integrity and protect worker
Third Portage Lake	South Camp Dike Thermal Cap 136.6 CRITICAL 136.3 MAX 135.6 APPROX BOTTOM 102	None		Resume or maintain standard operations.	* Investigate cause. * Inform stakeholder as per communication chart. * Liner installed at El.136.1 m. * E&I and Env to develop path forward with Environment & Critical Infrastructure Superintendent..	Increased risk of South Camp Dike overtopping and thawing of thermal cap. * Immediately take action to stop increase. * Inform stakeholder as per communication chart. * Environment & Critical Infrastructure Superintendent to develop action plan.	**South Camp Dike Thermal Cap** Overtopping of thermal cap of South Camp Dike. Uncontrolled inflow into site. * Deploy measure to ensure structure integrity and protect worker
Wally Lake	VAULT DIKE THERMAL CAP 142.5 CRITICAL 142.2 MAX OP 141.5 APPROX BOTTOM 120	None		Resume or maintain standard operations. * Liner installed up to El. 141 m.	* Investigate cause. * Inform stakeholder as per communication chart. * Liner installed at El.136.1 m. * E&I and Env to develop path forward with Environment & Critical Infrastructure Superintendent.	Increased risk of South Camp Dike overtopping and thawing of thermal cap. * Immediately take action to stop increase. * Inform stakeholder as per communication chart. * Environment & Critical Infrastructure Superintendent to develop action plan.	**VAULT DIKE THERMAL CAP** Overtopping of thermal cap of South Camp Dike. Uncontrolled inflow into site. * Deploy measure to ensure structure integrity and protect worker

AMARUQ

WATER BODY	OPERATIONAL LEVELS	DISCHARGE – STANDARD OPERATION	DISCHARGE – ALTERNATE SCENARIOS	RESPONSE – WITHIN OP. LEVELS	RESPONSE – ABOVE MAX	RESPONSE – ABOVE CRITICAL	RESPONSE – OTHER CRITICAL LEVELS
Whale Tail Attenuation Pond	PIT CREST 146 UPPER PUMP PAD 146.5 CRITICAL 145.5 MAX 143.5 LOWER PUMP PAD 143.0 MAX (LOWER PAD) 142.0 APPROX BOTTOM 135.0	**Summer:** IVR Attenuation Pond **Winter:** WTS Lake Diffuser via WTP or IVR attenuation pond	Condition 1 / Condition 2 / Discharge location A) Water meets discharge criteria / Summer (May to October) / Mammoth Lake diffuser B) Water meets discharge criteria / WTS diffuser available / WTS Diffuser C) Water meets discharge criteria / GPS-1 available / GSP-1 D) Water meets discharge criteria / / Mammoth Watershed or WTS watershed E) WTP is in function / Summer (May to October) / WTP > to Mammoth Lake diffuser F) WTP is in function / WTS diffuser available / WTP > to WTS Diffuser G) WTP is in function / GPS-1 available / WTP > to GSP-1 H) WTP is in function / Water meets discharge criteria / WTP > to Mammoth Watershed or WTS watershed I) GPS-1 available / / GSP-1 J) GPS-1 available / Water meets discharge criteria / WTP > to Mammoth Watershed or WTS watershed K) None / / Whale Tail Pit	Resume or maintain standard operations.	* Lower water level to operational level within 15 days. * Increase pumping from WT ATTN pond using current infrastucture or reduce inflows into WT ATTN pond or implement mitigation plan. * Inform stakeholder as per communication chart. E&I and Env to develop path forward with Environment & Critical Infrastructure Superintendent.	Risk of flooding of the upper pump pad. Immediately lower water to operational levels. * Inform stakeholder as per communication chart. * Environment & Critical Infrastructure Superintendent to develop action plan.	**PIT CREST ELEVATION** Uncontrolled release into Whale Tail Pit. Deploy measures to ensure worker safety.
IVR Attenuation Pond	IVR DIKE SPILLWAY 164.8 CRITICAL 164.3 MAX 163.2 UPPER PUMP PAD 165.5 LOWER PUMP PAD 163.8 APPROX BOTTOM 159.0	WTP to Mammoth lake or to WTS lake diffusers	Condition 1 / Condition 2 / Discharge location A) Water meets discharge criteria / Summer (May to October) / Mammoth Lake diffuser B) Water meets discharge criteria / WTS diffuser available / WTS Diffuser C) / / Whale Tail Attenuation Pond D) / / Mammoth Watershed or WTS watershed	Resume or maintain standard operations. 163.2 is the design max operating level (SNC).	Lower water level to operational level within 15 days. * Increase pumping using current infrastucture or reduce inflows into IVR Attenuation pond or implement mitigation plan. * Inform stakeholder as per communication chart. E&I and Env to develop path forward with Environment & Critical Infrastructure Superintendent.	Risk of activating the emergency spillway. * Immediately lower water to operational levels. * Inform stakeholder as per communication chart. * Environment & Critical Infrastructure Superintendent to develop action plan.	**IVR DIKE SPILLWAY ELEVATION** Spillway active and realease of water into Whale Tail Attenuation Pond. * Monitor spillway condition and closely monitor WT Attn pond level. * Ensure water from IWD does not enter into the IVR WRSF. * Assess spillway condition after use
WRSF Pond	LINER ELEVATION 157 CRITICAL 156.0 MAX 154.0 APPROX BOTTOM 153.5	Whale Tail Attenuation Pond	IVR Attenuation Pond	Resume or maintain standard operations. Due to limited capacity this system require close operational follow-up.	* Lower water level to operational level within 7 days. * Increase pumping using current infrastucture or reduce inflows into WRSF pond or implement mitigation plan. * Inform stakeholder as per communication chart. E&I and Env to develop path forward with Environment & Critical Infrastructure Superintendent.	Increased risk of WRSF dike foundation thawing leading to seepage to Mammoth Lake. *Immediately lower water to operational levels. * Inform stakeholder as per communication chart. * Environment & Critical Infrastructure Superintendent to develop action plan.	**LINER ELEVATION** Liner overtopping and uncontrolled relase into enviroment . * Deploy measure to ensure structure integrity and prevent damage to environment.
GSP-1 (AP5)	CREST ELEVATION 160.5 CRITICAL 155.0 MAX 154.0 APPROX BOTTOM 142.3	Whale Tail Attenuation Pond if TDS content is compliant		Resume or maintain standard operations. This location must be empty prior to freshet if TDS criteria are met.	* Lower water level to operational level within 30 days. * Increase pumping using current infrastucture or implement mitigation plan. * Inform stakeholder as per communication chart. E&I and Env to develop path forward with Environment & Critical Infrastructure Superintendent.	Risk of seepage through the till and till slope instability. * Immediately lower water to operational levels. * Inform stakeholder as per communication chart. * Environment & Critical Infrastructure Superintendent to develop action plan.	**CREST ELEVATION** Uncontrolled release into site. *Deploy measure to ensure worker safety
Mammoth Lake	MAMMOTH DIKE LINER 153.5 CRITICAL 153.3 MAX 153.0 MAMMOTH OUTLET 152.7 MIN 152.2 APPROX BOTTOM 135.1	If Mammoth Lake outlet (152.68) is obstructed, clear obstruction or conduct investigation		Resume or maintain standard operations. * Prior to freshet the level must not be above El. 152.5 m. * At freshet the rate of rise should be less than 0.05 m/day. *Go to yellow if rate of rise is 0.06 to 0.1 for more than 3 consecutive days *Mammoth Lake outlet is at 152.68.	* Investigate cause. * If possible, reduce inflows into Mammoth Lake * Inform stakeholder as per communication chart. E&I and Env to develop path forward with Environment & Critical Infrastructure Superintendent.	Increased risk of Mammoth Dike liner overtopping leading to pit inflow. * Immediately take action to stop increase. Could include outlet work. * Inform stakeholder as per communication chart. * Environment & Critical Infrastructure Superintendent to develop action plan.	**MAMMOTH DIKE LINER ELEVATION** Liner overtopping and uncontrolled release to Whale Tail Pit. * Deploy measures to ensure structure integrity and ensure worker safety.
Whale Tail Lake (WTS)	WTD SECANT WALL TOP 157 CRITICAL 156.3 MAX 155.8 MIN 152.5 SWTC INLET 155.3 APPROX BOTTOM 136.0	Mammoth Lake via SWTC	A) Whale Tail Attenuation Pond B) Mammoth Watershed Discharge	Resume or maintain standard operations. SWTC inlet at El. 155.3 m	* Ensure that water level is reduced to operational level within 15 days. * Investigate cause. * If possible, reduce inflows into WTS Lake. * Inform stakeholder as per communication chart. E&I and Env to develop path forward with Environment & Critical Infrastructure Superintendent.	Increased risk of WTD core overtopping. * Immediately lower water to operational level. Could include work at SWTC. * Inform stakeholder as per communication chart. * Environment & Critical Infrastructure Superintendent to develop action plan.	**WTD SECANT PILE WALL TOP ELEVATION** WTD secant wall overtopping and uncontrolled release downstream to WT Attenuation Pond. * Deploy measures to ensure structure integrity and ensure worker safety.

Appendix D

POTENTIAL MITIGATION FOR UNUSUAL CONDITIONS

Potential Mitigation Plans for Unusual Conditions on Water Management Infrastructures

Unusual Condition	Area / Cause		Comments / Monitoring	Contingency or Corrective Action
Overtopping and Subsidence	1a	Water level rise / storm event	Lake levels and crest elevations are monitored as part the water management infrastructure surveillance program. Outflow channels are inspected during thaw, open water season, and during ice break-up.	Add additional pumping unit. If rise is caused by a channel obstruction, remove the obstruction.
	1b	Dam crest settlement	This scenario requires extensive loss of support in the foundation since the rockfill of the dikes is essentially not settlement prone itself after construction and dewatering. For foundation settlement of this magnitude to occur, a piping event must develop or there is an unexpected layer of compressible soil in the foundation. The situation would develop slowly with crest settlement evident at least several weeks before a run-away event develops. Easily observed cracks should be evident. Monitoring of the crest settlement is conducted routinely.	The crest is wide and constructed of coarse rockfill. Significant damage to the dike is not credible, based on performance of other rockfill structures subjected to overtopping or flow through events. Rockfill can be placed to raise the dike crest and compensate settlement. Operations in the area may need to be suspended, but there will be considerable warning time given the slow development of the scenario.
	1c	Wave action	Large freeboard and wide crest zone make this a low concern	Rip-rap can be added and/or the dam crest can be raised.
Internal Erosion	2a	Dike section: Cut-off wall/geomembrane is defective, allowing high water flow. This defect occurs at a location where the core allows high flows and where the fills/geomembrane are defective; the combination allows erosion of the cut-off and/or the Core Backfill.	The cut-off wall/geomembrane and/or core backfill will develop a progressively increasing void ratio, thereby increasing the rate of water flow through the dike. This is not a catastrophic failure mode but could lead to an inability to manage water on site	Monitor seepage from downstream face for rate of seepage and for presence of sediment in seepage. Identify zone of seepage and establish a seepage capture and monitoring station with sufficient pumping capacity. Re-evaluate the impact of this water inflow on the site wide water balance.
	2b	Dike section: geomembrane is defective.	Results in increasing the rate of water flow through the dike. This is not a catastrophic failure mode as the rockfill will be stable and at its worst would lead to temporary suspension of operations.	Monitor seepage from downstream face for rate of seepage and for presence of sediment in seepage. Identify zone of seepage and establish a seepage capture and monitoring station with sufficient pumping capacity. Re-evaluate the impact of this water inflow on the site wide water balance.
	2c	Foundation till is possibly non-uniform with more transmissive zones and not self-filtering. It is possible that one of these zones may align with defective construction of the cut-off wall allowing high flows. Seepage would lead to erosion of the cut-off into the downstream rockfill. Seepage could also erode the foundation tills at the downstream toe or into the downstream rockfill because of the lack of filtering.	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 mode if increased seepage is not detected in time. No particular instrumentation is needed as this failure mode will show itself as localized and increasing seepage. It could be detected by walk-over inspection by an experienced engineer or technician.	Remedial action could comprise a reverse filter and rockfill buttress depending on location of the flow and configuration of the foundation, freezing, or grouting, if identified in time. In the worst case, the pit may be deliberately flooded in a controlled manner, the cut-off repaired, and the pit dewatered. Other options are to build an additional dike downstream or increasing pumping.

Unusual Condition	Area / Cause		Comments / Monitoring	Contingency or Corrective Action
Seepage	3a	Within the 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 and lead to instability.	Monitor seepage from downstream face for rate of seepage and for presence of sediment in seepage. Identify zone of seepage and establish a seepage capture and monitoring station with sufficient pumping capacity. Re-evaluate the impact of this water inflow on the site wide water balance.
	3b	Within the foundation	Defective construction of cut-off leading to transfer of an unexpectedly high fraction of the reservoir head into the downstream part of the dike foundation or leading to a piping event as described in internal erosion (2c). If this mechanism arises it should show itself during initial dewatering or very shortly thereafter.	Monitor seepage from downstream face for rate of seepage and for presence of sediment in seepage. Identify zone of seepage and establish a seepage capture and monitoring station with sufficient pumping capacity. Re-evaluate the impact of this water inflow on the site wide water balance. Re-assess stability (numerical modelling) and construct a stabilizing berm.
Structural - Slope Instability	4a	Normal operation: slope failure	The rockfill shoulders of the dike are wide and have high shear strength Slope failure requires failure in the foundation which would extend into the overlying dike. Sliding failure is considered unlikely given the low horizontal forces generated by the water and ice relative to the normal frictional force due to the weight of the dikes and the frictional angles of foundational materials. This mechanism should develop during construction or dewatering, due to the increase in load and associated pore water pressure development. Initial stages of failure should be observable as tension cracks in the dike crest. Walk-over inspection of the dike by a trained inspector is an appropriate monitoring strategy in addition to the instrumentation. Survey of crest face and toe is conducted.	Re-assess stability (numerical modelling) and construct a stabilizing berm if required. Fill inactive tension cracks with bentonite.
	4b	Earthquake induced: slope failure	Site is in a low seismic zone. Dam consisting of massive rock zone has a low sensitivity to seismic motion.	Perform an inspection and repair damage.
	4c	Erosion; washout, ice scour	Crest – minimum 50 m section. Downstream – large quarry rock face.	Repair erosion by placing additional rockfill and material.
Structural – Lateral Movement	5a	Failure of cut-off wall	Differential horizontal movement of the dike due to dewatering, water or ice loading, or pit wall failure may create a breach in the cut-off wall. Ice and water forces are not credible due to the ratio of frictional forces generated by the weight of the dike versus ice loads and water pressure. Large inflows through the breach may occur consequently if the cut-off wall breached. Pit would flood requiring suspension of operations. Potential for loss of life of workers inside dikes. Inclinometer, settlement prism, drone, and monument monitoring is done routinely.	Repair the cutoff wall.
Subsidence	6	Foundation soils	Foundation soils consolidated unexpectedly during dike construction or dewatering. A significant quantity of clay would be required to generate settlement resulting in a water release event. Prism, drone, and monument monitoring is done routinely.	A 1 m core settlement would be required to allow water to flow through the rockfill and over the settled cut-off. This flow would not cause failure of the rockfill shells. It would also be readily repaired by excavating rockfill above the cut-off wall and placing more till.
Premature Closure	7	Corporate bankruptcy or early resource depletion	Bond is provided for this eventuality. Design of rehabilitation is the same as rehabilitation at closure of project.	This would trigger the closure plan.
Pump and Pipeline Failure	8	Pumping infrastructures	Freezing protection is provided by heat tracing and insulation. Pipelines monitored by pump pressures at plant and frequent site inspection.	Replace defect in pipeline. Repair the pump and use another pump in the meantime.