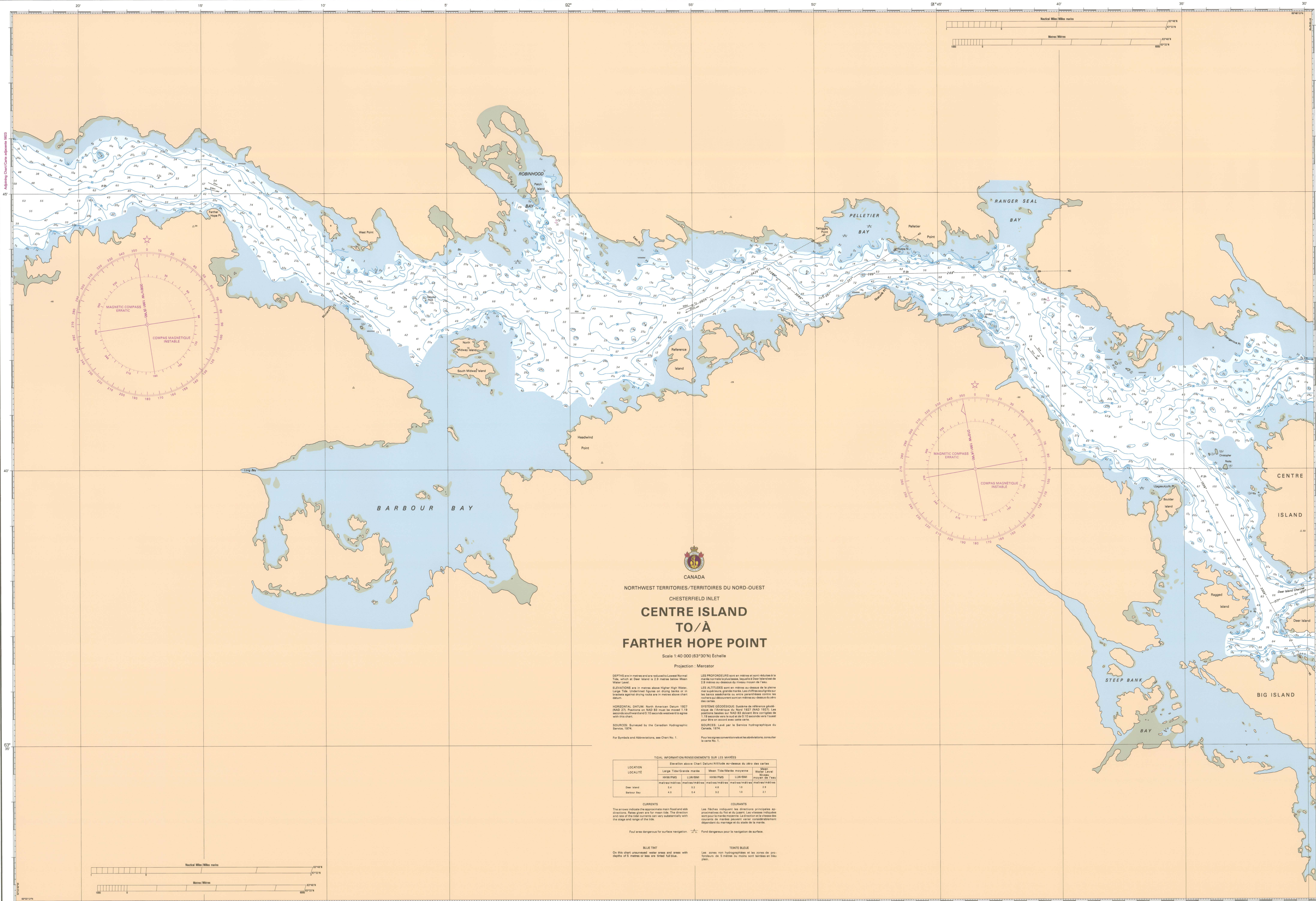

CANADA

NORTHWEST TERRITORIES/TERRITOIRES DU NORD-OUEST

CHESTERFIELD INLET

CENTRE ISLAND TO/À FARTHER HOPE POINT

Scale 1:40 000 (63°30'N) Échelle

Projection : Mercator

DEPTHS are in metres and are reduced to Lowest Normal Tide, which at Deer Island is 2.9 metres below Mean Water Level.

LES PROFONDEURS sont en mètres et sont réduites à la marée normale la plus basse, laquelle à Deer Island est de 2.9 mètres au-dessous du niveau moyen de l'eau.

ELEVATIONS are in metres above Higher High Water, Large Tide. Underlined figures on drying banks or in brackets against drying rocks are in metres above chart datum.

LES ALTITUDES sont en mètres au-dessus de la pleine mer supérieure, grande marée. Les chiffres soulignés sur les bancs asséchants ou entre parenthèses contre les rochers qui découvrent sont en mètres au-dessus du zéro des cartes.

HORIZONTAL DATUM: North American Datum 1927 (NAD 27). Positions on NAD 83 must be moved 1.19 seconds southward and 0.10 seconds westward to agree with this chart.

SYSTÈME GÉODÉSIQUE: Système de référence géodésique de l'Amérique du Nord 1927 (NAD 1927). Les positions basées sur NAD 83 doivent être corrigées de 1.19 seconde vers le sud et de 0.10 seconde vers l'ouest pour être en accord avec cette carte.

SOURCES: Surveyed by the Canadian Hydrographic Service, 1974.

SOURCES: Levé par le Service hydrographique du Canada, 1974.

For Symbols and Abbreviations, see Chart No. 1.

Pour les signes conventionnels et les abréviations, consulter la carte No. 1.

TIDAL INFORMATION/RENSEIGNEMENTS SUR LES MARÉES

LOCATION LOCALITÉ	Elevation above Chart Datum/Altitude au-dessus du zéro des cartes				
	Large Tide/Grande marée		Mean Tide/Marée moyenne		Mean Water Level Niveau moyen de l'eau
	HHW/PMS	LLW/BMI	HHW/PMS	LLW/BMI	
	metres/mètres	metres/mètres	metres/mètres	metres/mètres	metres/mètres
Deer Island	5.4	0.2	4.6	1.0	2.9
Barbour Bay	4.0	0.4	3.2	1.0	2.1

CURRENTS

The arrows indicate the approximate main flood and ebb directions. Rates given are for mean tide. The direction and rate of the tidal currents can vary substantially with the stage and range of the tide.

COURANTS

Les flèches indiquent les directions principales approximatives du flot et du jusant. Les vitesses indiquées sont pour la marée moyenne. La direction et la vitesse des courants de marées peuvent varier considérablement dépendant du marnage et du stade de la marée.

Foul area dangerous for surface navigation. — Fond dangereux pour la navigation de surface.

BLUE TINT

On this chart unsurveyed water areas and areas with depths of 5 metres or less are tinted full blue.

TEINTE BLEUE

Les zones non hydrographiées et les zones de profondeurs de 5 mètres ou moins sont teintées en bleu plein.

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PREVIOUS EDITIONS/ÉDITIONS ANTÉRIEURES 1975
NEW EDITION/NOUVELLE ÉDITION DEC./DÉC. 27 1991
NOTICE TO MARINERS/AVIS AUX NAVIGATEURS

FATHOMS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	BRASSES
FEET	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	PIEDS

METRES 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 MÈTRES

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CANADA

NORTHWEST TERRITORIES/TERRITOIRES DU NORD-OUEST

CHESTERFIELD INLET

FARTHER HOPE POINT TO/À TERROR POINT

Scale 1:40 000 (63°30′N) Échelle

Projection : Mercator

DEPTHS are in metres and are reduced to Lowest Normal Tide, which at Promise Point is 1.8 metres below Mean Water Level.

LES PROFONDEURS sont en mètres et sont réduites à la marée normale la plus basse, laquelle à Promise Point est de 1.8 mètre au-dessous du niveau moyen de l'eau.

ELEVATIONS are in metres above Higher High Water, Large Tide. Underlined figures on drying banks or in brackets against drying rocks are in metres above chart datum.

LES ALTITUDES sont en mètres au-dessus de la pleine mer supérieure, grande marée. Les chiffres soulignés sur les bancs asséchants ou entre parenthèses contre les rochers qui découvrent sont en mètres au-dessus du zéro des cartes.

HORIZONTAL DATUM: North American Datum 1927 (NAD 27). Positions on NAD 83 must be moved 1.22 seconds southward and 0.06 seconds eastward to agree with this chart.

SYSTÈME GÉODÉSIQUE: Système de référence géodésique de l'Amérique du Nord 1927 (NAD 1927). Les positions basées sur NAD 83 doivent être corrigées de 1.22 seconde vers le sud et de 0.06 seconde vers l'est pour être en accord avec cette carte.

SOURCES: Surveyed by the Canadian Hydrographic Service, 1974.

SOURCES: Levé par le Service hydrographique du Canada, 1974.

For Symbols and Abbreviations, see Chart No. 1.

Pour les signes conventionnels et les abréviations, consulter la carte No. 1.

TIDAL INFORMATION/RENSEIGNEMENTS SUR LES MARÉES

LOCATION LOCALITÉ	Elevation above Chart Datum/Altitude au-dessus du zéro des cartes				
	Large Tide/Grande marée		Mean Tide/Marée moyenne		Mean Water Level Niveau moyen de l'eau
	HHW/PMS	LLW/BMI	HHW/PMS	LLW/BMI	
	metres/mètres	metres/mètres	metres/mètres	metres/mètres	metres/mètres
Promise Point	3.6	0.1	3.0	0.5	1.8
Primrose Island	2.2	0.2	2.1	0.3	1.2

CURRENTS

The arrows indicate the approximate main flood and ebb directions. Rates given are for mean tide. The direction and rate of the tidal currents can vary substantially with the stage and range of the tide.

COURANTS

Les flèches indiquent les directions principales approximatives du flot et du jusant. Les vitesses indiquées sont pour la marée moyenne. La direction et la vitesse des courants de marées peuvent varier considérablement dépendant du marnage et du stade de la marée.

BLUE TINT

On this chart unsurveyed water areas and areas with depths of 5 metres or less are tinted full blue.

TEINTE BLEUE

Les zones non hydrographiées et les zones de profondeurs de 5 mètres ou moins sont teintées en bleu plein.

PREVIOUS EDITIONS/ÉDITIONS ANTÉRIEURES 1975
NEW EDITION/NOUVELLE ÉDITION NOV. 8 1991
NOTICE TO MARINERS/AVIS AUX NAVIGATEURS

FATHOMS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	BRASSES
FEET	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	PIEDS

METRES 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 MÈTRES

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CANADA

NORTHWEST TERRITORIES/TERRITOIRES DU NORD-OUEST

CHESTERFIELD INLET

TERROR POINT TO/AU SCHOONER HARBOUR

Scale 1:40 000 (63°30'N) Échelle

Projection : Mercator

DEPTHS are in metres and are reduced to Lowest Normal Tide, which at Primrose Island is 1.2 metres below Mean Water Level.

LES PROFONDEURS sont en mètres et sont réduites à la marée normale la plus basse, laquelle à Primrose Island est de 1.2 mètre au-dessous du niveau moyen de l'eau.

ELEVATIONS are in metres above Higher High Water, Large Tide. Underlined figures on drying banks or in brackets against drying rocks are in metres above chart datum.

LES ALTITUDES sont en mètres au-dessus de la pleine mer supérieure, grande marée. Les chiffres soulignés sur les bancs asséchants ou entre parenthèses contre les rochers qui découvrent sont en mètres au-dessus du zéro des cartes.

HORIZONTAL DATUM: North American Datum 1927 (NAD 27). Positions on NAD 83 must be moved 1.22 seconds southward and 0.18 seconds eastward to agree with this chart.

SYSTÈME GÉODÉSIQUE: Système de référence géodésique de l'Amérique du Nord 1927 (NAD 27). Les basées sur NAD 83 doivent être corrigées de 1.22 seconde vers le sud et de 0.18 seconde vers l'est pour être en accord avec cette carte.

SOURCES: Surveyed by the Canadian Hydrographic Service, 1974.

SOURCES: Levé par le Service hydrographique du Canada, 1974.

For Symbols and Abbreviations, see Chart No. 1.

Pour les signes conventionnels et les abréviations, consulter la carte No. 1.

TIDAL INFORMATION/RENSEIGNEMENTS SUR LES MARÉES

LOCATION LOCALITÉ	Elevation above Chart Datum/Altitude au-dessus du zéro des cartes				
	Large Tide/Grande marée		Mean Tide/Marée moyenne		Mean Water Level Niveau moyen de l'eau
	HHW/PMS	LLW/BMI	HHW/PMS	LLW/BMI	
	metres/mètres	metres/mètres	metres/mètres	metres/mètres	metres/mètres
Primrose Island	2.2	0.2	2.1	0.3	1.2
Baleen Island	2.9	0.6	2.7	0.7	1.7

CURRENTS

The arrows indicate the approximate main flood and ebb directions. Rates given are for mean tide. The direction and rate of the tidal currents can vary substantially with the stage and range of the tide.

COURANTS

Les flèches indiquent les directions principales approximatives du flot et du jusant. Les vitesses indiquées sont pour la marée moyenne. La direction et la vitesse des courants de marées peuvent varier considérablement dépendant du marnage et du stade de la marée.

Foul area dangerous for surface navigation. Fond dangereux pour la navigation de surface.

BLUE TINT

On this chart unsurveyed water areas and areas with depths of 5 metres or less are tinted full blue.

TEINTE BLEUE

Les zones non hydrographiées et les zones de profondeurs de 5 mètres ou moins sont teintées en bleu plein.

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PREVIOUS EDITIONS/ÉDITIONS ANTÉRIEURES 1975
NEW EDITION/NOUVELLE ÉDITION APRIL/AVRIL 26 1991
NOTICE TO MARINERS/AVIS AUX NAVIGATEURS

FATHOMS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	BRASSES
FEET	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	PIEDS

METRES 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 MÈTRES

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NORTHWEST TERRITORIES/TERRITOIRES DU NORD-OUEST

CHESTERFIELD INLET

SCHOONER HARBOUR TO/À BAKER LAKE

Scale 1:40 000 (63°30'N) Échelle

Projection : Mercator

DEPTHS are in metres and from Schooner Harbour to Baker Lake are reduced to Lowest Normal Tide which at Norton Island is 1.4 metres below Mean Water Level. In Baker Lake depths are reduced to a Low Water Datum which at the hamlet of Baker Lake is 5.3 metres below Topographical Bench Mark No. 45.

LES PROFONDEURS sont en mètres et de Schooner Harbour jusqu' à Baker Lake sont réduites à la marée normale la plus basse, laquelle à Norton Island est de 1.4 mètre au-dessous du niveau moyen de l'eau. À Baker Lake les profondeurs sont réduites à un niveau de basses eaux, lequel au hameau de Baker Lake est de 5.3 mètres au-dessous du repère de nivellement topographique No. 45.

ELEVATIONS and spot elevations are in metres above Higher High Water, Large Tide. Underlined figures on drying banks or in brackets against drying rocks are in metres above chart datum.

LES ALTITUDES et les points cotés sont en mètres au-dessus de la pleine mer supérieure, grande marée. Les chiffres soulignés sur les bancs asséchants ou entre parenthèses contre les rochers qui découvrent sont en mètres au-dessus du zéro des cartes.

HORIZONTAL DATUM: North American Datum 1927 (NAD 27). Positions on NAD 83 must be moved 1.24 seconds southward and 0.41 seconds eastward to agree with this chart.

SYSTÈME GÉODÉSIQUE: Système de référence géodésique de l'Amérique du Nord 1927 (NAD 27). Les positions basées sur NAD 83 doivent être corrigées de 1.24 seconde vers le sud et de 0.41 seconde vers l'est pour être en accord avec cette carte.

SOURCES: The hydrographic data are shown in the SOURCE CLASSIFICATION DIAGRAM.

SOURCES: Les données hydrographiques sont indiquées dans le DIAGRAMME DE CLASSIFICATION DES SOURCES.

For Symbols and Abbreviations, see Chart No. 1.

Pour les signes conventionnels et les abréviations, consulter la carte No. 1.

TIDAL INFORMATION/RENSEIGNEMENTS SUR LES MARÉES

LOCATION LOCALITÉ	Elevation above Chart Datum/Altitude au-dessus du zéro des cartes				
	Large Tide/Grande marée		Mean Tide/Marée moyenne		Mean Water Level Niveau moyen de l'eau
	HHW/PMS	LLW/BMI	HHW/PMS	LLW/BMI	
	metres/mètres	metres/mètres	metres/mètres	metres/mètres	metres/mètres
Norton Island	2.7	0.2	2.4	0.3	1.4

CURRENTS

The arrows indicate the approximate main flood and ebb directions. Rates given are for mean tide. The direction and rate of the tidal currents can vary substantially with the stage and range of the tide.

COURANTS

Les flèches indiquent les directions principales approximatives du flot et du jusant. Les vitesses indiquées sont pour la marée moyenne. La direction et la vitesse des courants de marées peuvent varier considérablement dépendant du marnage et du stade de la marée.

BLUE TINT

On this chart unsurveyed water areas and areas with depths of 5 metres or less are tinted full blue.

TEINTE BLEUE

Les zones non hydrographiées et les zones de profondeurs de 5 mètres ou moins sont teintées en bleu plein.

SOURCE CLASSIFICATION DIAGRAM

DIAGRAMME DE CLASSIFICATION DES SOURCES

Date of Survey/Date du levé	Sources	Line Spacing/Espacement des lignes
* a- 1949-50	CHS/SHC	150 m
* b- 1949	CHS/SHC	200 m
c- 1974	CHS/SHC	100 m
d- 1974	CHS/SHC	200 m
e- 1978	CHS/SHC	100 m
f- 1978	CHS/SHC	250 m

*The shoals have not been examined in this area.
*Les hauts-fonds n'ont pas été examinés dans ces zones.

CAUTION

Depths shown in areas a and b of the SOURCE CLASSIFICATION DIAGRAM are not reduced to the presently adopted chart datum. Extreme caution should be exercised when navigating in these waters.

ATTENTION

Les profondeurs indiquées dans les zones a et b du DIAGRAMME DE CLASSIFICATION DES SOURCES ne sont pas réduites au zéro des cartes présentement adopté. Soyez très prudents en naviguant dans ces eaux.

Cruise the Net / Naviguez dans Internet www.charts.gc.ca www.cartes.gc.ca

PREVIOUS EDITIONS/ÉDITIONS ANTÉRIEURES 1975
NEW EDITION/NOUVELLE ÉDITION JULY/JUIL 10 1992
Corrected to NOTICES TO MARINERS / Corrigé jusqu'à l'AVIS AUX NAVIGATEURS : 2007-05-11
See *Notices to Mariners* for subsequent corrections / Voir *Avis aux navigateurs* pour les corrections subséquentes

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APPENDIX B • MARINE MAMMAL MANAGEMENT AND MONITORING PLAN

WHALE TAIL PIT PROJECT

Marine Mammal Management and Monitoring Plan

Appendix B

APRIL 2018

VERSION 1

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DOCUMENT CONTROL

Version	Date	Section	Page	Revision	Author
1	April 2018	All	All	First draft of the Marine Mammal Management and Monitoring Plan	Agnico Eagles Mines Ltd.

ACRONYMS

Agnico Eagle	Agnico Eagle Mines Limited
CWS	Canadian Wildlife Service
DFO	Fisheries and Oceans Canada
ECSAS	Eastern Canada Seabird at Sea
ECCC	Environment and Climate Change Canada
MMMMP	Marine Mammal Management and Monitoring Plan
MMSO	Marine Mammal and Seabird Observer
NIRB	Nunavut Impact Review Board

SECTION 1 • INTRODUCTION

The Marine Mammal Management and Monitoring Plan (MMMMP) has been developed for the Project to meet commitments made during the Nunavut Impact Review Board (NIRB) hearings related to Marine Shipping. It should be considered a living document that can be updated throughout the Project lifecycle in order to implement adaptive management techniques.

The MMMMP has been designed to provide protocols for conducting a vessel-based Marine Mammal and Seabird Observer (MMSO) program during all routine shipping activities along the shipping route. During routine shipping operations, Project-specific mitigation measures designed to minimize Project impacts on marine mammals and seabirds will be initiated by vessel-based MMSOs and implemented by the ship's crew.

Data collected by the MMSOs will provide information annually to the Government of Nunavut and other applicable regulators (e.g., Environment and Climate Change Canada (ECCC) - Canadian Wildlife Service (CWS)) regarding the location, behaviour, abundance, and species observed as well as any interactions with Project vessels during shipping activities along the shipping route.

SECTION 2 • MARINE MAMMAL AND SEABIRD OBSERVER PROGRAM

2.1 Routine Shipping Operations

This section outlines the protocol for undertaking a vessel-based Marine Mammal and Seabird Observer (MMSO) program involving marine wildlife monitoring during all routine shipping activities in the shipping route in accordance with Project Certificate Condition 40, which states the following:

" The Proponent shall develop and implement a ship-based marine mammal monitoring program, as part of a Marine Mammal Management and Monitoring Plan, in consultation with Fisheries and Oceans Canada, communities, and other interested parties. The Proponent shall report any accidental contact by project vessels with marine mammals or seabird colonies to applicable responsible authorities including Fisheries and Oceans Canada and Environment and Climate Change Canada. "

The MMSOs will record marine mammal and seabird observations based on the protocols along the shipping routes presented in Figure 1. Datasheets outlined in Attachment A and Attachment B and daily reports outlined in Attachment C will be completed throughout the transit and provided to Agnico Eagle.

2.1.1 Program Protocol

Mitigation measures outlined in Section 4.2 of the Shipping Management Plan will be implemented during all Project shipping activities by the shipping contractor(s). MMSOs will not be directly responsible for implementing mitigation measures. The role of the MMSO is to record and report on marine mammals and seabird sightings during shipping activities, and to advise the ship's crew on the location of observed marine mammals and if any action is recommended based on mitigation measures outlined in the Shipping Management Plan.

The following protocol will be implemented during the MMSO program:

- A minimum of one assigned MMSO will be present on-board the Project shipping vessels[1] during all transits;
- The MMSO will conduct marine mammal and seabirds observations along the shipping route from the bridge during daylight hours;
- The MMSO will observe and record sightings of marine mammals and birds during vessel movements in the shipping routes (including sea birds, coastal waterfowls, and sea ducks[2]) as well as environmental conditions;

[1] Contractor is responsible to assign a crew member or contractor the task of marine mammal observations (MMSO).

[2] In accordance with Project Certificate No 008 Condition 39 and 40.

- The shipping contractor will initiate mitigation measures designed to minimize Project impacts on marine mammals and seabirds, as identified in the Shipping Management Plan.

The MMSO program will allow for the opportunity of adaptive management techniques to be implemented if monitoring identifies potential for adverse effects on marine wildlife along the shipping route. This may include modification of mitigation measures in response to new information arising from the monitoring carried out by the MMSO. Adaptive management will be conducted in consultation with the Kivalliq Inuit Association, the Hunters and Trappers Organizations of the Kivalliq communities, and the relevant regulators.

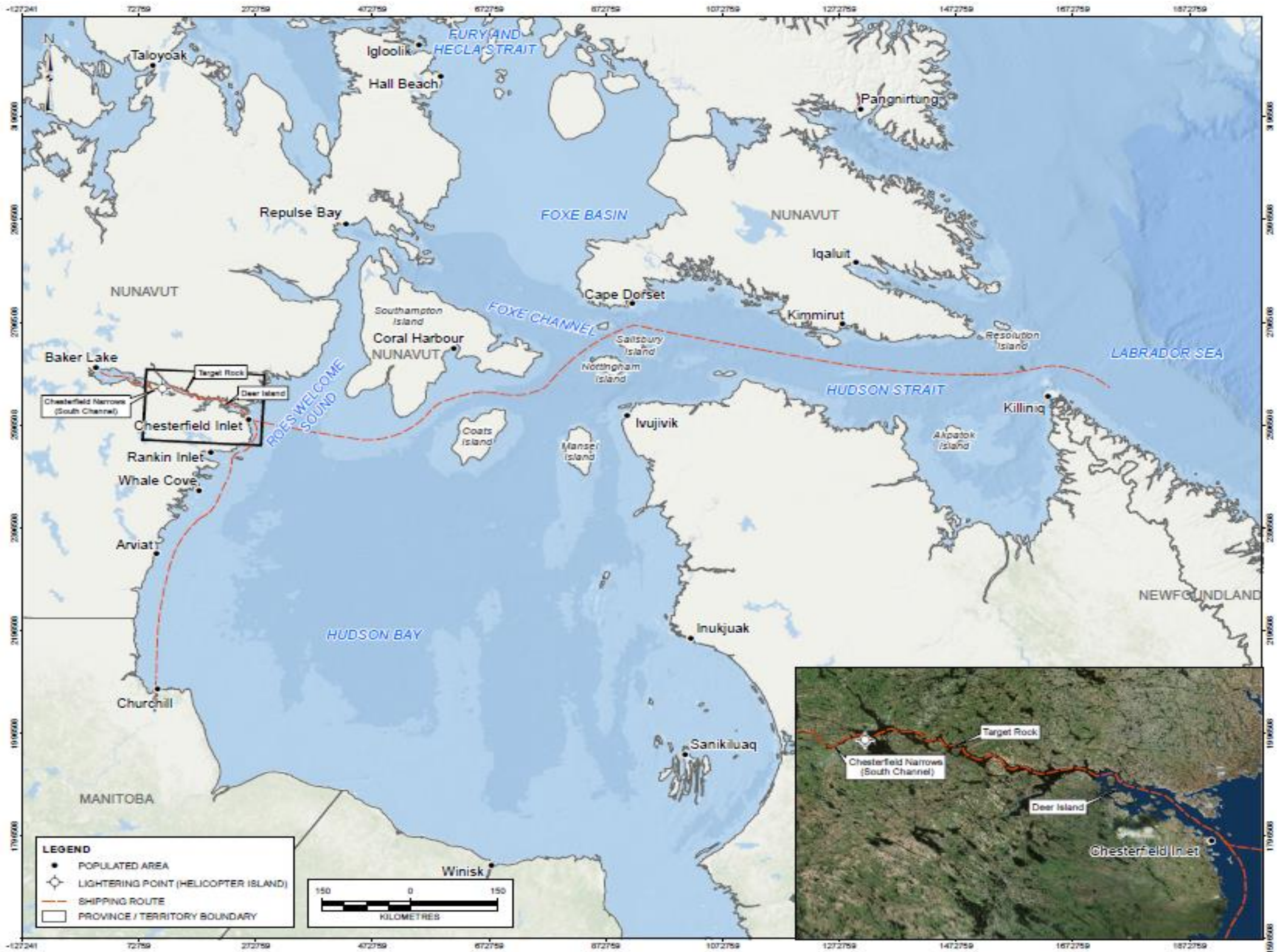


Figure 1: Meadowbank Mine and Whale Tail Pit Shipping Routes

2.1.3 Marine Mammal Observing Protocol

General environmental and marine mammal sightings information is to be collected and recorded by filling out form in Attachment A.

The protocol outlined in this section are best conducted along a transect line, therefore, it is best to start a marine mammal observation period when the vessel is and will be moving in a straight line for an extended period of time.

Observer Position

Observations will be done from a high location on the vessel and ideally outdoors if possible and will be conducted at the same location each time. For marine mammal observations with a single observer, depending on the weather conditions and safety requirements for the crew the MMSO will position themselves in the middle of the ship at the front (bow) to observe marine mammal on both the starboard and the port side (Figure 2).

Observation Period

MMSO observation periods (marine mammal and seabird observations) should not last longer than 2 hours to mitigate observer fatigue and eye strain.

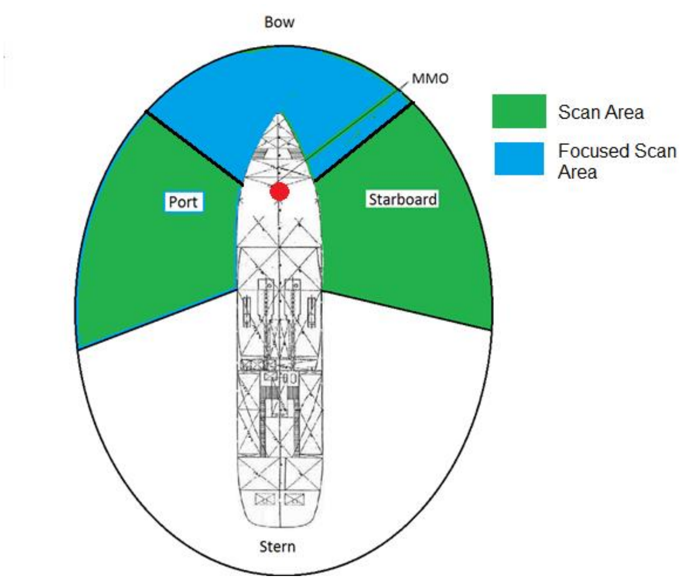


Figure 2. MMSO position and respective observation field on a hypothetical ship

2.1.3.1 Scan Routine

The following scan routine should be conducted throughout the marine mammal observation period. Scan the water with the naked eye and use binoculars only to focus on possible sightings. Perform S and U scans of the observation field about every 20 seconds (Figure 3). The most important aspect of marine mammal observing is to constantly scan the observation field to capture animals that could be located in the peripheral view for brief moments (e.g., surfacing). Scans should be made from the middle of the vessel (for one MMSO) and cover the scan area shown in Figure 2 with a focus on the water ahead and to the side to the moving vessel (e.g., focused scan area in Figure 2). If the vessel is stationary (e.g., anchored) scans should be conducted over the entire scan area (e.g., blue and green in Figure 2) in a uniform fashion. When the vessel is stationary, less priority can be attributed to marine mammal observations.

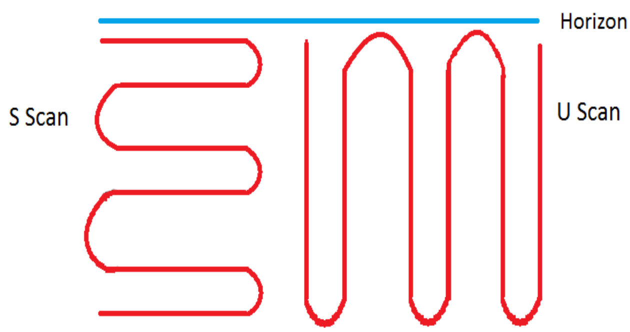


Figure 3: S & U scanning techniques

All marine mammals observed during the dedicated marine mammal observational periods as well as incidental sightings will be recorded including GPS location, distance to animal, angle to animal, number of individuals, species, behaviour etc. If a species is unknown or if a blow is the only detection of the animal observed, then mark the sighting as unknown. Marine mammals in large groups that are close together should be marked as a single sighting. When possible, photographs of marine mammal sightings will be taken and recorded alongside sightings records.

Angle to a marine mammal or group of marine mammal can be calculated using a Pelorus or by estimating the angle with an angle board. Figure 4 shows how an angle to a marine mammal from the vessel should be estimated.

On-effort sightings should be recorded by the MMSO only, with no assistance permitted by other crew members. Sightings of pinnipeds hauled-out on land will be recorded as off-effort sightings. Bow-riding dolphins or porpoises are also not recorded as on-effort sightings unless they are observed prior to their initial approach to the vessel (as it was assumed that the sighting of a bow-riding cetacean was not random but rather influenced by the presence of the vessel). Bow-riding dolphins or porpoises are recorded as incidental (off-effort) sightings.

All efforts will be made to avoid double counting individuals or groups of individuals. If a marine mammal is counted twice in the sightings record, then a note of a re-sighting should be marked.

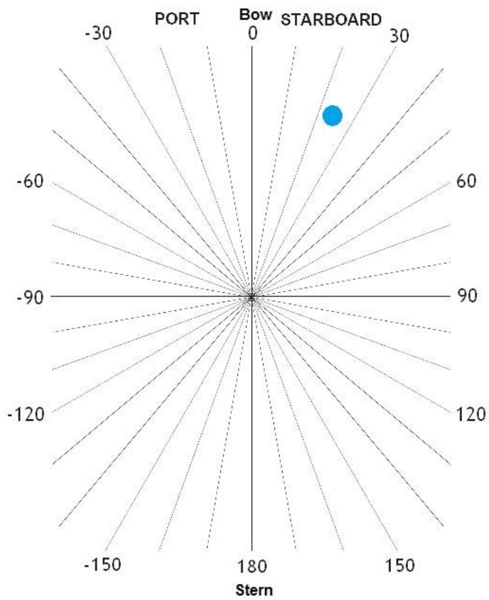


Figure 4. Angle to Marine Mammal (blue dot) is approximately 22º

2.1.3.2 Scan Routine

Record the distance to each marine mammal or group of marine mammal (to the centre of the group). For all marine mammals, estimate the angular distance between the marine mammal(s) and the observer.

Using Reticle binoculars

Reticle binoculars have a built in scale called a reticle. Estimating distances to marine mammals using reticles is based upon the distance to the horizon which is dependent on:

- the height of the observer eye above sea level in meters; and
- radians per reticle mark for the type of binoculars.

The height of the eye includes the height of the platform above the surface of the water. The number of radians (usually milliradians[3]) will depend on the type of reticles binoculars that are used. The number of radians per reticle mark can be used to produce a distance table based on an equation provided by the binocular manufacture. An example of an equation provided by Fujinon 2006 is:

Distance = (eye height + height above sea level in meters) x 1000 / # of milliradians

Reticle binoculars cannot be used to estimate distance if the horizon is obscured (by fog or land), or if they are used from a different height above sea level. Their use becomes minimal in nearshore waters.

[3] unit of angular measurement

2.1.4 Seabird Survey Protocol

Seabird survey will be conducted in the shipping route. The protocols laid out below were extracted and adapted from the CWS standardized protocol for pelagic seabird surveys from moving and stationary platforms (Gjerdrum et al. 2012).

Observer Position

Observations should be done from a high location on the vessel, when possible, at a location as close to the edge of the platform as possible to increase the detection of seabirds, especially for individuals that use the waters at the base of the vessel. All surveys should be conducted at the same location each time.

2.1.4.1 Survey Protocol – Moving Vessel

General environmental and bird sightings information is to be collected and recorded by filling out the form in Attachment B.

Transect Methods

During transect surveys, the observer is to look forward from the vessel, scanning at a 90° angle from either the port (left) or starboard (right) side depending where he or she is located. The transect width within seabirds are recorded is 300 m from the side of the vessel (see Figure 5). Scan ahead regularly (e.g., every minute) to spot birds that may dive as the vessel approaches.

All birds observed within this 300 m transect, whether flying or on the water, are recorded and are considered in-transect sightings. The methods for recording birds on the water verses birds in flight are outlined below. All five minute surveys should begin with a snapshot survey to capture flying birds. The perpendicular distance from the line to the seabirds detected on the water or in flight is estimated for each sighting. Birds observed outside the 300 m transect are also recorded if this does not affect observations within the 300 m transect. Distance categories “E” and “T” in Figure 5 are both considered not in transect. Binoculars and spotting scopes can be used to confirm species identification and other details as necessary.

Observation Period

Each seabird survey period will be conducted during six consecutive five-minute periods which is repeated three times a day to capture morning, afternoon and evening periods when possible. These five minute surveys should be dedicated to surveying for seabirds only. These surveys should be completed regardless if birds are present or not. If the vessel is not moving (stationary), use the method for stationary vessel described in Section 2.1.4.2 below.

Short breaks should be taken at the end of each five minute period to record the vessel’s position and any conditions that may have changed since the last five minute survey period. If ship speed or direction changes significantly during the survey period, record the time and location (GPS), cease the current survey and begin a new five minute survey period.

The frequency of the seabird surveys has been selected to provide time for the MMSO to:

- have dedicated seabird and marine mammal observation periods (as described above);
- conduct daily shipping-related activities if the MMSO is part of the ship's crew;
- take necessary breaks to avoid observer fatigue; and
- conduct daily reporting.

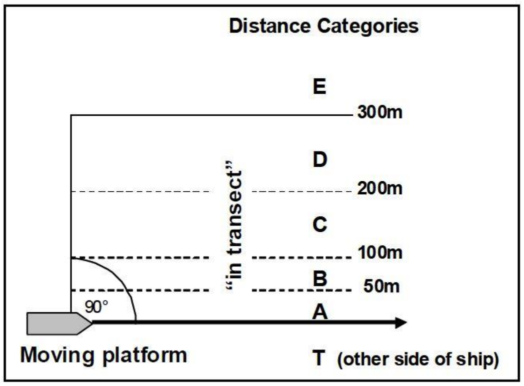


Figure 5. Illustration of a survey using a 90° scan, covering a 300 m transect from a moving platform (extracted from Gjerdrum et al. 2012)

Birds on the Water

All birds observed on the water are continuously recorded throughout the five minute survey period. If birds in the transect fly off the surface of the water as the vessel approaches, use binoculars to help count them, and record these birds as being on the water as outlined in the seabird survey sighting form (Attachment B). These birds are not subsequently counted as a flying bird during a snapshot survey (described below for flying bird).

Birds on the water may be observed up ahead of the platform, perhaps as far as 400 m or 500 m, but still within the 300 m transect (Figure 5). Because these individuals may dive or fly away as a result of the approaching ship, they should be counted as in transect and their perpendicular distance recorded when they are first observed. If the five minute survey will end before the ship reaches them they should be recorded in the next five minute survey period.

Birds in Flight – Snapshot method

All five min surveys should begin with a snapshot of flying birds. Flying birds are not recorded continuously throughout the five minute survey period as with birds on the water, as this would overestimate bird density. Create a routine of snapshot counts to record flying birds during the survey period. Only use the snapshot method when there are many birds observed flying in the area. The number of snapshots done will depend on the speed of the vessel (Table 1).

During each snapshot, record flying birds as in transect if they are flying above the 300 m transect. Record all other flying birds that are seen outside of the 300 m transect or between snapshot intervals as not in transect.

Some species may fly in long lines across the 300 m survey transect. At the time of the snapshot, the number of birds in the flock is recorded and the distance class is assigned according to the location of the centre of the flock. All the birds in the flock are recorded as in transect if the centre is within the 300 m transect. If the centre of the flock is outside the 300 m transect, all birds are recorded as not in transect.

Large Groups of Birds

When very large numbers of birds are encountered that overwhelm the observer's ability to count the number of birds and measure the distance to flocks the snapshot method can be used to count all birds in flight and on the water. If this protocol is used, note the change in protocol on the seabird survey sighting form (Attachment B). If it is not practical to estimate distance to each bird or flock of birds, the observer should at least indicate whether the birds were observed in or out of transect. If it is not practical to note which birds are on the water and which are in flight use the following guidelines:

- If the majority of the birds are in the air, they can be recorded as flying.
- If birds appear first on the water and then fly away as the vessel approached, or they continuously move between the water and air, recorded them being as on the water.

Birds that follow the Vessel

To avoid double counting birds, once a bird is recorded in-flight it is not subsequently recorded again if it follows the ship and it is not recorded on subsequent snapshots. If many birds are following the vessel and it becomes difficult to determine which individuals have already been recorded, the number of birds following the ship can be estimated and recorded at regular intervals (i.e., in between each five minute survey or as possible).

Table 1: Intervals at Which Instantaneous or "Snapshot" Counts of Flying Birds Should be conducted during a Moving Vessel Survey

Platform Speed (knots)	Interval Between Counts (minutes)
<4.5	2.5
4.5 – 5.5	2.0
5.5 – 8.5	1.5
8.5 – 12.5	1.0
12.5 - 19	0.5

Poor Visibility

When a survey period cannot be done because of poor visibility (i.e., when the entire width of the 300 m transect is not visible), the extent of visibility should be noted on the seabird survey information form.

Observation Periods with no birds

If no birds are observed during a five minute survey period, "no seabirds observed" must be noted on the seabird survey information form.

2.1.4.1 Survey Protocol – Stationary Vessel

Scan Method

Surveys while the vessel is stationary (e.g., on standby or anchored) are done using instantaneous counts, or “snapshots” of birds within a 300 m “semi-circle” area from the vessel. These surveys are conducted by scanning through a 180° arc, limiting observations to a semi-circle around the observer (Figure 6).

The area should be scanned from one side to the other, and all seabirds on water and in flight that are observed within 300 m are systematically recorded. Birds visible beyond 300 m are also, if possible. The distance to seabirds (inside and outside the 300 m area) from the observer is estimated and recorded for all birds. Birds observed outside the 300 m semi-circle are recorded as not in semi-circle on the seabird survey information form. Binoculars and spotting scopes can be used to confirm species identification and other details as necessary.

Observation Period

When the vessel is stationary, less priority can be attributed to marine mammal observations. The length of each scan will depend on the number of birds present at the time of the scan (e.g., it may only last a few seconds if there are no birds present).

Poor Visibility

When an observation period cannot be done because of poor visibility (i.e., when the entire width of the 300 m transect is not visible), the extent of visibility should be noted on the seabird survey information form.

Observation Periods with no birds

If no birds are observed during a five minute survey period, “no seabirds observed” must be noted on the seabird survey information form.

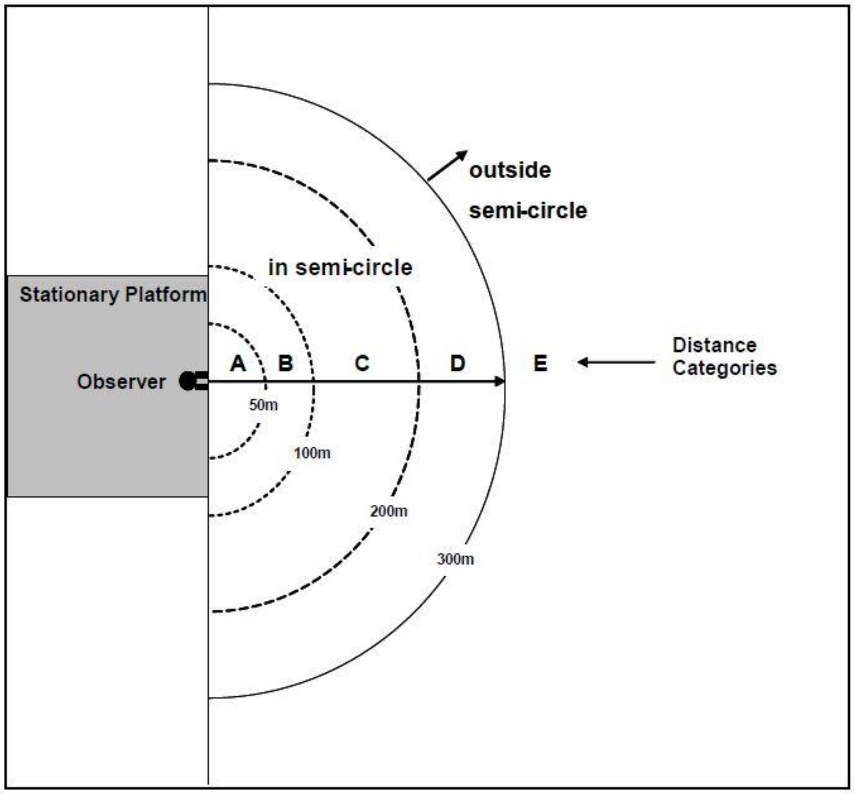


Figure 6. Survey using an 180o scan, surveying an area 300 m from a stationary observer (Extracted from Gjerdrum et al. 2012)

2.1.4.1 Estimating Distance

Record the distance to each bird or flock of birds (to the centre of the flock). For all birds, estimate the perpendicular distance between the bird(s) and the observer (Figure 6). If a group of birds is straddling the 300 m boundary with the flock centre located in D (some individuals inside and some individuals outside the transect) record the entire flock as being in D. If the flock centre is outside the transect, record the entire flock as distance class E. It is very important to record distance to birds within the 300 m strip, but if this is not possible (i.e., too busy), you may use the code 3 = within 300 m but no distance recorded. Distance T is used to indicate that the bird or flock was observed on the opposite side of the vessel.

2.1.5 Recording Observations

General environmental and marine mammal sightings information is to be collected and recorded by filling out forms in Attachments A & B.

MMSO's will record any responsive actions undertaken by the vessel crew in response to sightings. This will be recorded on a daily basis as outlined in the MMSO daily reporting template provided in Attachment C. All records of vessel strikes on marine mammals and bird collisions will be provided to Fisheries and Oceans Canada (DFO) and CWS on a weekly basis, as vessel communications allow (i.e., as internet connections allow). Immediate reporting will be required in the event that a ship strike occurs on a marine mammal, or multiple bird collisions occur (involving more than five individuals) and the incidents appear related (i.e., similar time period, location, and weather conditions). In this instance, the regional Environment and Climate Change Canada (ECCC) Wildlife Enforcement Officer (contact information provided below) will be contacted to provide advice on the implementation of adaptive management techniques to attempt to reduce the likelihood of collisions occurring in the future.

Attachment A

Marine Mammal Sightings Record

Observation Period Information:				
Company/agency			Sea state code	
Platform name and type			Wave height (m)	
Observer (s)			True wind speed (knots) **OR** Beaufort code	
Date (DD/MMM/YYYY)			True wind direction	
Time at start (UTC)			Ice type code	
Time at end (UTC)			Ice concentration code	
Latitude at start / end			True platform speed (knots)	
Longitude at start / end			True platform direction	
Visibility (km)			Observation side	Starboard Port Middle
Weather code			Height of eye (m)	
Glare conditions code			Outdoors or Indoors	Out or In
Platform Activity			Notes	

Date and Time of Sighting	Vessel Travel Direction and Speed	Weather / Sea State	Re-Sighting? (Y or N)	Sighting Waypoint or Lat/Long(Garmin GPS)	Species, Number of Individuals	Distance to Animal (m or km)	Angle to Sighting	Behaviour/Travel Direction	Age/Sex	Mitigation Required?	Photo Number (if any)
Notes:											

Species	How Animal Was Spotted	Certainty of ID	Animal Activity
Narwhal Whale	By Eye	Definite	Slow Swimming
Beluga Whale	Reticle Binoculars	Probable	Medium Swimming
Bowhead Whale	Big-eye Binoculars	Possible	Fast Swimming
Atlantic Walrus			Looking – Seals
Bearded Seal			Feeding
Ringed Seal			Flipper Slapping
Harbour Seal			Surfacing
Hooded Seal			Resting
Harp Seal			Diving
Polar Bear			Diving (Fluke Visible)
Killer Whale			Splashing
			Surfacing
			Fluking
			Lobtailing
			Bow Riding
			Wake Riding
			Porpoising
			Spyhopping
			Breaching
			Acrobatic
			Startle Response
			Milling
			Unknown

Attachment B

Record Sheet for a Moving Platform Survey[3]

Record Sheet for a Stationary Platform Survey[3]

Appendix I - Estimating Distance Categories Using Ruler Gauge[3]

Appendix II Through VI - Codes for General Weather Conditions and Glare, Sea State and Beaufort Wind Force, Ice Conditions, Species Codes for Eastern Seabirds, and Codes for [4]Associations and Behaviours[3]

[4] Eastern Canada Seabirds at Sea (ECSAS) Seabird Sightings Records and Background Material (Extracted from Gjerdrum et al. 2012)

Record sheet for a moving platform survey

Observation Period Information:

Company/agency		Sea state code	
Platform name and type		Wave height (m)	
Observer (s)		True wind speed (knots) **OR** Beaufort code	
Date (DD/MMM/YYYY)		True wind direction (deg)	
Time at start (UTC)		Ice type code	
Time at end (UTC)		Ice concentration code	
Latitude at start / end			True platform speed (knots)	
Longitude at start / end			True platform direction (deg)	
Platform activity		Observation side	Starboard Port
Visibility (km)		Height of eye (m)	
Weather code		Outdoors or Indoors	Out or In
Glare conditions code		Snapshot used?	Yes or No

Notes:

Bird Information: *this field <u>must</u> be completed for each record

* Species	* Count	* Fly or Water?	* In transect?	* Distance[1]	Assoc.	Behav.	Flight Direc.[2]	Age[3]	Plum.[4]	Sex	Comments

[1] ***A*** = 0-50m, ***B*** = 51-100m, ***C*** = 101-200m, ***D*** = 201-300m, ***E*** = > 300m, ***3*** = within 300m but no distance recorded.
[2]Indicate flight direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, or ***NW***); ***ND*** = no apparent direction
[3]***J***(uvenile), ***I***(mmature), or ***A***(dult); [4]***B***(reeding), ***NB***(non-breeding), ***M***(oult)

Record sheet for a stationary platform survey

Scan Information:

Company/agency		Weather code	
Platform name and type		Glare conditions code	
Observer (s)		Sea state code	
Date (DD/MMM/YYYY)		Wave height (m)	
Time at start (UTC)		True wind speed (knots) **OR** Beaufort code	
Latitude		True wind direction (deg)	
Longitude		Ice type code	
Platform activity		Ice concentration code	
Scan type	180º or other (specify:)	Height of eye (m)	
Scan direction		Outdoors or Indoors	Out or In
Visibility (km)			

Notes:

Bird Information: *this field <u>must</u> be completed for each record

* Species	* Count	* Fly or Water?	* In semi-circle?	* Distance[1]	Assoc.	Behav.	Flight Direc.[2]	Age[3]	Plum.[4]	Sex	Comments

[1] ***A*** = 0-50m, ***B*** = 51-100m, ***C*** = 101-200m, ***D*** = 201-300m, ***E*** = > 300m, ***3*** = within 300m but no distance recorded.
[2]Indicate flight direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, or ***NW***); ***ND*** = no apparent direction
[3]***J***(uvenile), ***I***(mmature), or ***A***(dult); [4]***B***(reeding), ***NB***(non-breeding), ***M***(oult)

APPENDIX I. Estimating distance categories

The various distance categories can be estimated using the following equation[1]:

$$d_h = 1000 \frac{(ah3838\sqrt{h}) - ahd}{h^2 + 3838d\sqrt{h}}$$

e.g. if a = 0.730 m, h = 12.5 m, and d = 300 m

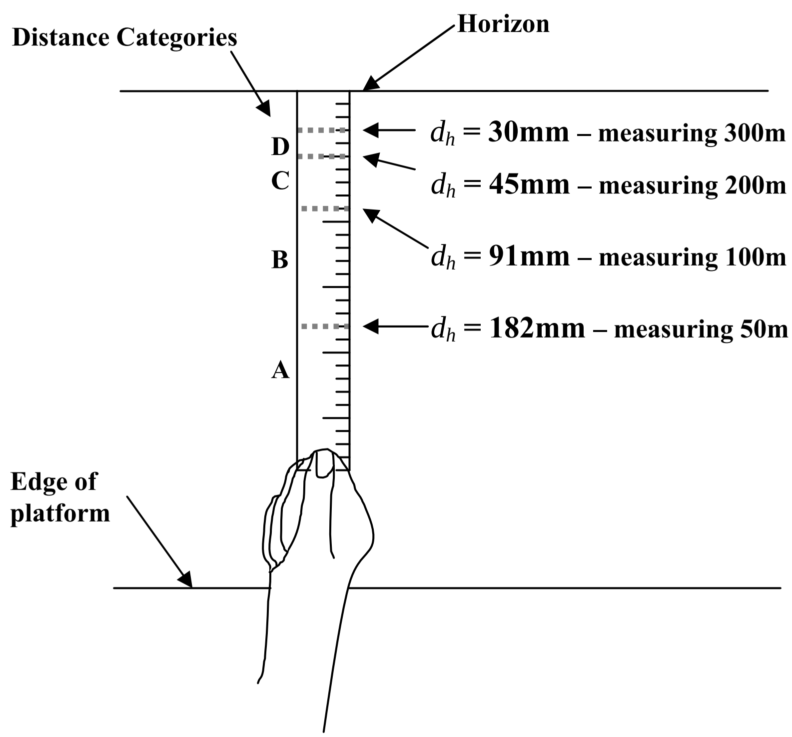
then d_h = 30.0 mm

where:

d_h = distance below horizon (mm)
a = distance between the observer's eye and the ruler when observer's arm is fully out-stretched (m)
h = height of the observer's eye above the water at the observation point (m)
d = distance to be estimated (m; a separate calculation is required for each of 50, 100, 200, 300)

Distances are easily estimated using a gauge made from a transparent plastic ruler. A different ruler will be required for each combination of observer arm length (a) and platform height (h). Calculate d_h for the boundary of each distance class (A, B, C, D) and mark them on the ruler (dashed lines in figure). To use the gauge, extend the arm fully and keep the top end of the ruler aligned with the horizon. The dashed lines now demark the distance class boundaries on the ocean surface. Keep the gauge nearby during surveys to quickly verify bird distances.

Measurements for an observer with a = 73 cm and h = 12.5 m:



[1] Formula derived by J. Chardine, based on Heinemann 1981. A spreadsheet is available from the corresponding author to perform this calculation.

APPENDIX II. Codes for general weather conditions and glare

Code	Description	Explanation
Weather conditions		
0		< 50% cloud cover (with no fog, rain, or snow)
1		> 50% cloud cover (with no fog, rain, or snow)
2		patchy fog
3		solid fog
4		mist/light rain
5		medium to heavy rain
6		fog and rain
7		snow
Glare conditions		
0		none
1		slight/grey
2		bright on the observer's side of vessel
3		bright and forward of vessel

APPENDIX III. Codes for sea state and Beaufort wind force

Wind Speed (knots)	**Sea state code and description**	**Beaufort wind force and description**
0	**0** Calm, mirror-like	**0** calm
01 – 03	**0** Ripples with appearance of scales but crests do not foam	**1** light air
04 – 06	**1** Small wavelets, short but pronounced; crests do not break	**2** light breeze
07 – 10	**2** Large wavelets, crests begin to break; foam of glassy appearance; perhaps scattered white caps	**3** gentle breeze
11 – 16	**3** Small waves, becoming longer; fairly frequent white caps	**4** moderate breeze
17 – 21	**4** Moderate waves with more pronounced form; many white caps; chance of some spray	**5** fresh breeze
22 – 27	**5** Large waves formed; white foam crests more extensive; probably some spray	**6** strong breeze
28 – 33	**6** Sea heaps up; white foam from breaking waves blows in streaks in direction of wind	**7** near gale
34 – 40	**6** Moderately high long waves; edge crests break into spindrift; foam blown in well-marked streaks in direction of wind	**8** gale
41 – 47	**6** High waves; dense streaks of foam in direction of wind; crests of waves topple and roll over; spray may affect visibility	**9** strong gale
48 – 55	**7** Very high waves with long overhanging crests; dense foam streaks blown in direction of wind; surface of sea has a white appearance; tumbling of sea is heavy; visibility affected	**10** storm
56 - 63	**8** Exceptionally high waves; sea is completely covered with white patches of foam blown in direction of wind; edges blown into froth; visibility affected	**11** violent storm
64 +	**9** Air filled with foam and spray; sea completely white with driving spray; visibility seriously affected	**12** hurricane

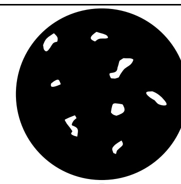
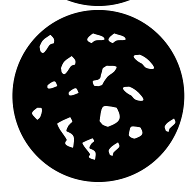
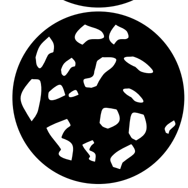
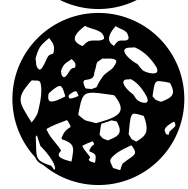
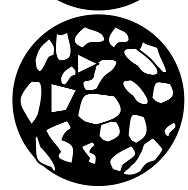
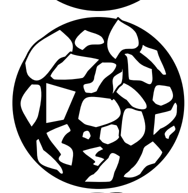
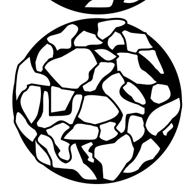
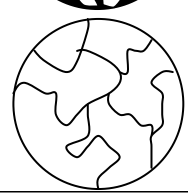
APPENDIX IV. Codes for ice conditions

Adapted from NOAA: Observers Guide to Sea Ice

Sea Ice Forms

Code	Name	Description
0	New	small, thin, newly formed, dinner plate-sized pieces
1	Pancake	rounded floes 30 cm - 3 m across with ridged rims
2	Brash	broken pieces < 2 m across
3	Ice Cake	level piece 2 - 20 m across
4	Small Floe	level piece 20 - 100 m across
5	Medium Floe	level piece 100 -500 m across
6	Big Floe	level, continuous piece 500 m - 2 km across
7	Vast Floe	level, continuous piece 2 - 10 km across
8	Giant Floe	level, continuous piece > 10 km across
9	Strip	a linear accumulation of sea ice < 1 km wide
10	Belt	a linear accumulation of sea ice from 1 km to over 100 km wide
11	Beach Ice or Stamakhas	irregular, sediment-laden blocks that are grounded on tidelands, repeatedly submerged, and floated free by spring tides
12	Fast Ice	ice formed and remaining attached to shore

Sea Ice Concentration

Code	Concentration	Description	
0	< one tenth	"open water"	
1	two-three tenths	"very open drift"	
2	four tenths	"open drift"	
3	five tenths	"open drift"	
4	six tenths	"open drift"	
5	seven to eight tenths	"close pack"	
6	nine tenths	"very close pack"	
7	ten tenths	"compact"	

APPENDIX V. Species codes for birds seen in Eastern Canada

Common name	Species code	Latin name
COMMON, REGULAR OR FREQUENTLY SEEN SPECIES		
Northern Fulmar	NOFU	*Fulmarus glacialis*
Great Shearwater	GRSH	*Puffinus gravis*
Manx Shearwater	MASH	*Puffinus puffinus*
Sooty Shearwater	SOSH	*Puffinus griseus*
Wilson's Storm-Petrel	WISP	*Oceanites oceanicus*
Leach's Storm-Petrel	LESP	*Oceanodroma leucorhoa*
Northern Gannet	NOGA	*Morus bassanus*
Red Phalarope	REPH	*Phalaropus fulicaria*
Red-necked Phalarope	RNPH	*Phalaropus lobatus*
Long-tailed Jaeger	LTJA	*Stercorarius longicaudus*
Parasitic Jaeger	PAJA	*Stercorarius parasiticus*
Pomarine Jaeger	POJA	*Stercorarius pomarinus*
Great Skua	GRSK	*Stercorarius skua*
Herring Gull	HERG	*Larus argentatus*
Iceland Gull	ICGU	*Larus glaucoides*
Glaucous Gull	GLGU	*Larus hyperboreus*
Great Black-backed Gull	GBBG	*Larus marinus*
Black-legged Kittiwake	BLKI	*Rissa tridactyla*
Common Murre	COMU	*Uria aalge*
Thick-billed Murre	TBMU	*Uria lomvia*
Razorbill	RAZO	*Alca torda*
Dovekie	DOVE	*Alle alle*
Atlantic Puffin	ATPU	*Fratercula arctica*
SPECIES MORE COMMONLY SEEN INSHORE		
Common Loon	COLO	*Gavia immer*
Red-throated Loon	RTLO	*Gavia stellata*
Red-necked Grebe	RNGR	*Podiceps grisegena*
Horned Grebe	HOGR	*Podiceps auritus*
Great Cormorant	GRCO	*Phalacrocorax carbo*
Double-crested Cormorant	DCCO	*Phalacrocorax auritus*
Greater Scaup	GRSC	*Aytha marila*
Common Eider	COEI	*Somateria mollissima*
Harlequin Duck	HARD	*Histrionicus histrionicus*
Long-tailed Duck	LTDU	*Clangula hyemalis*
Surf Scoter	SUSC	*Melanitta perspicillata*
Black Scoter	BLSC	*Melanitta nigra*
White-winged Scoter	WWSC	*Melanitta fusca*
Red-breasted Merganser	RBME	*Mergus serrator*
Black Guillemot	BLGU	*Cepphus grylle*

Common name	Species code	Latin name
INFREQUENTLY OR RARELY SEEN SPECIES		
Cory's Shearwater	COSH	*Calonectris diomedea*
Audubon's Shearwater	AUSH	*Puffinus lherminieri*
Lesser Scaup	LESC	*Aythya affinis*
King Eider	KIEI	*Somateria spectabilis*
South Polar Skua	SPSK	*Stercorarius maccormicki*
Bonaparte's Gull	BOGU	*Larus philadelphia*
Ivory Gull	IVGU	*Pagophila eburnea*
Black-headed Gull	BHGU	*Larus ridibundus*
Laughing Gull	LAGU	*Larus articilla*
Ring-billed Gull	RBGU	*Larus delawarensis*
Lesser Black-backed Gull	LBBG	*Larus fuscus*
Sabine's Gull	SAGU	*Xema sabini*
Common Tern	COTE	*Sterna hirundo*
Arctic Tern	ARTE	*Sterna paradisaea*
Roseate Tern	ROTE	*Sterna dougallii*
CODES FOR BIRDS IDENTIFIED TO FAMILY OR GENUS		
Unknown Bird	UNKN	
Unknown Shearwater	UNSH	*Puffinus* or *Calonectris*
Unknown Storm-Petrel	UNSP	Hydrobatidae
Unknown Duck	UNDU	Anatidae
Unknown Eider	UNEI	*Somateria*
Unknown Phalarope	UNPH	*Phalaropus*
Unknown Jaeger	UNJA	*Stercorarius*
Unknown Skua	UNSK	*Stercorarius*
Unknown Gull	UNGU	Laridae
Unknown Tern	UNTE	*Sternidae*
Unknown Alcid	ALCI	Alcidae
Unknown Murre or Razorbill	MURA	*Uria* or *Alca*
Unknown Murre	UNMU	*Uria*

APPENDIX VI. Codes for associations and behaviours

From Camphuysen and Garthe (2004). Choose one or more as applicable.

Code	Description
Association	
10	Associated with fish shoal
11	Associated with cetaceans
13	Associated with front (often indicated by distinct lines separating two water masses or concentrations of flotsam)
14	Sitting on or near floating wood
15	Associated with floating litter (includes plastic bags, balloons, or any garbage from human source)
16	Associated with oil slick
17	Associated with sea weed
18	Associated with observation platform
19	Sitting on observation platform
20	Approaching observation platform
21	Associated with other vessel (excluding fishing vessel; see code 26)
22	Associated with or on a buoy
23	Associated with offshore platform
24	Sitting on offshore platform
26	Associated with fishing vessel
27	Associated with or on sea ice
28	Associated with land (e.g., colony)
50	Associated with other species feeding in same location

Code	Description	Explanation
Foraging behaviour		
30	Holding or carrying fish	carrying fish towards colony
32	Feeding young at sea	adult presenting prey to attended chicks (e.g., auks) or juveniles (e.g., terns)
33	Feeding	method unspecified (see behaviour codes 39,40,41,45)
36	Aerial pursuit	kleptoparisitizing in the air
39	Pattering	low flight over the water, tapping the surface with feet while still airborne (e.g., storm-petrels)
40	Scavenging	swimming at the surface, handling carrion
41	Scavenging at fishing vessel	foraging at fishing vessel, deploying any method to obtain discarded fish and offal; storm-petrels in the wake of trawlers picking up small morsels should be excluded
44	Surface pecking	swimming birds pecking at small prey (e.g., fulmar, phalaropes, skuas, gulls)
45	Deep plunging	aerial seabirds diving under water (e.g., gannets, terns, shearwaters)
49	Actively searching	persistently circling aerial seairds (usually peering down), or swimming birds frequently peering (and undisturbed by observation platform) underwater for prey
General behaviour		
60	Resting or apparently sleeping	reserved for sleeping seabirds at sea
64	Carrying nest material	flying with seaweed or other material; not to be confused with entangled birds
65	Guarding chick	reserved for auks attending recently fledged chicks at sea
66	Preening or bathing	birds actively preening feathers or bathing
Distress or mortality		
71	Escape from ship (by flying)	escaping from approaching observation platform
90	Under attack by kleptoparasite	bird under attack by kleptoparasite in an aerial pursuit, or when handling prey at the surface
93	Escape from ship (by diving)	escaping from approaching observation platform
95	Injured	birds with clear injuries such as broken wings or bleeding wounds
96	Entangled in fishing gear or rope	birds entangled with rope, line, netting or other material (even if still able to fly or swim)
97	Oiled	birds contaminated with oil
98	Sick/unwell	weakened individuals not behaving as normal, healthy birds, but without obvious injuries
99	Dead	bird is dead

Attachment C

MMSO Daily Reporting Template

1.0 MARINE MAMMALS AND SEABIRD OBSERVING (MMSO) DAILY REPORT

Project Information	
Client:	**Date:**
Project Name:	**Location:**
Ship Contractor Information	
Ship Contractor Name:	**Site Supervisor or Captain:**
Ship Name/Type:	
MMSO name:	
General weather conditions (throughout the day)	**Cloud cover:** **Precipitation:** **Wind (knots):** **Sea state:** **Swell height:** **Air temperature:** **Ice presence:** **Notes:**
Time start/Time end MMSO duties (UTC):	

2.0 MITIGATION LOG

Mitigation Implemented	Time (UTC)	GPS Location	Rational for Implementation

Under Activity note the following: Description of any vessel mitigation implemented (e.g., reduction in speeds, evasive maneuvers etc.)

3.0 RECORD OF VESSEL-ANIMAL COLLISIONS/INTERACTIONS

Species	Number of Individuals	Time (UTC)	GPS Coordinates	Visibility/Sea State	Comments

Extracted from the Meliadine Shipping Management Plan, 2017

In the comments note the following: Animals observed on the deck (seabirds) or in the water (seabirds or marine mammals), if search lights or vessel lighting sources were active at the time of collision, and any other relevant notes.

4.0 MMSO CHECKLIST

Item or Location to Check	Yes	No	Comments - Discussed (D) with relevant Ship personnel - Observed (O) - Not Applicable (NA) - Action required (as/if applicable)
General			
Copy of SMP and appendices posted on-site			
Orientation to mitigation measures outlined in Section 4.2 of the SMP			
Overview of MMSO duties and protocols (e.g., ship crews should be made aware that the MMSO is the only individual that can mark sightings during the dedicated surveys/observation periods)			
Add additional items as necessary and depending on the role of the MMSO			
General Notes:			

5.0 SUMMARY OF ISSUES AND RECOMMENDATIONS / ACTIONS

Date Noted	Issue	Recommendation/Action	Completed (Date Resolved)	Comments

Extracted from the Meliadine Shipping Management Plan, 2017

Thermal Monitoring Plan, Version 2

WHALE TAIL PIT PROJECT

Thermal Monitoring Plan

In Accordance with
Project Certificate No. 008, T&C 14

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

Version 2
March 2019

EXECUTIVE SUMMARY

Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle) received a Project Certificate No.008 from the Nunavut Impact Review Board for the development of the Whale Tail Pit, a satellite deposit located on the Amaruq Exploration property.

The deposit will be mined as an open pit (i.e., Whale Tail Pit), and ore will be hauled by truck to the approved infrastructure at Meadowbank Mine for milling. Approximately 8.3 million tonnes (Mt) of ore will be mined from the open pit and processed over a three to four-year mine life. Ore from Whale Tail Pit will be crushed on site after which it will be transported to Meadowbank Mine for milling. The mill rate will be approximately 9,000 to 12,000 tonnes per day.

This document presents the Thermal Monitoring Plan for the Whale Tail Pit in accordance with Terms and Conditions No. 14 included in the Project Certificate.

DISTRIBUTION LIST

Agnico – Engineering Superintendent

Agnico – Geotechnical Coordinator

Agnico – Environment Superintendent

Agnico – Environment General Supervisor

Agnico – Environmental Coordinator

DOCUMENT CONTROL

Version	Date (YMD)	Section	Revision
1	2018-05-04	All	To address Project Certificate No. 008. T&C 14
2	2019-03-31	All	Comprehensive update of the plan

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Appendix A: Thermal data results

1 INTRODUCTION

Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle) is developing the Whale Tail Pit Project (Project), a satellite deposit located on the Amaruq property, to continue mine operations and milling at Meadowbank Mine.

The Amaruq property is a 408 km^2 site located on Inuit Owned Land approximately 150 km north of the hamlet of Baker Lake and approximately 50 km northwest of Meadowbank Mine in the Kivalliq Region of Nunavut. The deposit will be mined as an open pit (i.e., Whale Tail Pit), and ore will be hauled to the approved infrastructure at Meadowbank Mine for milling. The planned project involves: one year of construction, three years of mine operation, eight years of closure-related activities, and the post-closure period.

This document presents a Thermal Monitoring Plan prepared for the following mine facilities and natural locations:

- Waste rock storage facility (WRSF)
- Water management facilities including Whale Tail Dike, Mammoth Dike, North-East Dike, WRSF Dike, and Attenuation Pond
- Whale Tail Pit
- Whale Tail Lake shore

The Thermal Monitoring Plan provides general descriptions of the different facilities, describes the anticipated impact of operation of the facilities on the permafrost and presents general guidelines that are used to define instrumentation needs for each facility. This document is not intended to provide detailed specifications for the instrumentation program, which will be defined as mining progresses and infrastructures are built. The Thermal Monitoring Plan will be reviewed periodically to adjust to the dynamics of mine construction and operation and adapt the monitoring strategy defined for each facility as needed.

1.1 CONCORDANCE

Meadowbank Mine is an approved mining operation and Agnico Eagle is planning to extend the life of the mine by constructing and operating the Project. The Project was subject to an environmental review established by Article 12, Part 5 of the Nunavut Agreement. In June 2016, Agnico Eagle submitted a Final Environmental Impact Statement (FEIS) seeking a reconsideration of the Meadowbank Mine Project Certificate (No. 004/File No. 03MN107) and Type A Water Licence Amendment (No. 2AM-MEA1526) from the NIRB.

On July 2016, the NIRB determined that the proposed Project required a separate screening assessment under the Nunavut Agreement and the *Nunavut Planning and Project Assessment Act* (NuPPAA). A separate Project Certificate (NIRB Project Certificate No. 008) was issued for the Project on March 15, 2018 by the NIRB. This Thermal Monitoring Plan reflects the commitments made with respect to submissions provided during the technical review of the FEIS, to comply with Terms and Condition No. 14 included in the Project Certificate.

1.2 OBJECTIVES

The primary objective of the Thermal Monitoring Plan is to document and monitor ground thermal conditions at site and identify impacts to the permafrost, if any, that could be associated with development, operation and closure of the different mine facilities. This is done through the implementation of a monitoring program designed to assess variations in the ground thermal conditions and a data analysis program that will compare results obtained to baseline conditions prior to mine developments.

The monitoring program will allow for identification of affected permafrost zones and for the comparison between the anticipated and observed effects of the mine facilities on the permafrost. The results of the monitoring program will also be used to guide activities that might be required in future to document the development and/or evolution of permafrost at site.

In certain areas, effects of mine operations on the permafrost are anticipated to be temporary and normal conditions are expected to be restored progressively upon closure of the mine. The monitoring plan will constitute a means to assess and validate this assumption, and monitoring results will be used to determine if mitigation actions are required and define what these will be at specific locations, as needed.

2 BACKGROUND

2.1 CLIMATE ENVIRONMENT

The Project site has the following mean climate characteristics (Agnico Eagle 2016):

- Mean annual air temperature of -11.3 °C
- In summer months from June through September, the mean monthly air temperature ranges from 4.9 to 11.6 °C. In winter months from October to May, the mean monthly air temperature ranges from -6.4 to -31.3 °C
- Mean annual total rainfall of 168 mm
- Mean annual total snowfall (water equivalent) of 160 mm

2.2 REGIONAL PERMAFROST

The Project is located in the zone of continuous permafrost. Permafrost refers to subsurface soil or rock where temperatures remain at or below 0ºC for at least two consecutive years. This is synonymous to perennially cryotic ground, which may be frozen, partially frozen, or non-frozen depending on the ice/water content of the ground, and the salinity of the groundwater. The base of the permafrost is expected to be an undulating surface and the actual depth to permafrost is variable.

The Project footprint is underlain by permafrost except under portions of Whale Tail Lake where water is too deep to freeze to the bottom during winter. Taliks (areas of unfrozen ground) are expected beneath a water body where the water depth is greater than the ice thickness. Closed talik formations show a depression in the permafrost table below relatively shallow and small lakes. Open talik formations that penetrate through the permafrost and connect the lake waterbody with the sub-permafrost regime are to be expected for relatively deeper and larger lakes in the project area.

2.3 SITE SUBSURFACE GEOLOGY

The Whale Tail deposit is located in the northern portion of the Whale Tail Lake. Based on previous site investigation data, soils in the project area are typically medium to coarse grained glacial till and colluvium with high coarse fragment content overlying bedrock at shallow depths. Saturated soil layers overlying frozen layers have been observed on site. A review of the records of the six thermistor boreholes indicates soil thicknesses varying from 6.1 to 12.4 m. Underlying the soil, bedrock in the area generally consists of a stratigraphic sequence of greywacke, iron formation and komatiite, with varying thicknesses.

2.4 BASELINE FIELD INVESTIGATIONS

The Project site permafrost conditions were initially assessed by Knight Piésold (2015) between June and October of 2015 which included the installation of six thermistors in the vicinity of the proposed development of Whale Tail Lake to collect ground temperature data.

Golder Associates completed an additional thermal assessment for the Whale Tail Lake in 2017 (Golder 2017a) and installed four thermistors within the vicinity of Whale Tail Lake.

A Westbay well was installed on-site between March and April in 2016 where groundwater samples were collected from multiple intervals (Golder 2016a). A first estimation of the thickness of the permanently frozen permafrost was made based on information collected from the Westbay well.

Additional investigations and thermistor installations were carried out by SNC-Lavalin in 2016 and 2017 for the purpose of dike design.

2.4.1 Existing Instrumentation on-Site

A total of 14 thermistors have been installed at Whale Tail Site project area between 2015 and 2018. Data from these thermistors have been used to estimate the site permafrost and talik conditions (Golder 2017a, 2018a). Ten of the 14 thermistors are currently active.

The location and installation summary of the 10 active thermistors within the Project site are presented in Table 1. Figure 1 shows locations of active and inactive thermistors. Data are collected from the thermistor by data loggers or using manual readout units.

Results of each of these active and inactive thermistors are presented in Appendix A.

Figure 1. Location of Thermistors

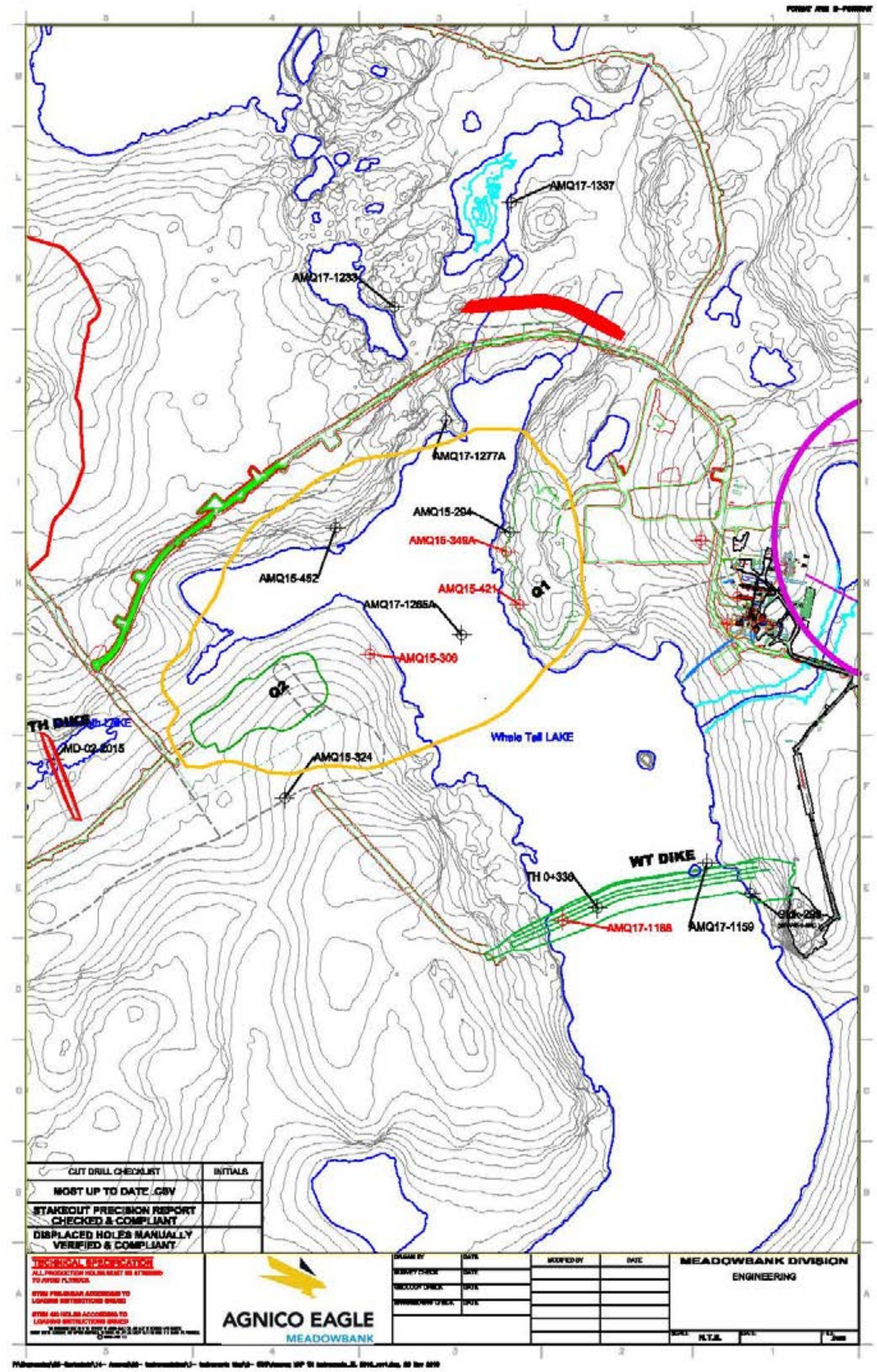

Table 1: Summary of Active Thermistors within the Project Site

Borehole	Location	Collar Coordinates					Thermistor Depth Below Ground Surface (m)	Reading Mode
		Northing	Easting	Elevation	Inclination (deg)	Azimuth (deg)		
AMQ15-294	Whale Tail Pit, at East Lake Shore	607,073.2	7,255,676.1	155.9	-45.18	322.7	144.4	Data Logger
AMQ15-324	To the southwest of Whale Tail Pit, at West Lake Shore	606,496.8	7,254,995.2	161.8	-55.46	325.5	317.4	Data Logger
AMQ15-452	Whale Tail Pit, at Northwest Lake Shore	606,627.2	7,255,687.9	156.2	-49.98	159.5	382.3	Data Logger
AMQ17-1265A	Within Whale Tail Dike and Whale Tail Pit	606,950.1	7,255,413.6	152.5	-80.0	196.0	349.6 (depth below lake level)	Manual Reading
AMQ17-1233	East Shore of Lake A49	606,777.7	7,256,253.8	161.9	-59.06	252.7	132.4	Manual Reading
AMQ17-1337	East Shore of Lake A47	607,078.4	7,256,522.0	155.2	-59.62	260.4	218.0	Data Logger
AMQ17-1277A	Whale Tail Pit, at North Lake Shore	606,911.1	7,255,963.6	153.2	-60.17	193.1	217.4	Data Logger
MD-02-2015	Mammoth Dike	605,906.1	725,5094.5	NA	NA	NA	15	Manual Reading
AMQ17-1159	Whale Tail Dike	607,580.2	725,4827.6	NA	NA	NA	20	Manual Reading
Stkd299	Whale Tail Dike	607,689.9	725,4751.0	NA	NA	NA	15	Manual Reading

NA=data not available.

2.5 BASELINE THERMAL MODELLING

Thermal modelling has been conducted to predict variations in the thermal regime of the permafrost. Modelling results are presented in the following reports:

- 2015 Site Permafrost Characterization by Knight Piésold (2015).
- 2017 Whale Tail Lake Thermal Assessment by Golder (2017a).
- 2017 and 2018 Golder Waste Rock Storage Facility thermal analysis for cover design by Golder (2017b, 2018b).
- 2018 Pit Lake Post-closure Thermal Assessment by Golder (2018a, In-progress).
- 2018 Dike Thermal Assessment by SNC-Lavalin (2018).

General results obtained from these studies are used to define the permafrost baseline conditions summarized in Section 2.6.

2.6 SUMMARY OF CURRENT PERMAFROST CONDITIONS

Current permafrost conditions on the Project site were estimated as follows based on thermistor data up to October 2017 and previous works. This information describes the baseline permafrost condition at the site.

- The depth of permafrost in the project site is estimated to be in the order of 427 to 495 m.
- The extrapolated mean annual ground surface temperature is estimated to be in the range of -3.4 to -9.9 °C.
- The estimated depths of zero amplitude from temperature profiles measured by the existing thermistors range from 18 m to 35 m.
- The temperatures at the depths of zero amplitude are in the range of -3.0 °C to -8.4 °C.
- The geothermal gradient is in the range of 0.005 °C/m to 0.025 °C/m.
- Based on the measured salinity concentration of 0.3% to 0.4% from groundwater samples collected on site, a freezing point depression of about 0.2 °C is estimated, which may reduce the frozen ground depth by approximately 20 m.

Ground thermal conditions under Whale Tail Lake were estimated by both thermal assessment and thermistor data. Results indicate the following:

- Under the northern portion of the lake including under the proposed pit location and along the proposed ramp area, there is likely a closed talik formation.
- An open talik is expected in the southern portion of the lake where it becomes wider and deeper
- Data from the thermistor AMQ17-1265A installed within the lake (near southeast side of the Pit) suggests the talik depth at this location is about 112 m from the lake water level. Permafrost is present beneath the talik at that location to a depth of about 343 m.

3 THERMAL MONITORING PLAN

This section presents a general description of each facility, the expected thermal effects on the permafrost, planned thermal monitoring and results documentation. The monitoring program will allow for evaluation of the actual impacts on the permafrost thermal regime during construction, operations, and closure of the facilities, and post-closure.

The information presented herein will be reviewed periodically during operations to reflect the actual site conditions.

3.1 WASTE ROCK STORAGE FACILITY

3.1.1 Facility Description

The WRSF is located north-west of the open pit, and consists of West WRSF and East WRSF. Waste rock and overburden will be trucked to the WRSF throughout mine operations, with distribution between the East and West portions based on the pile operation schedule. Agnico Eagle plans to deposit a total of 68.2 million dry tonnes (Mt) of waste rock and overburden material between 2018 and 2022.

The final height of the WRSF is anticipated to be 95 m. The construction process incorporates 20-m high benches composed of four 5-m thick layers. Each bench toe will start at a setback distance of 20 m from the crest of the previous bench to form an overall side slope of 2.5H:1V.

The diorite and south greywacke material, which are both non-acid generating and non-metal leaching, represent approximately 17% (10.5 Mt) of the waste rock to be mined from the open pit and can be used as cover material for the Whale Tail WRSF.Closure of the WRSF will begin when practical as part of the progressive reclamation program. As part of the Whale Tail Pit – Waste Rock Management Plan (Agnico Eagle 2017), the Whale Tail WRSF will be covered with non-potentially acid generating and non-metal leaching (NPAG/NML) waste rock to promote freezing of the pile as a control strategy to prevent acid generation and transport of contaminants.

3.1.2 Expected Thermal Effects on Permafrost

Construction of the WRSF on the permafrost is expected to result in aggradation of permafrost into the pile. The permafrost under the pile would remain, but temperatures in the upper permafrost zone are expected to increase gradually until a thermal equilibrium is established with the active zone and zero-amplitude zone moving upward and being located within the waste rock pile. Convective cooling conditions often occur in waste piles and would potentially offset some of the temperature increase in the permafrost.

The waste rock pile itself is expected to freeze back with time and have an active layer formed on the upper portion (Golder 2018b). Climate change in the long-term is expected to extend the depth of the active layer in the pile, but the thick waste rock pile will constitute a protection to the underlying permafrost. If heat generation occurs associated with the oxidation of sulphide-bearing minerals within the pile, the process of freeze-back would be delayed and, depending on the location of the heat generation source, the upper portion of the permafrost foundation could be impacted.

3.1.3 Thermal Monitoring

Currently there are no thermistors installed in the WRSF area.

Vertical thermistors will be installed through the waste rock and underlying permafrost during construction of the pile to monitor the evolution of temperature profiles with time and to evaluate if the process of permafrost aggradation and pile freeze-back is developing as anticipated. Thermistors installed during construction of the pile will be located in completed benches, and additional thermistors will be installed on top of the pile upon end of operations and installation of the cover system for closure of the facility. Thermistors installed after placement of the thermal cap on top of the facility will be used to assess whether the defined cover thickness of 4 m (Golder 2018b) is effective to maintain the top of the pile away from the active zone subject to seasonal freezing and thawing.

The thermistor strings will be connected to data loggers for automatic data collection and storage. Data will be reviewed periodically or as-needed, and results will be summarized in monitoring reports in a yearly basis during operation and for five years after closure. The frequency of reporting will be reviewed after that and might be reduced.

3.2 WATER MANAGEMENT FACILITIES

3.2.1 Facility Description

Water management infrastructure includes contact water collection ponds, freshwater collection ponds, diversion channels, retention dikes, dams, culverts, water treatment plant for effluent, potable water treatment plant, sewage treatment plant, and a discharge diffuser. All contact water on-site will be directed to an Attenuation Pond. Contact water will be treated and then released to Mammoth Lake through a discharge diffuser.

The Whale Tail Dike was constructed before operations to allow mining of the open pit. After dewatering of the lake area downstream of the dike the operational lake water level upstream of the dike is predicted to be at El. 156 masl, about 3.5 m higher than the current average lake level. The dike will be breached during closure to restore the lake, and will form a permanent pit lake as the open pit is flooded.

The Mammoth Dike is also a dewatering structure constructed at west side of the pit, and east side of Mammoth Lake to limit flow from Mammoth Lake into the pit. Similarly, the North East Dike will be constructed to limit inflow from lakes A46, A47 and AP68.

The Attenuation Pond will be located between the Whale Tail Dike and the Whale Tail Pit to collect mine water, runoff and seepage from the dike. The pond operational water level is expected to be at El. 146 masl.

The WRSF Dike is planned to be a water retaining dam to store contact water from the waste rock pile. The facility will be emptied annually and water will be pumped to the Attenuation Pond.

3.2.2 Expected Thermal Effects on Permafrost

The Whale Tail Dike will be constructed within the lake where talik is anticipated to exist, therefore there will be no direct negative impact on the permafrost zone underneath the talik. The construction of the Whale Tail Dike is expected to have a cooling effect on the lake ground underneath the dike due to exposure to lower dike temperature than lake water. Minimal effects to the permafrost at the abutment areas are expected.

Upon lake dewatering and beginning of operations, areas downstream of the Whale Tail Dike are expected to freeze back progressively, and the upstream area of the dike is expected to remain unfrozen.

After the dike is breached in the final stages of closure, the Whale Tail lake will be restored, causing frozen zones located downstream of the dike to thaw and progressively restoring the original lake talik.

The other dewatering dike areas are expected to have similar thermal impacts on the permafrost associated with construction, operation and closure of the dikes.

The WRSF Dike may contain a pond formed from water flowing out of the waste rock facility. Depending on pond depth and operational conditions there would be impact with possible thawing of a shallow upper permafrost zone underlying the pond.

The talik zone under the Attenuation Pond would remain, but depth of the talik could be reduced as the Attenuation Pond will likely be shallower than the existing lake at that location. The surrounding areas to the pond would freeze back progressively after dewatering, but would restore to talik condition after breaching of the dewatering dikes and flooding of the area.

3.2.3 Thermal Monitoring

There are thermistors currently installed in the Whale Tail Dike and Mammoth Dike areas. No thermistors are present in North-East Dike nor WRSF Dike areas. Additional thermistors will be installed after construction of the dikes along the dike alignments, dike abutments, and adjacent lake shore areas to monitor changes in the thermal regimes, monitor performance of the dikes and confirm/validate the expected effects as described above. The exact location, quantity and specifications of new thermistor lines will be defined in future based on the final lay-out of site facilities.

Thermistors have not been installed within the footprint of the proposed Attenuation Pond. Considering that the Attenuation Pond is not anticipated to have any negative effects on permafrost due to its planned location within an existing talik area, the need for installation of thermistors will be evaluated upon completion of the detailed engineering design of the pond.

At the location of the WRSF Dike, thermistors will be installed within the dike footprint to monitor variations in the underlying permafrost condition.

All new thermistors will be connected to data loggers for automatic data collection and data storage. Existing thermistors that are not connected to a logger will be read manually in at least monthly basis, or be further connected to data loggers. Data will be reviewed periodically or as-needed. Results will be presented in annual reports during operation and closure of until dike decommissioning.

3.3 OPEN PIT

3.3.1 Facility Description

The proposed Whale Tail Pit will extend across the northern edge of Whale Tail Lake. Approximately 8.3 Mt of ore will be mined from the Whale Tail Pit and processed over a three to four-year mine life. The base of the pit is designed to be at El. 37 masl, about 115.5 m below the existing average lake water level of 152.5 masl.

Construction of the Whale Tail Pit site started in 2018. The operational phase will span from Year 1 (2019) to Year 4 (2022). Mining activities are currently expected to end in Year 3 (2021) and ore processing is expected to end during Year 4 (2022). Pit flooding is anticipated to commence in 2022 marking the beginning of the closure period, and is expected to reach the top of the pit / base of Whale Tail Lake (138 masl) in 2025 and the initial lake in 2028.

3.3.2 Expected Effects on Permafrost

The pit will be excavated through an upper closed talik zone and underlying permafrost. During operations of the pit the talik zone is expected to freeze back progressively and the lower permafrost zone surrounding the pit walls will, in general, experience reduction in temperature other than at a shallow active zone adjacent to the pit walls subjected to seasonal thawing during summer.

Upon closure and subsequent flooding of the pit, permafrost areas underneath the pit lake are expected to gradually thaw. Thermal assessments have indicated this process would take hundreds of years (Golder 2018a). The pit lake would eventually reduce the permafrost depth in the pit surrounding ground, but this process could take significantly longer time (in the order of 10,000 years) to complete.

3.3.3 Thermal Monitoring

A total of eight thermistors are currently active in the area of the future pit. Some of the existing thermistors may be destroyed during pit mining. Additional thermal investigations around the pit at shallow depth may be undertaken; the need for this will be defined during mining.

For/if any thermistors remain active or are installed in this area, they may be connected to data loggers for automatic data collection and data storage. Data will be reviewed periodically or as-needed, and results will be summarized in annual monitoring reports during operation and for five years after closure. The frequency of reporting may be modified in time as the thermal regime of the area stabilizes.

3.4 WHALE TAIL LAKE SHORE

The shore of Whale Tail Lake south basin will be affected by increased water levels upstream of the Whale Tail dike, while the shores of the Whale Tail Lake north basin will be affected by lake dewatering downstream of the dikes, mining of open pit, and re-flooding after breaching of dewatering dikes during closure of the facilities.

The design lake level of El. 156 m upstream of the Whale Tail Dike is about 3.5 m higher than the current average lake water level. This will result in flooding of part of the lake shore and shallow thawing of the upper portion of the permafrost during operations. Given the short mine operation period, the impact is anticipated to be small. Deeper portions of the permafrost in newly flooded areas upstream of the dikes are not expected to be effected significantly. After the dewatering dikes are breached, the original lake level will be restored and permafrost conditions will recover gradually as the lake water level lowers.

There are thermistors currently installed on the lake shore of Whale Tail North Basin. These thermistors will monitor thermal conditions on the shore prior to, during and after operations into post-closure.

There are no thermistors installed on the lake shore of Whale Tail South Basin upstream of the dike. Given the short period of time (three to four years) during which the lake shore in the South Basin will be flooded, the effects on the permafrost will be temporary and limited to the shallow upper portion of the ground. It is not considered necessary to install additional thermistors in that area.

Thermistors on the shore of Whale Tail North Basin will be connected to data loggers for automatic data collection and storage. Data will be reviewed periodically or as-needed, and results will be summarized in annual monitoring reports during operations and for five years after closure.

4 CLOSURE

The Thermal Monitoring Plan presented in this document is intended to constitute a guide for instrumentation and monitoring of the Project facilities to evaluate the effects of mine developments on the thermal regime of the natural ground and relevant site infrastructures.

The instrumentation program at the different facilities will consist primarily of thermistor strings installed horizontally, vertically and at angles as needed. Data obtained from the thermistor strings will constitute the primary source of information for evaluation of changes in the thermal regime of the permafrost basin associated with construction, operations, and closure of the mine facilities.

The actual schedule of instrumentation and quantity, type of instrument, location, depth and length of the thermistor strings to be installed will be defined specifically for each facility based on the mining plan, construction schedule and accessibility to be defined during mine operation. The activities listed in this Plan will be periodically reviewed to reflect the dynamics of site development and operation. Decisions on thermistor installation will be based on the results of the monitoring program, as deemed required for a given area to assess effects on the thermal regime of the ground or facility.

Installation of different types of instrumentation such as vibrating-wire piezometers, monitoring wells and oxygen probes may be considered in the future in areas such as the WRSF if there is a need to better understand the process of water percolation, air-flow convection and heat generation within the pile.

5 REFERENCES

Agnico Eagle (Agnico Eagle Mines Limited). 2016. Final Environmental Impact Statement, Volume 8, Appendix 8-B.2 – Water Management Plan.

Agnico Eagle. 2017. Meadowbank Division, Whale Tail Volume 8, Appendix 8-A.1 Whale Tail Pit – Waste Rock Management Plan. Version 1. January 2017.

Burn, C.R. 2002. Tundra Lakes and Permafrost, Richards Island, Western Arctic coast, Canada. Canadian Journal of Earth Sciences, 39: 1281-1298.

Golder (Golder Associates Ltd.) 2003. Report on Permafrost Thermal Regime Baseline Studies, Meadowbank Project, Nunavut. Golder Project No. 03-1413-078. Prepared for Cumberland Resources Ltd. Submitted 18 December 2003.

Golder 2016a. Westby System Installation Summary – Whale Tail Pit Project, Nunavut. Golder Reference No. 1649355-033-TM-Rev0-4000. Prepared for Agnico Eagle Mines Limited. Submitted 7 July 2016.

Golder. 2017a. Whale Tail Lake Thermal Assessment. Golder Reference No. 1665859-085-TM-Rev0-5100. Prepared for Agnico Eagle Mines Limited. Submitted 22 February 2017.

Golder. 2017b. Commitment 39: Whale Tail Pit Project Waste Rock Storage Facility Cover Thermal Assessment. Golder Reference No. 1774579-124-TM-Rev0-2500. Prepared for Agnico Eagle Mines Limited. Submitted 10 July 2017.

Golder. 2018a. Whale Tail Phase 1, Post-Closure Pit Lake Thermal Assessment. Golder Reference No. 1789810-174-TM-RevA. Draft Technical Memorandum Prepared for Agnico Eagle Mines Limited. Submitted 17 April 2018.

Golder. 2018b. Whale Tail Pit Project Waste Rock Storage Facility Cover Thermal Assessment. Draft for discussion technical memorandum. Golder Reference No. 1789310-177-TM-RevA. Prepared for Agnico Eagle Mines Limited. Submitted 9 April 2018.

Knight Piésold. 2015. Agnico Eagle Mines Ltd.: Meadowbank Division – Whale Tail Pit – Permafrost and Hydrogeological Characterization. Submitted 24 November 2015.

SNC-Lavalin. 2018. Amaruq Whale Tail Dike Detailed Engineering, Report of Thermal Analysis at Whale Tail Dike. Submitted 19 February 2018.

APPENDIX A

Subject: Summary of Thermal monitoring at Whale Tail Site from 2015-2018

This document present a summary of the thermal monitoring at the Amaruq project from 2015 to 2018. During that period, thermistor strings were installed around the Amaruq site to support various studies for the construction of the different infrastructures of the project.

A total of 14 boreholes for thermistors were installed between May 2015 and December 2018. 10 of the installation are still functional and continue to be monitored on a bi-weekly basis, either manually or with Dataloggers.

Table 1 present the thermistors installation, their coordinate and their status.

Figure 1 show a plan view of the location of the thermistors installed between May 2015 and December 2018.

Figure 2 to 15 present the thermistors data with a description of the instrument and the thermal results highlights for the active instruments.

Table 1: Permanent and temporary thermistors installation coordinates and status

Name	*Area*	*Easting (X)*	*Northing (Y)*	*Elevation (Z)*	*Azimuth*	*Dip*	*Installed*	*Active (Y) or (N)*
AMQ17-1159	WTD	**607580.20**	**7254827.60**	**152.56**	--	-90	2017	Y
AMQ17-1188	WTD	**607209.90**	**7254681.30**	**151.76**	--	-90	2017	N
Stkd299	WTD	**607689.94**	**7254751.01**	**153.74**	--	-90	2017	Y
MD-02-2015	MD	**605906.10**	**7255094.50**	**152.27**	--	-90	2015	Y
AMQ15-294	WTP	**607073.20**	**7255676.10**	**155.93**	322.67	-45.18	2015	Y
AMQ15-349 A	WTP	**607064.90**	**7255627.50**	**155.30**	204.41	-45.32	2015	N
AMQ15-421	WTP	**607098.30**	**7255490.80**	**155.09**	273.93	-51.31	2015	N
AMQ15-306	WTP	**606714.80**	**7255363.80**	**154.92**	96.30	-45.41	2015	N
AMQ15-324	WTP	**606496.80**	**7254995.20**	**161.79**	323.41	-55.46	2015	Y
AMQ15-452	WTP	**606627.20**	**7255687.90**	**156.16**	159.5	-49.98	2015	Y
AMQ17-1265 A (2)	WTP	**606950.00**	**7255414.00**	**140.00**	196.03	-79.99	2017	Y
AMQ17-1277 A	WTP	**606911.00**	**7255964.00**	**153.00**	193.06	-60.17	2017	Y
AMQ17-1337	IVR	**607078.00**	**7256522.00**	**155.00**	260.37	-59.62	2017	Y
AMQ17-1233	IVR	**606778.00**	**7256254.00**	**162.00**	252.71	-59.06	2017	Y

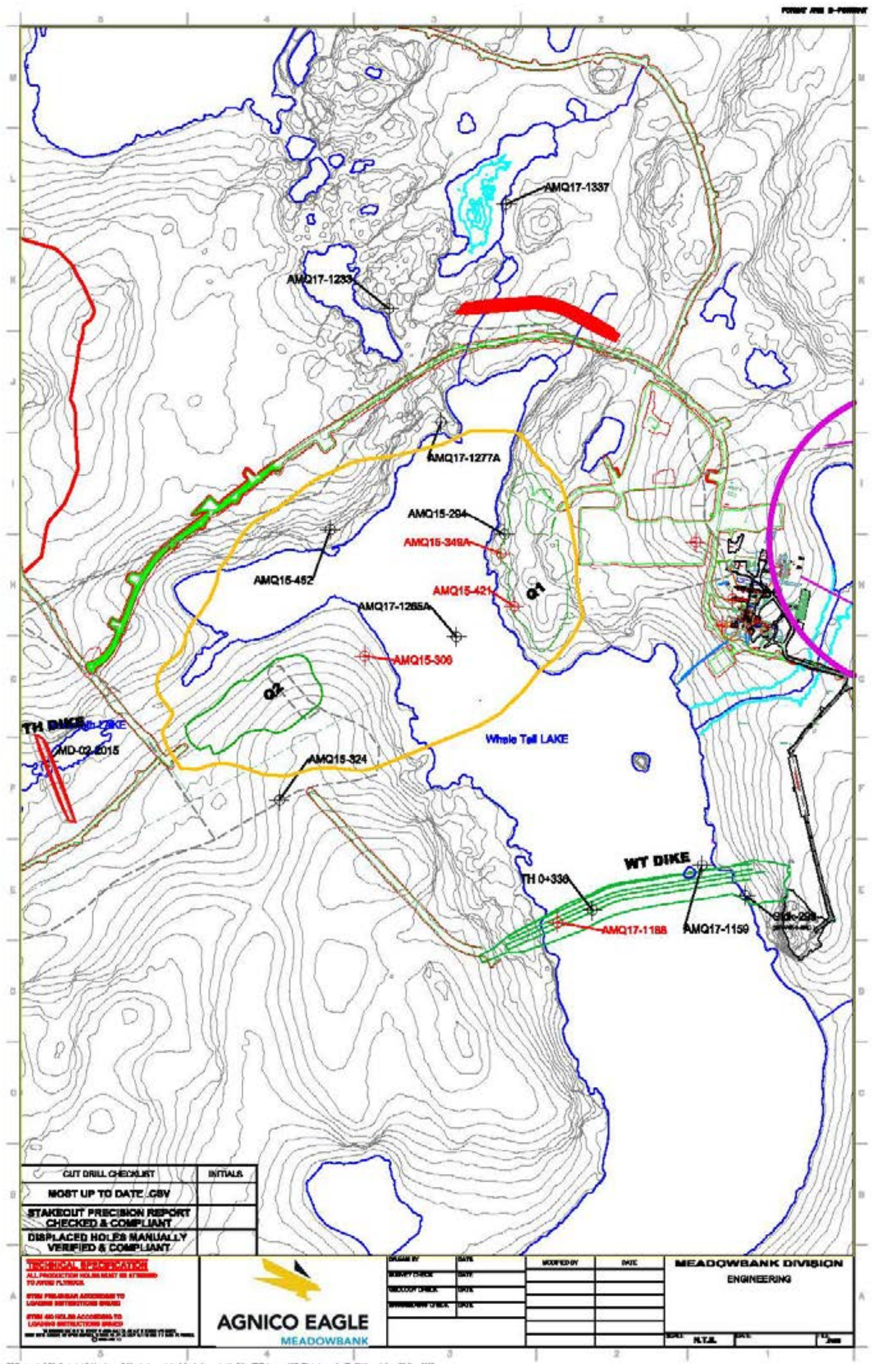

Figure 1: Amaruq Thermistor Location Plan View (active instrument in black)

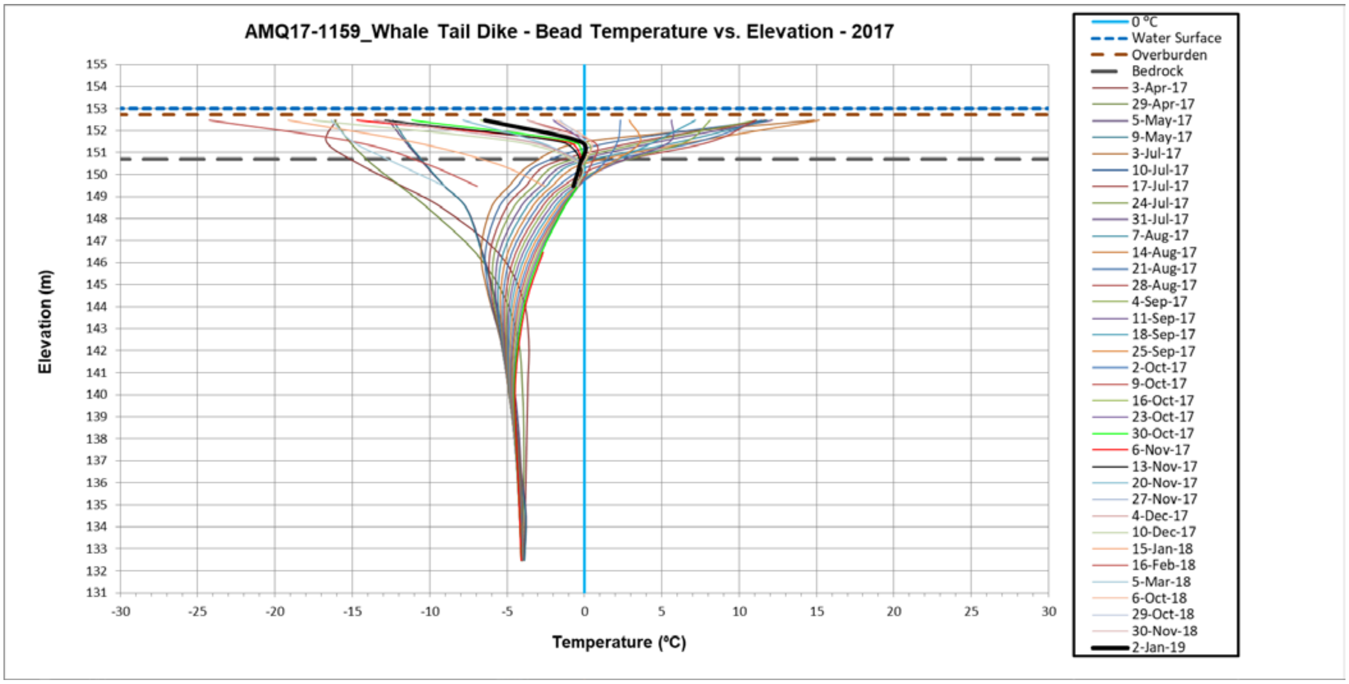

Figure 2: Temperature profile (Celsius) as a function of elevation (masl) from installation to January 2019 for thermistor AMQ17-1159

Location of the instrument:

- In proximity of the east abutment of Whale Tail dike; in shallow water (0.3m).
- Depth : 20.2m

Monitoring objective:

- Thermal condition of the surficial overburden under Whale Tail dike foundation

Thermal results highlights:

- Active layer: 3.2m (from elev. 152.7 to 149.5)
- Depth of zero annual amplitude: 13.7m (from elevation 152.7 to 139)
- Steady permafrost temperature of around -4ºC down to bottom of hole (elev 132.5)
- Geothermal gradient: Thermistor not deep enough to evaluate gradient
- Permafrost thickness: > 17m; Thermistor not deep enough to reach bottom of permafrost layer.

Annual variation in ground temperature: Similar from 2017 to 2018.\

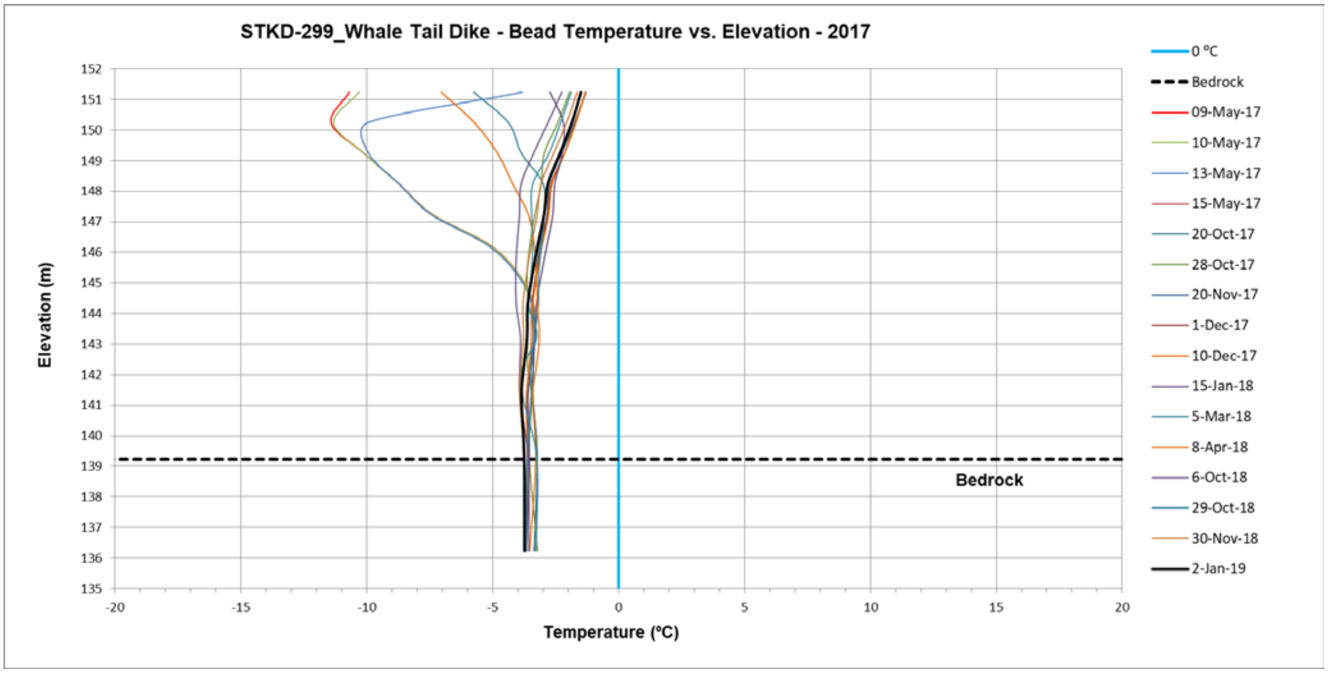

Figure 3: Temperature profile (Celsius) as a function of elevation (masl) from installation to January 2019 for thermistor STKD-299

Location of the instrument:

- In proximity of the east abutment of Whale Tail dike; on the shore.
- Depth : 16.0m

Monitoring objective:

- Thermal condition of the surficial overburden under Whale Tail dike foundation

Thermal results highlights:

- Active layer: Unknown ; Lack of surficial thermistor beads
- Depth of zero annual amplitude: 8.4m (from elevation 152.4 to 144)
- Steady permafrost temperature of around -3.7ºC down to bottom of hole (elev 136.2)
- Geothermal gradient: Thermistor not deep enough to evaluate gradient
- Permafrost thickness: > 15m; Thermistor not deep enough to reach bottom of permafrost layer.
- Annual variation in ground temperature: Similar from 2017 to 2018.

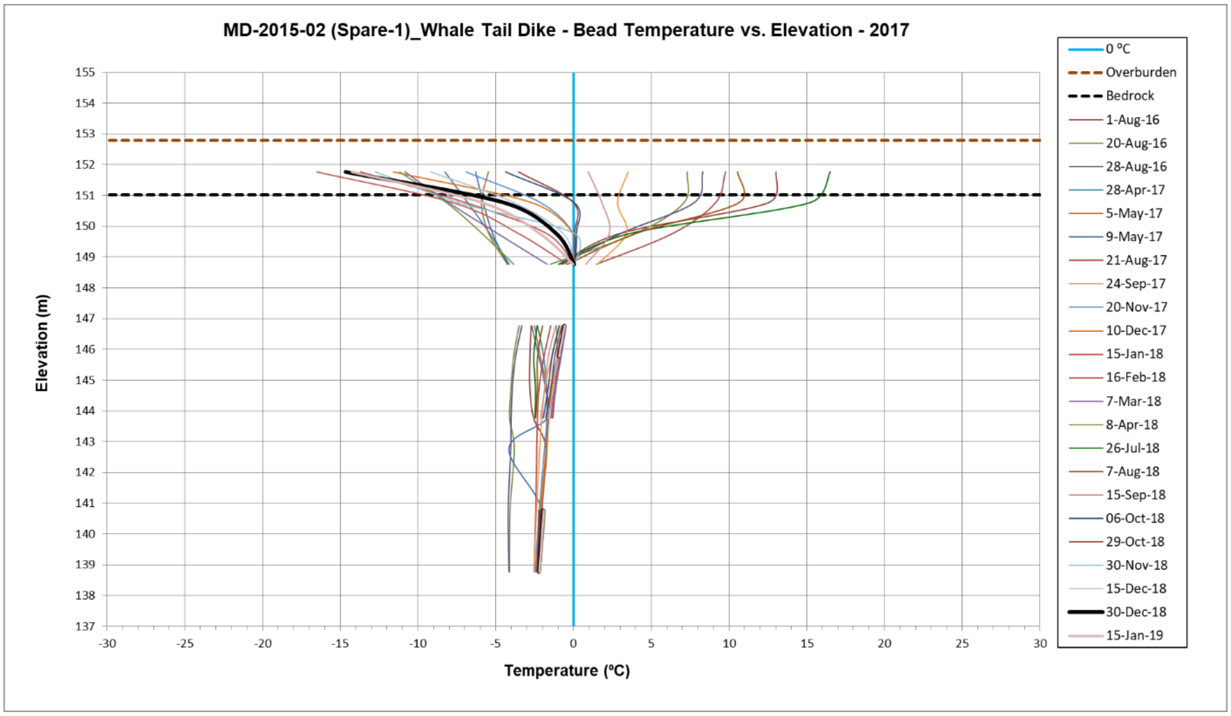

Figure 4: Temperature profile (Celsius) as a function of elevation (masl) from installation to January 2019 for thermistor MD-2015-02

<u>Location of the instrument:</u>

- In proximity of the deepest portion of Mammoth dike; in shallow water (<0.3m).
- Depth : 14.1m

<u>Monitoring objective:</u>

- Thermal condition of the surficial overburden under Mammoth dike foundation

<u>Thermal results highlights:</u>

- Active layer: 4.3m (from elev. 152.8 to 148.5)
- Depth of zero annual amplitude: 11.8m (from elevation 152.8 to 141)
- Steady permafrost temperature of around -2.1ºC down to bottom of hole (elev 138.7)
- Geothermal gradient: Thermistor not deep enough to evaluate gradient
- Permafrost thickness: > 9.8m; Thermistor not deep enough to reach bottom of permafrost layer.
- Annual variation in ground temperature: Similar from 2017 to 2018. 2016 data looks offset by -1 ºC

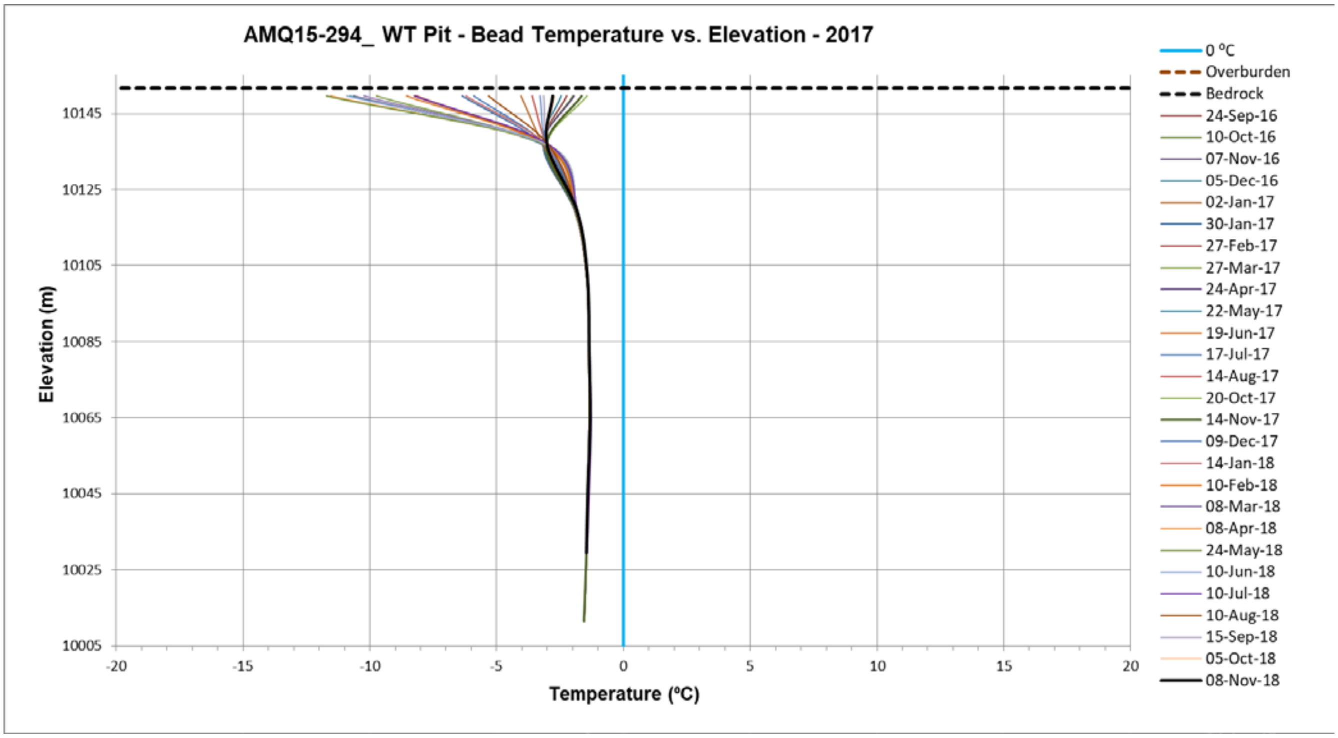

Figure 5: Temperature profile (Celsius) as a function of elevation (masl) from installation to November 2018 for thermistor AMQ15-294

<u>Location of the instrument:</u>

- Within the Whale Tail pit footprint (east wall). On the shore (not the lake).
- Depth : 144.4m

<u>Monitoring objective:</u>

- Thermal condition of the open pit walls (east). Calibration of the global thermal model.

<u>Thermal results highlights:</u>

- Active layer: Unknown ; Lack of surficial thermistor beads (not the objective of the instrument)
- Depth of zero annual amplitude: Unknown ; Lack of surficial thermistor beads (not the objective of the instrument)
- Steady permafrost temperature of around -1.4ºC down to bottom of hole (elev 011.5)
- Geothermal gradient: Thermistor not deep enough to evaluate gradient
- Permafrost thickness: > 140m; Thermistor not deep enough to reach bottom of permafrost layer.
- Annual variation in ground temperature: Similar from 2016 to 2018. Instrument broken as of nov 2018.

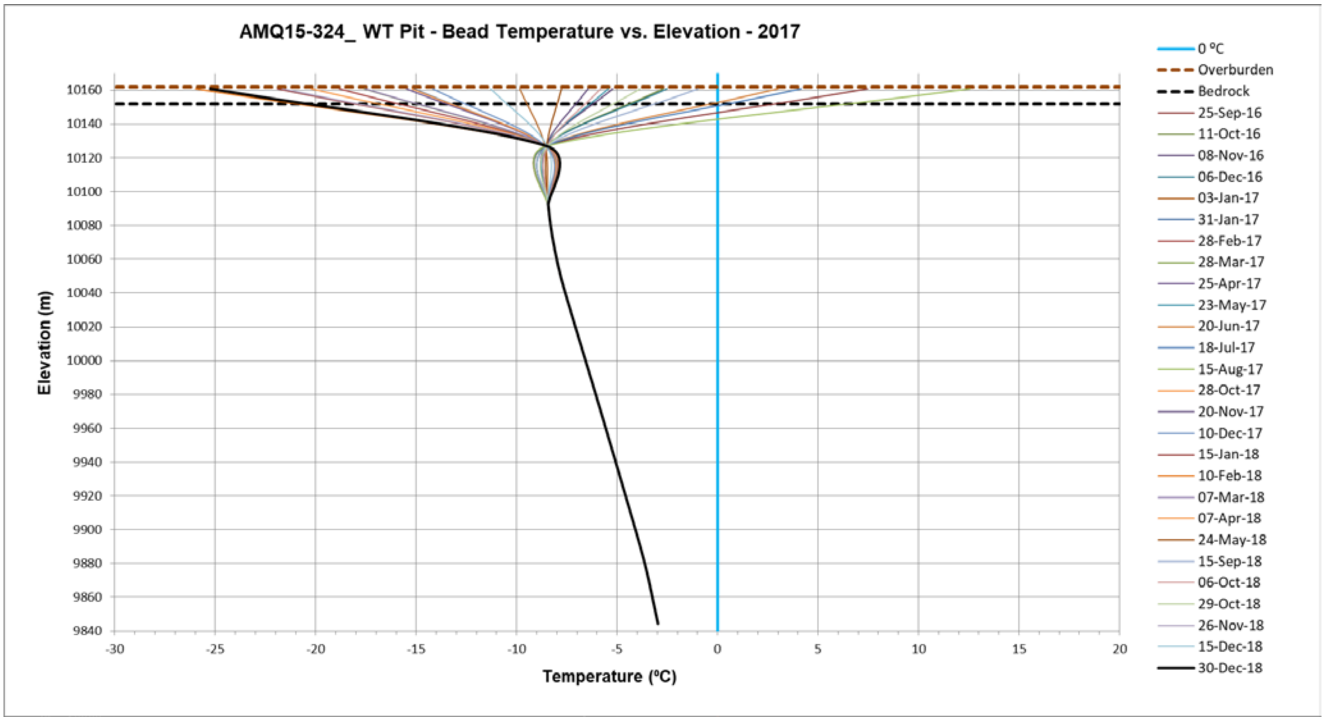

Figure 6: Temperature profile (Celsius) as a function of elevation (masl) from installation to December 2018 for thermistor AMQ15-324

<u>Location of the instrument:</u>

- West of Whale Tail Lake and Whale Tail pit.
- Depth : 317 m

<u>Monitoring objective:</u>

- Thermal condition of deep permafrost (far from talik influence). Calibration of the global thermal model.

<u>Thermal results highlights:</u>

- Active layer: Unknown ; Lack of surficial thermistor beads (not the objective of the instrument)
- Depth of zero annual amplitude: Unknown ; Lack of surficial thermistor beads (not the objective of the instrument)
- Variable permafrost temperature; from -8.0 ºC (ele 056) to -3 ºC (elev -155)
- Geothermal gradient: approximately +0.024ºC/m
- Permafrost thickness: > 315m; Thermistor not deep enough to reach bottom of permafrost layer.
- Annual variation in ground temperature: Similar from 2016 to 2018.

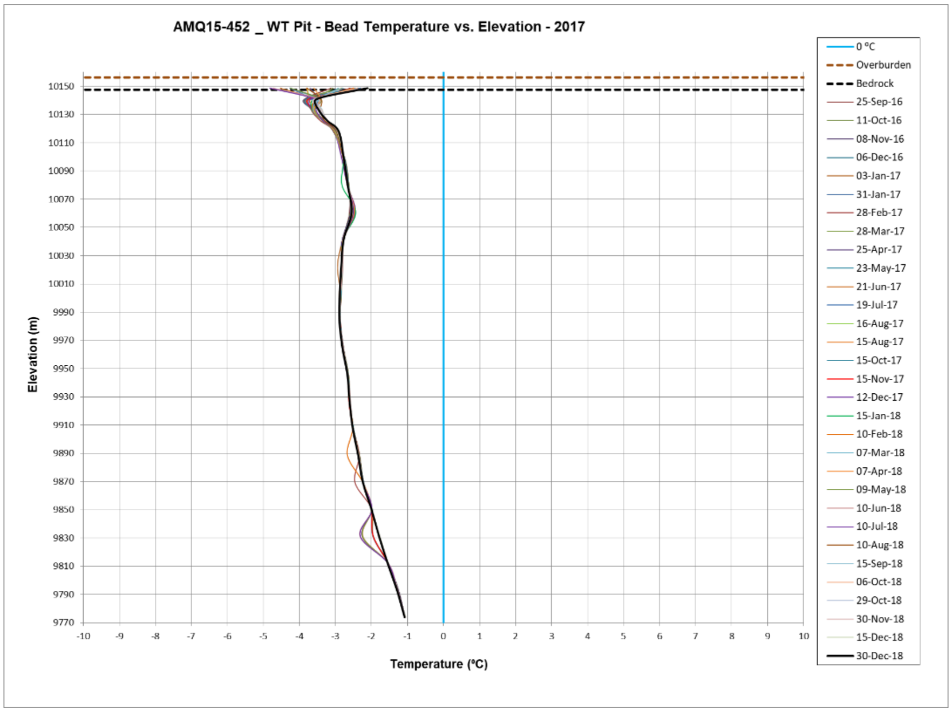

Figure 7: Temperature profile (Celsius) as a function of elevation (masl) from installation to December 2018 for thermistor AMQ15-452

Location of the instrument:

- North of Whale Tail Lake (on the shore); Within Whale Tail pit north walls.
- Depth : 382 m

Monitoring objective:

- Thermal condition of permafrost (near from talik influence). Calibration of the global thermal model.

Thermal results highlights:

- Active layer: Unknown ; Lack of surficial thermistor beads (not the objective of the instrument)
- Depth of zero annual amplitude: Unknown ; Lack of surficial thermistor beads (not the objective of the instrument)
- Variable permafrost temperature; from -2.9 ºC (ele -016) to -1.0 ºC (elev -226)
- Geothermal gradient: approximately +0.009ºC/m
- Permafrost thickness: > 380m; Thermistor not deep enough to reach bottom of permafrost layer.
- Annual variation in ground temperature: Similar from 2016 to 2018.

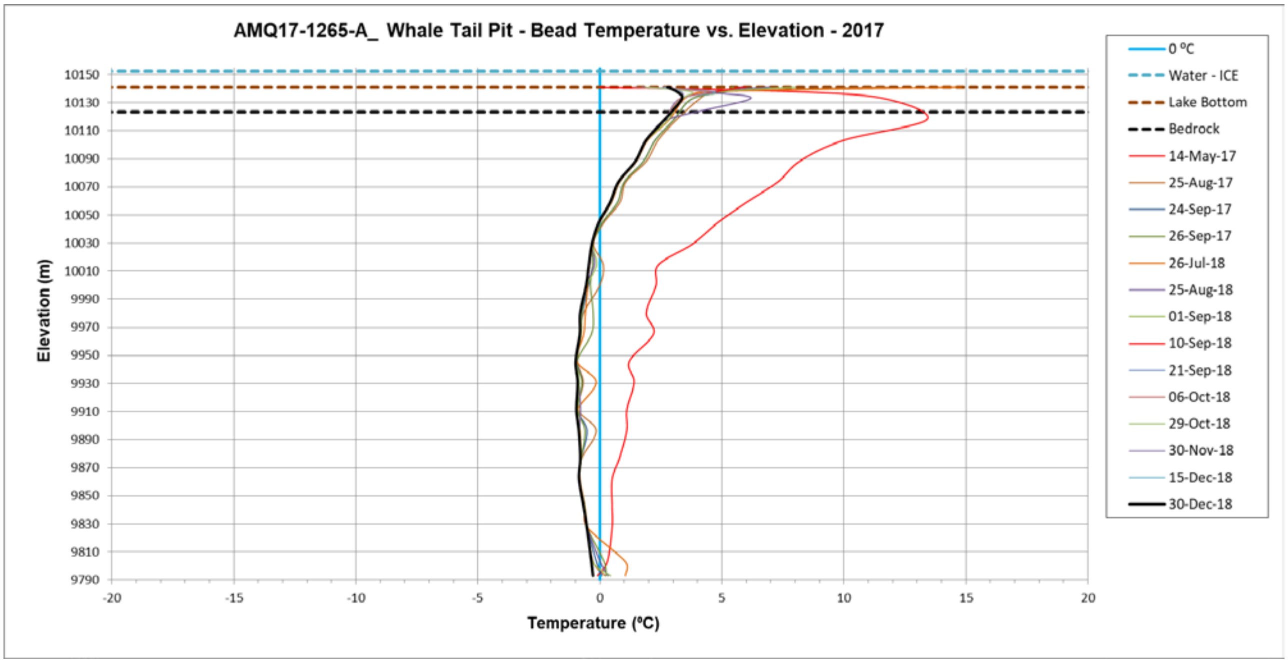

Figure 8: Temperature profile (Celsius) as a function of elevation (masl) from installation to December 2018 for thermistor AMQ17-1265A

<u>Location of the instrument:</u>

- In the middle of Whale Tail Lake (deep portion @ 11m of water);
- Depth : 348 m

<u>Monitoring objective:</u>

- Thermal condition of talik underneath the lake. Calibration of the global thermal model.

<u>Thermal results highlights:</u>

- Active layer: Not applicable – Talik area
- Depth of zero annual amplitude: Not applicable – Talik area
- Depth of talik: 97m (elev 141 to 044)
- Variable permafrost temperature; from -1.0 ºC (ele -055) to -0.3 ºC (elev -207)
- Geothermal gradient: approximately +0.00046ºC/m
- Permafrost thickness: approximately 250m (elev. 044 to -207)
- Annual variation in ground temperature: Similar from 2016 to 2018.

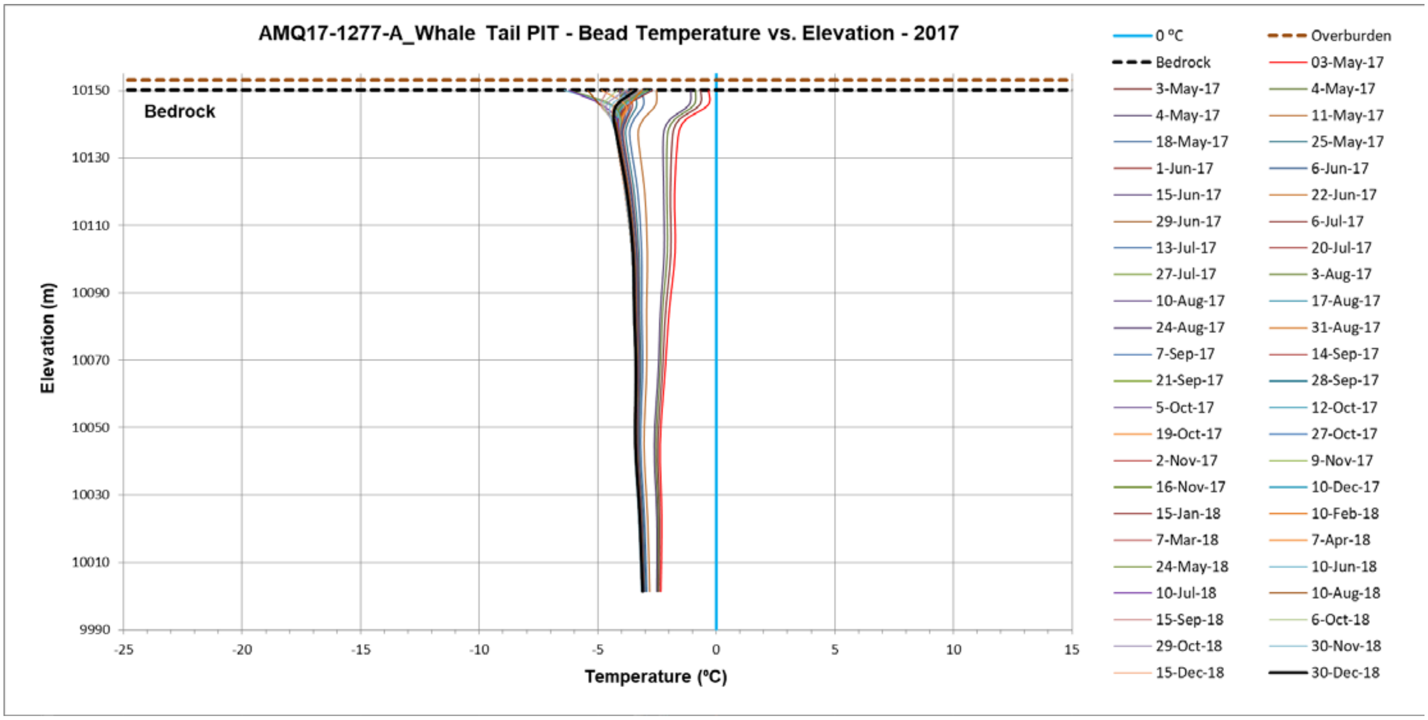

Figure 9: Temperature profile (Celsius) as a function of elevation (masl) from installation to December 2018 for thermistor AMQ17-1277A

<u>Location of the instrument:</u>

- North East of Whale Tail Lake (on the shore); Within the Whale Tail pit footprint
- Depth : 152 m

<u>Monitoring objective:</u>

- Thermal condition of talik underneath the lake. Calibration of the global thermal model.

<u>Thermal results highlights:</u>

- Active layer: Unknown ; Lack of surficial thermistor beads (not the objective of the instrument)
- Depth of zero annual amplitude: Approximately 12m (elev 153 to 141)
- Variable permafrost temperature; from -4.3 ºC (elev 141) to -3.1 ºC (elev 001)
- Geothermal gradient: approximately +0.0086ºC/m
- Permafrost thickness: > 150m; Thermistor not deep enough to reach bottom of permafrost layer.
- Annual variation in ground temperature: Similar from 2017 to 2018. Early 2017 data were under stabilization (post-installation)

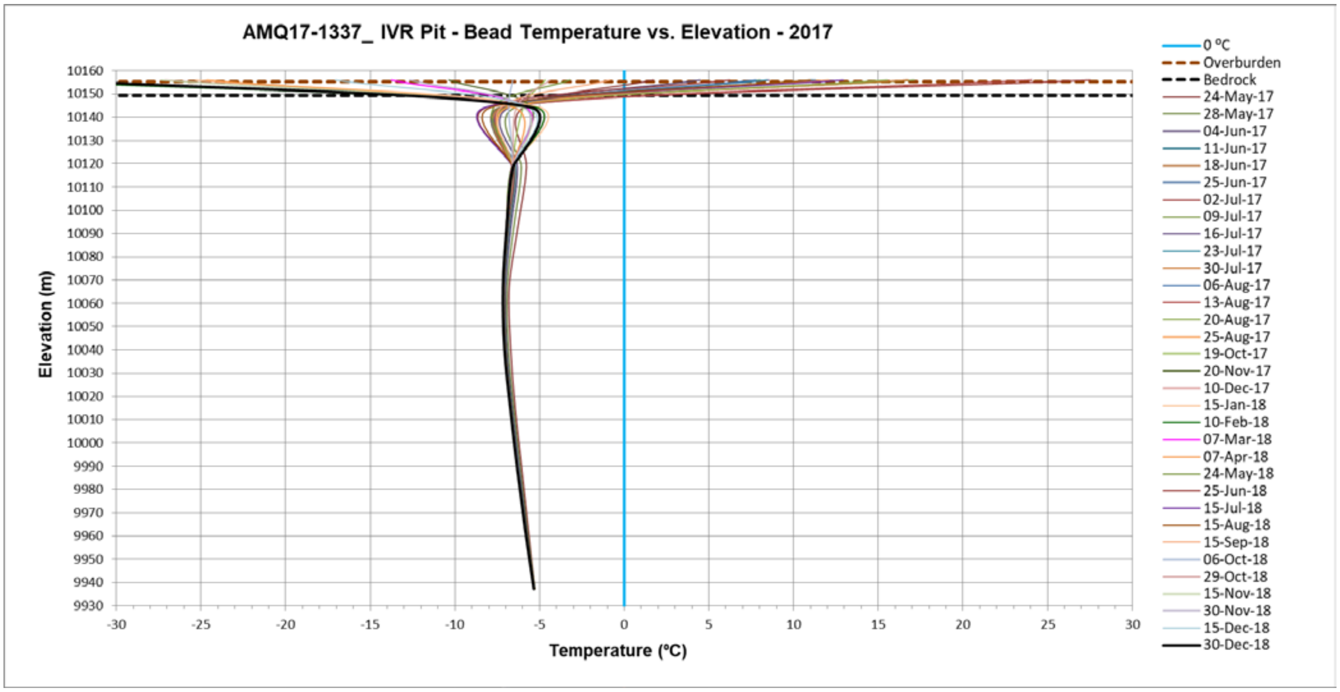

Figure 10: Temperature profile (Celsius) as a function of elevation (masl) from installation to December 2018 for thermistor AMQ17-1337

Location of the instrument:

- Within the IVR pit footprint
- Depth : 218 m

Monitoring objective:

- Thermal condition within the IVR pit area. Calibration of the global thermal model.

Thermal results highlights:

- Active layer: Unknown ; Lack of surficial thermistor beads (not the objective of the instrument)
- Depth of zero annual amplitude: Unknown ; Lack of surficial thermistor beads (not the objective of the instrument)
- Variable permafrost temperature; from -7.1 ºC (elev 040) to -5.3 ºC (elev -063)
- Geothermal gradient: approximately +0.017ºC/m
- Permafrost thickness: > 215m; Thermistor not deep enough to reach bottom of permafrost layer.
- Annual variation in ground temperature: Similar from 2017 to 2018.

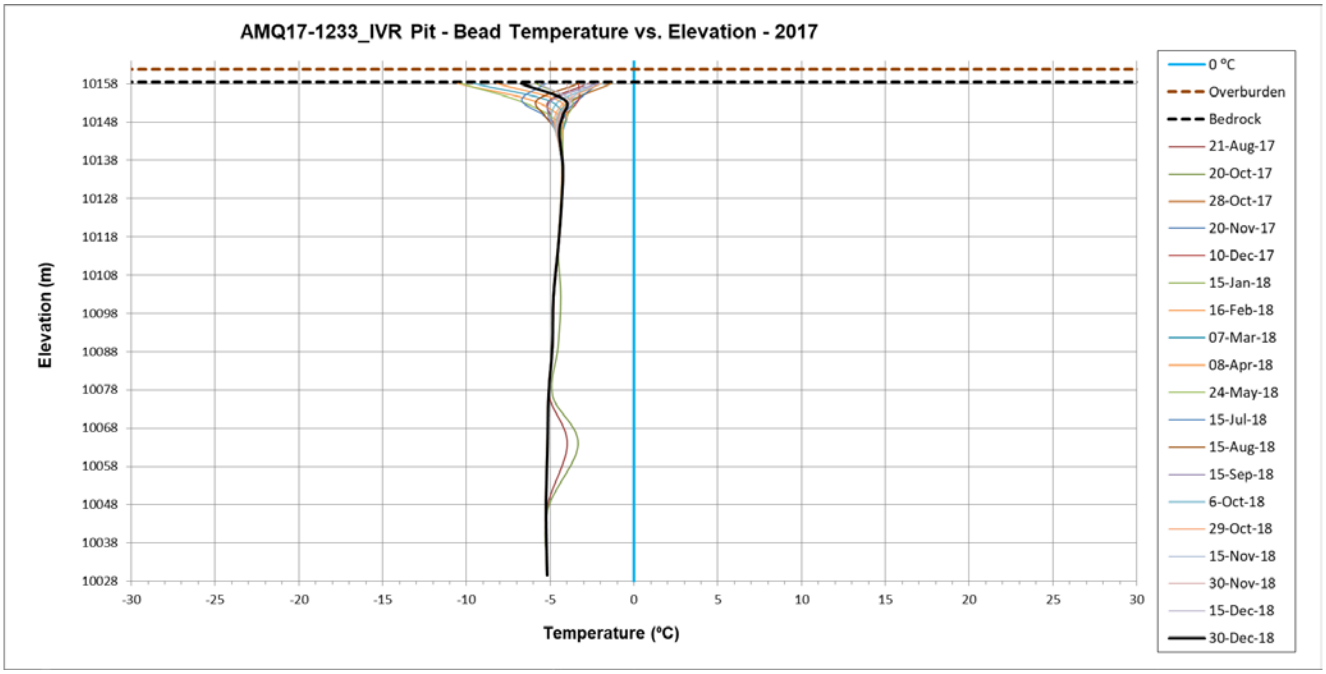

Figure 11: Temperature profile (Celsius) as a function of elevation (masl) from installation to December 2018 for thermistor AMQ17-1233

Location of the instrument:

- Within the IVR pit footprint
- Depth : 132 m

Monitoring objective:

- Thermal condition within the IVR pit area. Calibration of the global thermal model.

Thermal results highlights:

- Active layer: Unknown ; Lack of surficial thermistor beads (not the objective of the instrument)
- Depth of zero annual amplitude: Approximately 25m (from elev 161 to 136)
- Stable permafrost temperature around -5.3 ºC
- Geothermal gradient: Thermistor not deep enough to evaluate gradient
- Permafrost thickness: > 132m; Thermistor not deep enough to reach bottom of permafrost layer.
- Annual variation in ground temperature: Similar from 2017 to 2018.

Non Active thermistors:

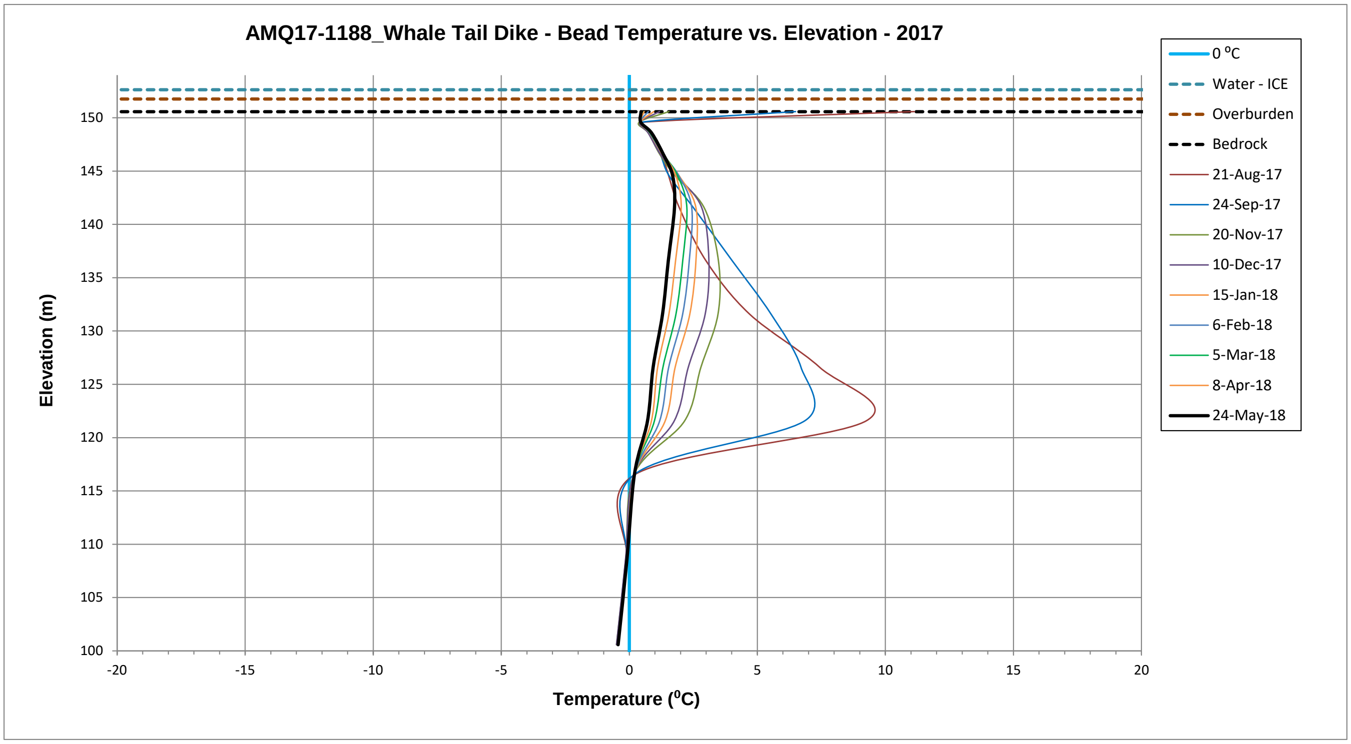

Figure 12: Temperature profile (Celsius) as a function of elevation (masl) from installation to May 2018 for thermistor AMQ17-1188

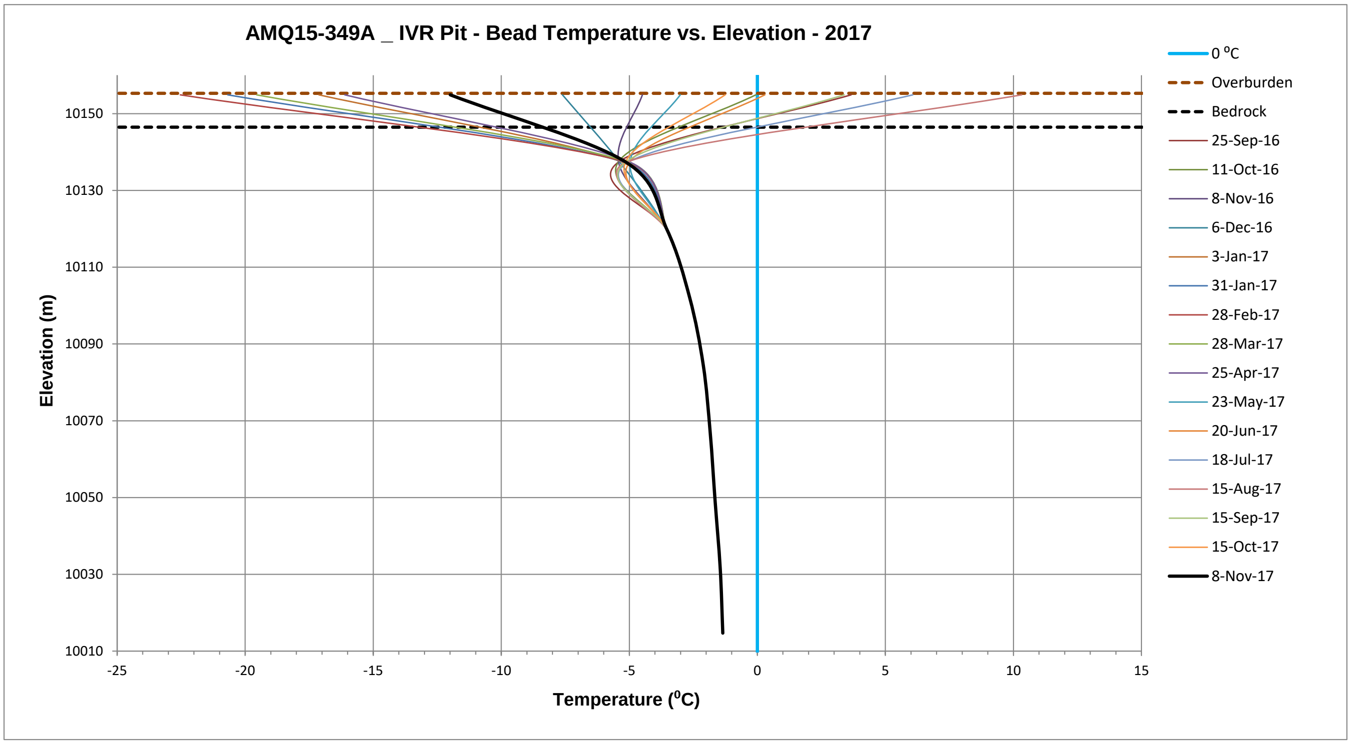

Figure 13: Temperature profile (Celsius) as a function of elevation (masl) from installation to November 2017 for thermistor AMQ15-349A

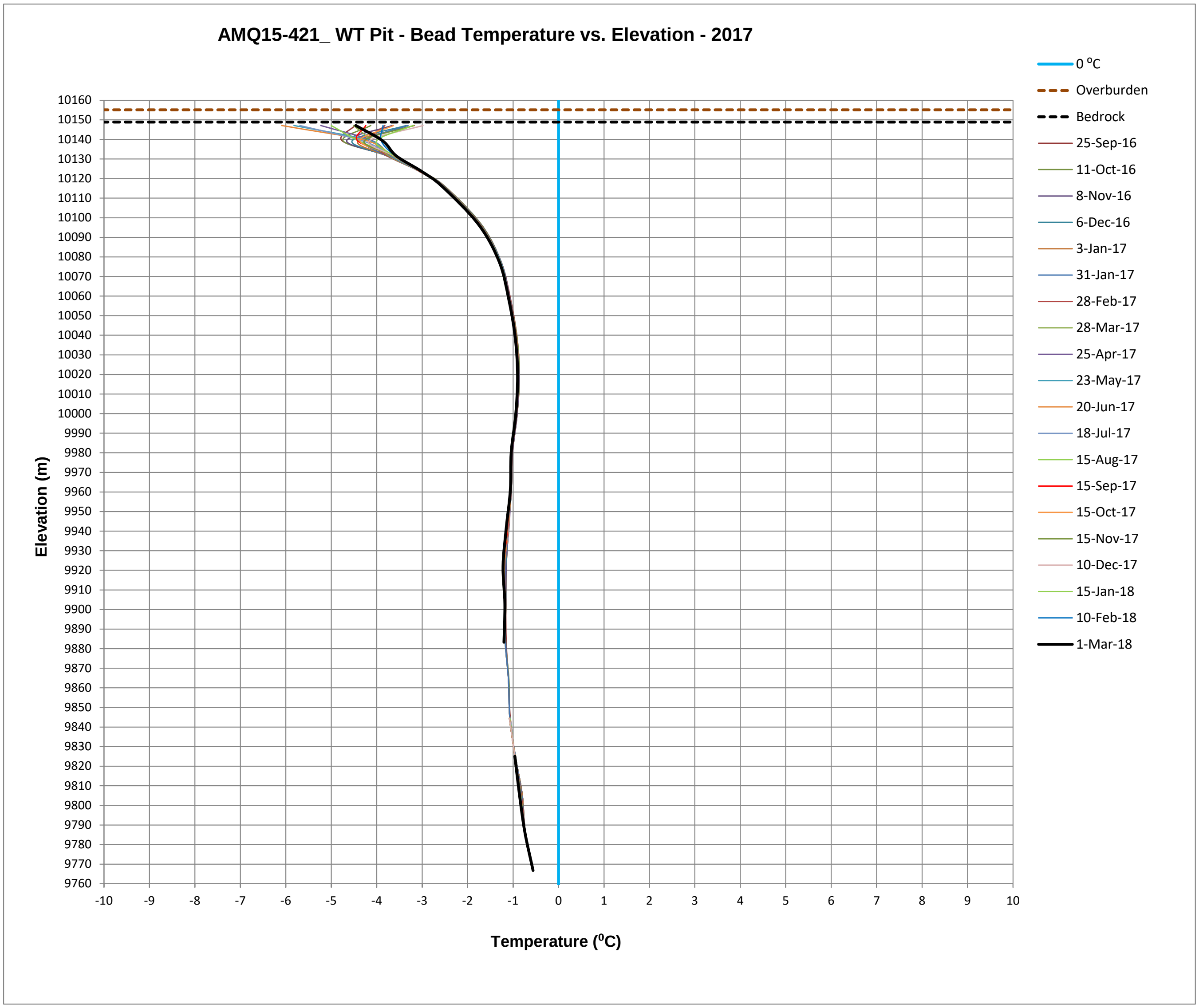

Figure 14: Temperature profile (Celsius) as a function of elevation (masl) from installation to Mars 2018 for thermistor AMQ15-421

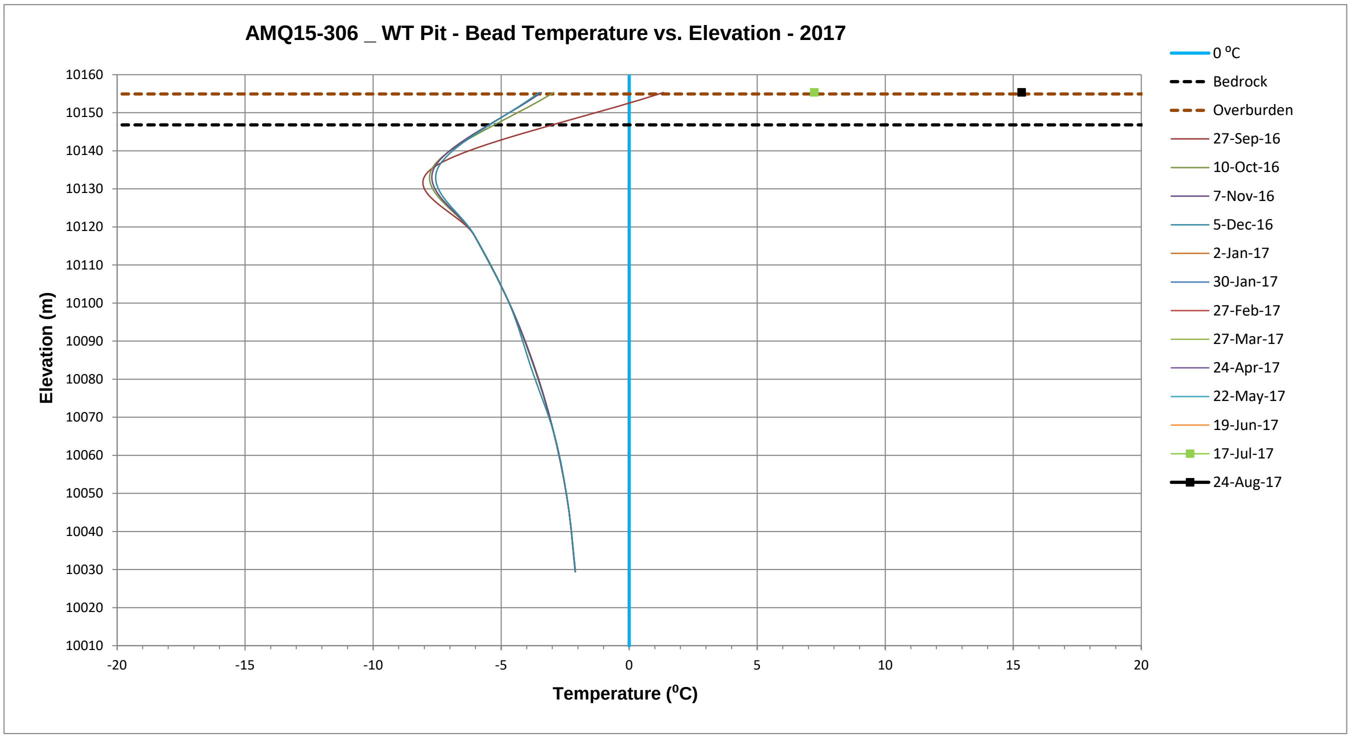

Figure 15: Temperature profile (Celsius) as a function of elevation (masl) from installation to August 2017 for thermistor AMQ15-306

Water Management Infrastructures - Operation, Maintenance and Surveillance Manual, Version 1

WHALE TAIL PROJECT

WATER MANAGEMENT INFRASTRUCTURES

Operation, Maintenance and Surveillance Manual

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

Version 1
March 2019

AMARUQ DIKES

OPERATION, MAINTENANCE AND

SURVEILLANCE MANUAL

WHALE TAIL PROJECT

AGNICO EAGLE MINES LIMITED

This Operation, Maintenance and Surveillance Manual has been prepared by Agnico Eagle Mines Limited with support from SNC-Lavallin and is to be used for the operation, maintenance and surveillance of Whale Tail water management infrastructures. All Users of this manual are responsible for ensuring that they are using the most recent revision of this document which can be found in Intelex or in paper version in the Engineering Superintendent office at Meadowbank. This Operation, Maintenance and Surveillance Manual, may not be copied in whole or in part without the written consent of Agnico Eagle Mines Limited.

IMPLEMENTATION SCHEDULE

This Plan is immediately implemented.

DISTRIBUTION LIST

AEM- General Mine Manager

AEM- Environment Superintendent

AEM- Mine Operations Superintendent

AEM- Engineering Superintendent

AEM- Energy & Infrastructure Superintendent

AEM – Maintenance Superintendent

AEM- Nunavut Division Engineer of Record

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Approved by:

Luc Chouinard
Mine Manager

Pierre McMullen
Engineering Superintendent

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SECTION 1 • INTRODUCTION

1.1 OBJECTIVE OF THE OMS MANUAL

The objective of this manual is to define the technical aspect related to the operation, maintenance and surveillance (OMS) of the water management infrastructure at the Whale Tail Pit Project operated by Agnico Eagle Mines Limited (AEM), Meadowbank Division.

This manual is intended as a practical document used by the personnel involved in with the Whale Tail Project water management infrastructure. It incorporates operating, maintenance and surveillance procedures recommended by the Canadian Dam Association (CDA) "Dam Safety Guidelines" (CDA 2013 & 2014) and the Mining Association of Canada (MAC) "Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities" (MAC, 2018). This manual was written by the Meadowbank Engineering team with the support of SNC-Lavalin and the Nunavut Engineer of Record.

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 water management infrastructure
- The water management infrastructure covered in the scope of this OMS manual
- Plans, procedures and processes for :
    - The operation, maintenance and surveillance of the Whale Tail Project water management infrastructures to ensure that it functions in accordance with their design, meets performance objectives and link to emergency response planning
    - Evaluating performance of the structures, and report performance results
    - Managing change

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

Element related to design, construction and closure of water management infrastructures, infrastructures related to management of underground water and 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.

The person responsible for the preparation, update and distribution of this manual is the Engineering Superintendent. Any change to this OMS manual must be submitted to and approved by the Engineering Superintendent who will be responsible to update the OMS manual in Intelex.

It is each user responsibility to ensure that they are using the latest version of this document. In case of issue with retrieving the electronic version of this document, the most up to date paper version of this document will always be kept in the Engineering Superintendent Office.

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

Table 1-1: OMS Manual Distribution List

Position	Name
General Mine Manager	Luc Chouinard
General Superintendant	Eric Côté / Jacques Proulx
Environment Superintendent	Nancy Duquet-Harvey
Mine Operations Superintendent	Yan Côté, Nicolas P. Deschamps (asst.)
Engineering Superintendent	Pierre McMullen, Miles Legault (asst.)
Maintenance Superintendant	Christian Quirion
Energy & Infrastructures Superintendent	Guillaume Gemme
Engineer of Record, Meadowbank Division	Thomas Lepine

1.3 MANAGEMENT OF CHANGE

This manual will be reviewed on an annual basis at the beginning of Q3 and revised as necessary to accommodate changes in the condition and operation of the facilities. The Engineering Superintendent will be responsible to coordinate this review process.

In conducting the review and update of the OMS manual the following must be taken into account:

- Performance of the structure
- Current life cycle of the structure
- 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 need to be completed in a timely manner following the document control criteria specified in Section 1.2.

As a good practice the Engineering Superintendent should organise on a yearly basis a session to present the change in the OMS manual to the person in its distribution list.

1.4 REQUIRED LEVELS OF KNOWLEDGE

To preserve the integrity of the operation of these structures, the personnel must have a good comprehension of the factor that can impact the performance of the water management infrastructures. It must also be know that any deviation can signify the emergence of a problem and the role that each person must have in the operation, maintenance and surveillance of these infrastructures.

It is the responsibility of each person in the distribution list of this manual to be familiar with it and understand its whole content. They also need to ensure that everyone under their supervision who's duty involve task related to the operation, maintenance or surveillance of any component of the water management infrastructures have the appropriate level of knowledge and the resources to comply with the protocol presented in this document.

1.5 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 address conditions related to operation under normal or upset conditions, as opposed to emergency situation. An Emergency Response Plan (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 observation that would results in an emergency being declared
- Roles and responsibilities of key personnel in transition from normal or upset conditions to an emergency
- Actions to be taken to transition from normal or upset conditions to an emergency situation

Once an emergency has been declared reference must be made to the Emergency Response Plan (Reference included in Table 1-2). The most recent version of the ERP can be found on Intelex and in the Engineering Superintendent Office

Table 1-2 Emergency Response Reference Documents

Document	Current Revision
Emergency Response Plan	Updated by AEM. Version 12, January 2018. (Intelex)

SECTION 2 • ROLES AND RESPONSIBILITIES

A functional chart for the water management infrastructure at the Whale Tail project is shown in Figure 2-1.

The roles and responsibilities of the key personnel involved in the water management infrastructure of the Whale Tail Project are shown in Table 2-1. Contact information for each position is indicated in Table 2-2.

Personnel who have task directly related to the water management infrastructure need to receive training when they start in the position to ensure they understand their roles and responsibility related to this OMS manual.

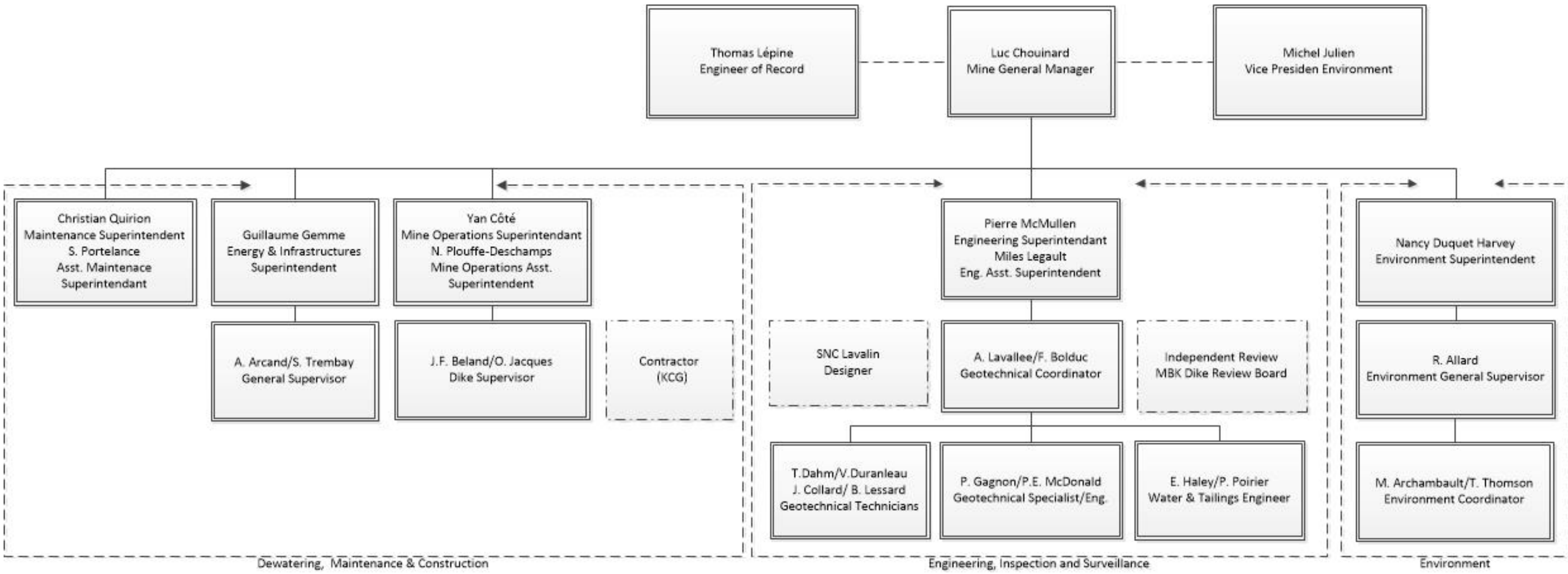

Figure 2-1: Organizational structure

Table 2-1: Responsibilities related to Whale Tail Water Management

Role	Responsibilities
Vice-President Environment	• Be aware of key outcome of water management risk assessment and 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 and defines the personnel duties, responsibility and reporting relationships, supported by job description and organisational charts to implements the water management system though all stages in the facility life cycles • Provide assurance to AEM and its Community of Interest that the water management infrastructure are managed responsibly
General Mine Manager	• Identifies the scope of work and budget requirement for all aspect of water management • Approve budget for OMS related activity • Establish an organisational structure with Roles and Responsibility that meets the operational needs • Delegate specific tasks and responsibilities for water management to qualified personnel • Liaise with independent reviewer (MDRB) as required
Engineer of Record (EoR)	• Input into the OMS activities in accordance with the design • Receive and review the OMS manual on a regular basis • Receive and review dewatering performance data at a frequency determined based on the risks • Either confirm operation is compliant or identify deviations from performance objectives and advise the Owner with recommendations • Advise on contemplated change on the structure operation • Maintain records relating to design construction and operation • Participate in inspection and independent review
Independent Reviewer – Meadowbank Dike Review Board (MDRB)	• Provide independent, objective, expert commentary, advice and recommendations, to assist in identifying, understanding, and managing risk associated with water management facilities
Engineering Superintendent	• Revise and update the OMS Manual to reflect as-built conditions and any other changes. • Review and update OMS manual into Intelex • Maintain up to date distribution list of the OMS Manual. • Establish a formal relationship with the EOR to ensure operation is compliant with design intent • Identify when/where contemplated operational changes are a potential deviation from the design intent and engage the EoR and Designer as part of processes to manage change

Role	Responsibilities
	• Coordinate work force as required for monitoring and maintenance.
Mine Operations Superintendent / Dike Supervisor	• Maintain access to the structure and seepage collection systems, including making road repairs, controlling dust and removing snow. • Carry out field maintenance related to earthwork as required, • Supervise Mine Contractor for aspect related to earthwork construction and maintenance
Geotechnical Coordinator	• Supervise the work of the geotechnical engineer, geotechnical technician and water and tailings engineer
Geotechnical Engineer	• Carry out inspections of the structures as required in the OMS Manual. • Carry out instrument monitoring as required in the OMS Manual. • Review and analyse surveillance data to evaluate dike performance with respect to design parameters. • Review and distribute surveillance reporting as required in the OMS Manual • Analyse geotechnical instrumentation monitoring data to evaluate dike performance with respect to design parameters
Geotechnical Technician	• Carry out inspections of the structures as required in the OMS Manual. • Monitor instrumentation as required in the OMS Manual. • Maintain instrumentation, readout units, data acquisition system and cabins • Responsible for data acquisition as required in the OMS manual • Prepare reports on instrumentation readings, dike performance, visual observations, etc. as required in the OMS Manual.
Water & Tailings Engineer	• Carry out inspections of the structures as required in the OMS Manual. • Carry out instrument monitoring as required in the OMS Manual. • Coordinate equipment, labour, materials and maintenance activities required for pumps and pipelines associated with dewatering, seepage collection systems and any runoff diversions. • Prepare reports on instrumentation readings, dike performance, visual observations, etc. as required in the OMS Manual.
Environment Department Superintendent / General Supervisor / Coordinator / Technician	• Ensure monitoring of water quality and total suspended solids as required in the water management plan • Review environmental monitoring data for compliance with Water License and regulations and to determine dike performance with respect to design parameters. • Liaise with external stakeholders including NIRB, Nunavut Water Board, NGO's, government agencies.

Role	Responsibilities
Energy & Infrastructures Superintendent / General Supervisor / Pump crew supervisor / electrical supervisor	• Installation and operation of pumps and pipeline (electrical, mechanical) • Maintain and service pumps and pipelines • Coordinate equipment, labour and materials for maintenance of electrical and mechanical equipment • Carry out field operations including pumping. • Carry out field maintenance on pumps and pipeline including electrical and mechanical repairs.
Mine Contractor	• Rent equipment and manpower for construction and maintenance of water management infrastructure
Design Engineer	• Advise on contemplated change to the structure design • Advisor on structure performance as required • Participate in inspection and independent review as required
Maintenance Superintendent/ Pump mechanics	• Ensure preventive maintenance is carried out regularly on each pumping equipment • Repair pumping equipment as required • Update and maintain a list of operational pumping equipment • Keep records of maintenance on pumping equipment

Table 2-2: OMS Manual Contact for each position

Role	Name	Work Contact Info
Vice-President Environment	Michel Julien	michel.julien@agnicoeagle.com 416-947-1212 x3738 514-244-5876
General Mine Manager	Luc Chouinard	819-759-3555 x4606896
Engineer of Record (EoR)	Thomas Lepine	thomas.lepine@agnicoeagle.com 416-947-1212 x3722 418-473-8077
Engineering Superintendent / Assistant	Pierre McMullen Miles Legault	819-759-3555 x4606721
Mine Operations Superintendent / Assistant	Yan Côté Nicolas Plouffe-Deschamps	819-759-3555 x4606832
Dike Supervisor	Jean-François Béland Olivier jacques	819-759-3555 x4606807
Geotechnical Coordinator	Frédérick L.Bolduc	819-759-3555 x4606837

Role	Name	Work Contact Info
	Alexandre Lavallée	
Geotechnical Engineer	Patrice Gagnon Pier-Eric McDonald	819-759-3555 x4606726
Geotechnical Technician	Vincent Duranleau Thomas Dahm Bruno Lessard Jerome Collard.	819-759-3555 x4606818 819-759-3555 x4606851
Water & Tailings Engineer	Eric Haley Pascal Poirier	819-759-3555 x4606752
Environment Superintendent	Nancy Duquette	819-759-3555 x4606980 x3175
Environment General Supervisor	Robin Allard	819-759-3555 x4606838
Environment Coordinator	Martin Archambault Tom Thomson	819-759-3555 x4606744
Energy & Infrastructures Superintendent	Guillaume Gemme	819-759-3555 x4606632
Maintenance Superintendent	Pierre Laberge Sylvain Portelance	819-759-3555 x4606722
Energy & Infrastructure General Supervisor	Alexandre Arcand Steven Tremblay	819-759-3555 x4606822
Pump crew supervisor	Shawn Valiquette	819-759-3555 x4606616
Electrical Supervisor	Alain Villeneuve	819-759-3555 x4606762
Mine Contractor	KCG	819-759-3555 x4606963 418-615-0559
Designer – SNC Lavalin	Yohan Jalbert	418-621-5500
Independent Reviewer – Meadowbank Dike Review Board (MDRB)	• Anthony Rattue • Don Hayley	anthony.rattue@bell.net don.hayley@icloud.com

SECTION 3 • WATER MANAGEMENT INFRASTRUCTURES DESCRIPTION

The Whale Tail Project is a deposit on the Amaruq property which is a satellite operation to the Meadowbank Mine. The Amaruq property is a 408 km² site located on Inuit Owned Land, approximately 150 km north of the Hamlet of Baker Lake and approximately 50 km northwest of the Meadowbank Mine in the Kivalliq region of Nunavut. A description of the physical conditions of the site, as well as a geological and geotechnical conditions can be found in the design document of each structure referred to in this section.

The Whale Tail Project includes the construction and operation of a series of water management infrastructure as shown in Figure 3-1. Table 3-1 indicate the water management infrastructure of the Whale Tail Project

Table 3-1: Description of the water management infrastructure of the Whale Tail Project

Infrastructure	Function
Whale Tail Dike	Non-contact water retention and dewatering structure. WTD isolates the Whale Tail pit mining activities from Whale Tail Lake
Mammoth Dike	Non-contact water retentions structure. Isolates the Whale Tail pit mining activities from Mammoth Lake
WRSF Dike	Contact water retention structure. Prevents contact water from snow melt and runoff from direct precipitation on the waste rock stockpile from reporting into Mammoth Lake by storing it in the WRSF pond
WRSF Pond and pumping infrastructure	Pond formed by the WRSF Dike. It stores contact water which is pumped to the attenuation pond
North-East Dike (NE)	Non-contact water retention structure. Prevents runoff from the watershed behind it from reporting into the Whale Tail Pit by accumulating the water in the NE pond
NE Pond and pumping infrastructure	Pond formed by the NE dike. It stores non-contact water which is discharged to the environment or to the attenuation pond based on water quality
Attenuation Pond and pumping infrastructure	Pond formed by the dewatering of the Whale Tail North basin. It stores contact water which is pump to a water treatment plant (WTP) and then discharged through an approved diffuser

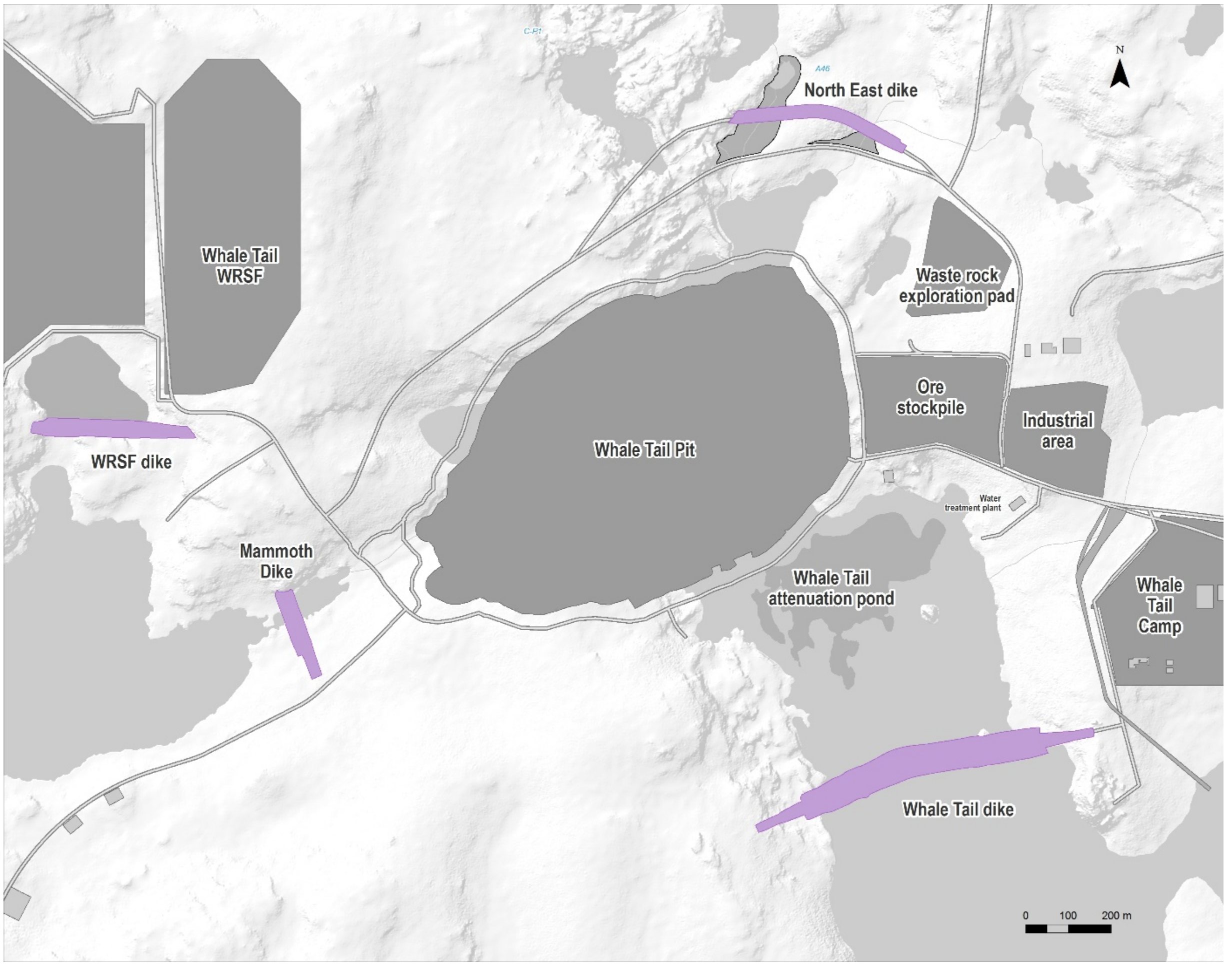

Figure 3-1: Site Plan and Water Management Infrastructure Location

3.1 WHALE TAIL DIKE

Whale Tail Dike (WTD) is a structure to isolate the Whale Tail Pit from Whale Tail Lake. WTD is located on a shallow plateau of the lake floor with an approximate 2 m depth of water. This plateau is located between deeper sections of the lake with water depths of about 12 m.

The downstream side of the dike will be dewatered and the upstream side of the dike will allow a 3.5 m raise of the water level at which time discharge will occur through the South Whale Tail Diversion Channel (SWTDC).

3.1.1 Whale Tail Dike - Design and Construction

Reference to key document for the design and construction of Whale Tail Dike are presented in Table 3-2. Table 3-3 summarise the main design criteria of WTD.

Table 3-2: Reference documents for Whale Tail Dike Design and Construction

Dike	Type of Information	Reference Document	Link to retrieve document
Whale Tail Dike	Design Report	Design Report of Whale Tail Dike (SNC, 2018) 6118-E-132-002-TCR-007_651298-2700-4GER-0001_01	..\..\1 – Whale Tale Dike\2- Detailed Engineering\3- Deliverable\1-Design Report\2- Design Report\6118-E-132-002-TCR-007_651298-2700-4GER-0001_00.pdf
	Drawings	Design Report of Whale Tail Dike (SNC, 2018) 651298-2500-4GDD-0000 to 0011	..\..\1 – Whale Tale Dike\2- Detailed Engineering\3- Deliverable\3-Drawings\Final\WTD Final Drawing_Combined.pdf
	Technical Specifications	Technical Specifications for the Construction of Whale Tail Dike (SNC, 2018) 6118-E-132-002-SPT-001_651298-2400-40EF-0001-00	..\..\1 – Whale Tale Dike\2- Detailed Engineering\3- Deliverable\2-Specification\6118-E-132-002-SPT-001_651298-2400-40EF-0001-00_WTD Technical Specs.pdf
	As-built (to come 90 days after end of construction)	NA	NA

Table 3-3 Design criteria for Whale Tail Dike

Use	Water type	Classification (CDA, 2013)	Inflow Design Flood	Water Level (m)		Crest Elevation (m)
				Normal	Design Flood	
Water Retention / Dewatering	Non-contact	High	1/3 between 1000-year and PMF[1]	156.0	157.0	159.0
Note 1: PMF means Probable Maximum Flood						

The construction of Whale Tail Dike started on July 2018 and ended on February 2019. This structure is a zoned rockfill dike with a core composed of a dynamically compacted fine filter. The low permeability element of this structure is a cement-bentonite (CB) cutoff wall consisting of secant piles drilled through the densified fine filter core.

The main highlight of the dike construction are summarised below:

- The South Whale Tail Diversion Channel will reroute the water accumulation on the upstream of the dike. This channel is designed with the same design flood as for Whale Tail Dike and will be built before freshet 2020;
- The dike is made of NPAG and NML material;
- The cutoff wall was constructed through a central zone of granular material referred to as the fine filter zone. A coarse filter zone is provided between the fine filter and the end dumped upstream and downstream rockfill zones;
- At the west abutment, the WTD alignment crosses an esker which extends well below lake level and contained a frozen core. The esker was excavated to about elevation 153 m. below that elevation, a key trench to the bedrock was progressively excavated in the thawed esker to expose its surface. At the east abutment, the strategy the active layer was removed during the summer season in order to reduce expected settlement and the impact of thaw settlement;
- The foundation preparation within the lake section of the key trench of WTD consisted of underwater excavation of the lakebed soils to the bedrock surface;
- A grout curtain was installed where the bedrock was in unfrozen condition. The grout holes were carried out from the crest at a 0.7 m upstream offset from the secant pile wall;

3.2 MAMMOTH DIKE

Mammoth Dike is a water retaining infrastructure built to isolate the Whale Tail Pit from Mammoth Lake. Mammoth Lake receives water from Whale Tail Lake through the SWTDC, treated water from the Attenuation Pond and from the North-East Sector. Mammoth dike is located across the northeast finger of the Mammoth Lake.

3.2.1 Mammoth Dike – Design and Construction

Reference to key document for the design and construction of Mammoth Dike are presented in Table 3-4. Table 3-5 summarise the main design criteria of Mammoth Dike.

Table 3-4: Reference documents for Mammoth Dike Design and Construction

Dike	Type of Information	Document Reference	Link to Retrieve Document
Mammoth Dike	Design Report	Design Report of Mammoth Dike (SNC, 2018) 6118-E-132-002-TCR-015_651298-5000-40ER-0001_01	..\..\2- Mammoth Dike\2- Detailed Engineering\3-Reporting\1-Design Report\6118-E-132-002-TCR-015_651298-5000-40ER-0001_00-Mammoth Dike Detailed Design Final_Rev 00.pdf
	Drawings	Design Report of Mammoth Dike (SNC, 2018) 651298-500-4GDD-0000 to 0005	..\..\2- Mammoth Dike\2- Detailed Engineering\3-Reporting\3-Drawings\Final
	Technical Specifications	Technical Specifications for the Construction of Mammoth Dike (SNC, 2018) 6118-E-132-002-SPT-005_651298-5000-4GEF-0001-00	..\..\2- Mammoth Dike\2- Detailed Engineering\3-Reporting\2-Specification\6118-E-132-002-SPT-005_651298-5000-4GEF-0001-00_Mammoth Specifications.pdf
	As-built (to come 90 after end of construction)	NA	NA

Table 3-5: Design Criteria for the Mammoth Dike

Use	Water Type	Classification (CDA, 2007/13)	Inflow Design Flood	Water Level (m)		Crest Elevation (m)
				Normal	Design Flood	
Water Retention	Non-Contact	High	1/3 (1,000-PMF)	Low or no water	153.5	155.0

The construction of Mammoth Dike occurred from February 2019 to March 2019 to maintain the frozen condition of the foundation. This structure is a zoned rockfill dike with a filter system. The low permeability element of the dike consist of a bituminous geomembrane (BGM) installed on the upstream face anchored in a key trench with fine filter amended with bentonite (FFAB). The key trench is excavated in frozen glacial till or bedrock.

The main highlight of the dike construction are summarised below:

- The dike was constructed with NPAG and NL material
- Blasting activity was required for foundation excavation

3.3 WRSF DIKE

WRSF dike is a water retention infrastructure designed to prevent contact water from the Whale Tail waste rock storage facility (WRSF) accumulating in the WRSF pond from reporting to Mammoth Lake. The water collected in the WRSF pond located upstream of the dike is pumped to the Attenuation Pond and treated prior to being discharged. An area of approximately 109 ha drains towards the WRSF pond. The WRSF dike is located south of the Whale Tail WRSF.

3.3.1 WRSF Dike – Design and Construction

Reference to key document for the design and construction of WRSF Dike are presented in Table 3-6. Table 3-7 summarise the main design criteria of WRSF Dike.

Table 3-6: Reference documents for WRSF Dike Design and Construction

Dike	Type of Information	Document Reference	Link to Retrieve Document
WRSF Dike	Design Report	Design Report of WRSF Dike (SNC, 2018) 6118-E-132-002-TCR-014_651298-6000-40ER-0001_00	..\..\3- WRSF Dike\1-Detailled Engineering\3-Reporting\1-Design Report\651298-6000-40ER-0001_00 GH WRSF Dike Detailed Design.pdf
	Drawings	Design Report of WRSF Dike (SNC, 2018) 511298-6000-4GDD-0000 to 0005	..\..\3- WRSF Dike\1-Detailled Engineering\3-Reporting\3-Drawings\Final\Pages from 651298-6000-40ER-0001_00 GH WRSF Dike Detailed Design_DRAWINGS.pdf
	Technical Specifications	Technical Specifications for the Construction of WRSF Dike (SNC, 2018) 6118-E-132-002-SPT-003_651298-6000-4GEF-0001-00	..\..\3- WRSF Dike\1-Detailled Engineering\3-Reporting\2-Specification\6118-E-132-002-SPT-003_651298-6000-4GEF-0001-PB_AEM_MG.PDF
	As-built (to come 90 days after end of construction)	NA	NA

Table 3-7: Design Criteria for the WRSF Dike

Use	Water Type	Classification (CDA, 2014)	Inflow Design Flood	Water Level (m)		Crest Elevation (m)
				Normal	Design Flood	
Runoff storage	Contact	Low	100	155.0	157.8	158.4

The construction of WRSF Dike occurred from January to February 2019 to maintain the frozen condition of the foundation. This structure is a zoned rockfill dike with a filter system. The low permeability element of the dike consist of a bituminous geomembrane (BGM) installed on the upstream face anchored in a key trench with fine filter amended with bentonite (FFAB). The key trench is excavated in frozen glacial till or bedrock.

The main highlight of the dike construction are summarised below:

- The dike is constructed with NPAG and NL material
- Foundation excavation in the key trench area was done in the fall of 2018 to avoid blasting and aggrade frost penetration

3.4 NORTH-EAST DIKE

The North-East Dike (NE) dike is designed to prevent non-contact water from the Nemo Lake watershed from reporting into Whale Tail Pit. The NE Dike is located south of the Whale Tail Pit.

Water from the pond that will be created on the upstream side of the dike will be periodically pumped out and treated for suspended solids prior to being discharged to the environment.

3.4.1 North-East Dike– Design and Construction

Reference to key document for the design and construction of NE Dike are presented in Table 3-8. Table 3-9 summarise the main design criteria of NE Dike.

Table 3-8: Summary of key reference documents for the dikes

Dike	Type of Information	Document Reference	Link to Retrieve Document
North-East Dike	Design Report	Design Report of North-East Dike (SNC, 2018) 6118-E-132-002-TCR-012_651298-7000-40ER-0001-02	..\..\4- North East dike\1-Detailled Engineering\3- Deliverable\1-Design Report\6118-E-132-002-TCR-012_651298-7000-40ER-0001-02 _ NE Dike design report.pdf
	Drawings	Design Report of North-East Dike (SNC, 2018) 651298-7000-4GDD-0000 to 0005	..\..\4- North East dike\1-Detailled Engineering\3- Deliverable\3-Drawings\Final\651298-7000-4GDD-NE Dike combined.pdf
	Technical Specifications	Technical Specifications for the Construction of North-East Dike (SNC, 2018) 6118-E-132-002-SPT-002_651298-7000-4GEF-0001-01	..\..\4- North East dike\1-Detailled Engineering\3- Deliverable\2-Specification\6118-E-132-002-SPT-002_651298-7000-4GEF-0001-01_NE Dike spec_no drawings.pdf
	As-built (to come 90 days after construction)	NA	NA

Table 3-9: Design criteria for NE Dike

Use	Water Type	Classification (CDA, 2014)	Inflow Design Flood	Water Level (m)		Crest Elevation (m)
				Normal	Design Flood	
Runoff storage	Non-contact	Significant	100 – 1000 yr	No water	156.7 (1)	157.5
Note 1: Above this elevation, water is discharged towards Nemo Lake. The integrity of the dike will not be at risk of failure.						

The construction of NE Dike occurred from January to February 2019 to maintain the frozen condition of the foundation. This structure is a zoned rockfill dike with a filter system. The low permeability element of the dike consist of a bituminous geomembrane (BGM) installed on the upstream face anchored in a key trench with fine filter amended with bentonite (FFAB). The key trench is excavated in frozen glacial till or bedrock.

The main highlight of the dike construction are summarised below:

- The dike is constructed with NPAG and NL material
- Due to the presence of a hill in the middle of its alignment, the dike is divided into two legs ; the East and West Legs;
- Foundation excavation in the key trench area was done in the fall of 2018 to avoid blasting and aggrade frost penetration

3.5 ATTENUATION POND AND PUMPING INFRASTRUCTURE

The dewatered part of the North Whale Tail basin between the Whale Tail Dike and the Whale Tail Pit is referred as the Whale Tail attenuation pond. All surface contact water from the Whale Tail site are directed in this pond where they are stored prior to being send to the water treatment plant (WTP) and discharged in Mammoth Lake through an approved diffuser. An attenuation pond ramp will be built to allow pumping of the water from the attenuation pond to the WTP

The majority of the water movement on the Whale Tail Project will be done by pumping. Figure 3-2 indicates the position of the attenuation pond and of the pumping infrastructure of the Whale Tail Project.

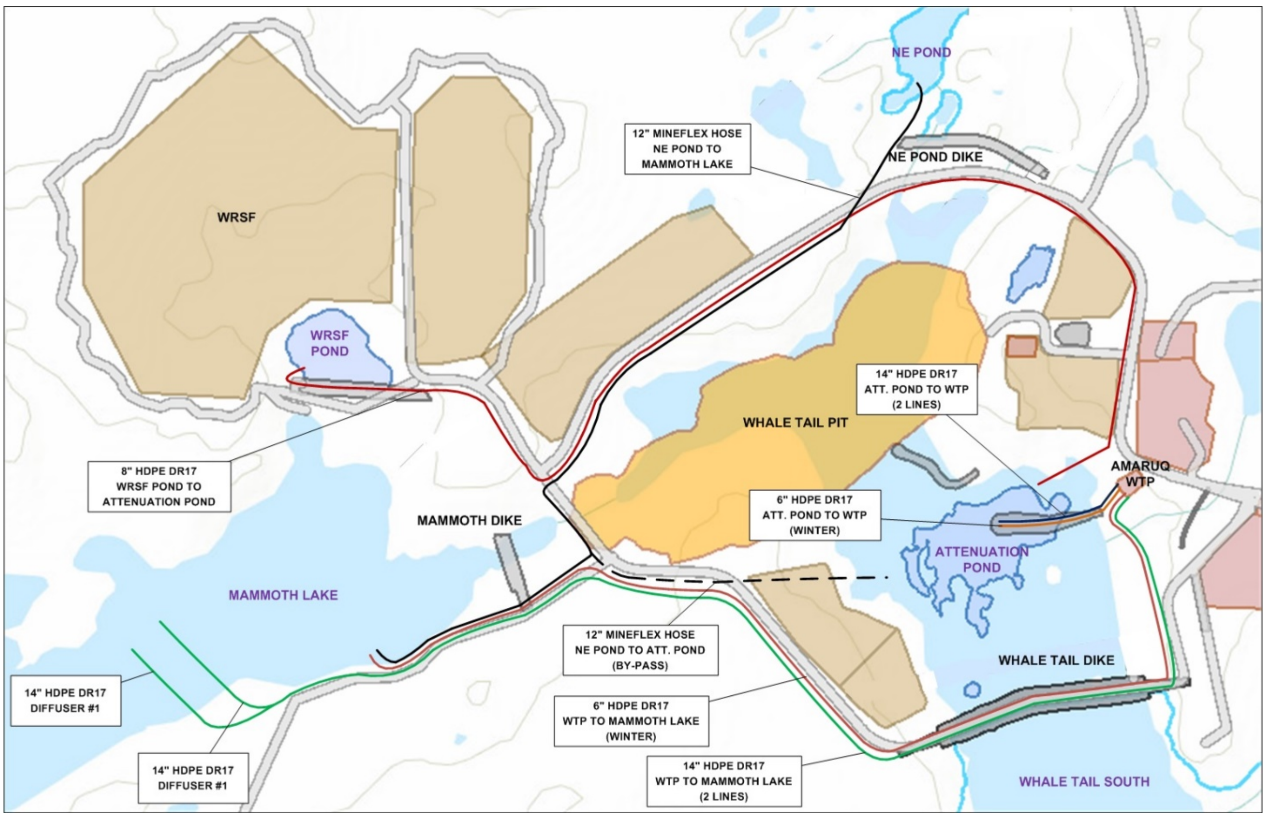

Figure 3-2 :Attenuation Pond and Pumping Infrastructure Layout

Reference to key document for the design and construction of the attenuation pond and pumping infrastructure of the Whale Tail Project are presented in Table 3-10. Reference is also given to the OMM manual of the WTP. A description of the permanent pumping setup installed is given in Table 3-11.

Table 3-10: Key reference documents for attenuation pond and pumping infrastructure

Type of information	Document Reference	Link to Retrieve Document
Detail Engineering Report	Amaruq water management pumping infrastructure (SNC 2018) 651298-8000-40ER-0001_E00	..\..\..\04- Water Management\1- Engineering Study\2- Detailed Engineering Phase 1\5- Deliverable\1- Design Report\3- Detailed Eng Water Management Infra\651298-8000-40ER-0001_E00.pdf
	Whale Tail water management and geotechnical infrastructure (SNC 2018) 6118-E-132-002-TCR-010_651298-8000-4HER-0001-00-WMinfra	..\..\..\04- Water Management\1- Engineering Study\2- Detailed Engineering Phase 1\5- Deliverable\1- Design Report\3- Detailed Eng Water Management Infra
	Mammoth Diffuser (SNC 2018) 611298-8000-40ER-E01	..\..\..\04- Water Management\1- Engineering Study\2- Detailed Engineering Phase 1\5- Deliverable\1- Design Report\4- Diffuser
	Attenuation Pond Ramp	\\Cambfs01\groups\Engineering\05- Geotechnic\14- Amaruq\04- Water Management\1- Engineering Study\2- Detailed Engineering Phase 1\5- Deliverable\1- Design Report\5- Dewatering\Attenuation Pond Ramp Detailed Eng.pdf
Specification & Drawings	Installation Specifications Amaruq Water Management Pumping Infrastructure (SNC 2018) 651298-8000-40EF-0001	..\..\..\04- Water Management\1- Engineering Study\2- Detailed Engineering Phase 1\5- Deliverable\3- Specifications\Spec water manag infra 6118-E-132-002-SPT-004_R1.pdf
OMS manual	Operation & Maintenance Manual Construction Water Treatment Plant (AEM June 2018)	..\..\..\04- Water Management\1- Engineering Study\2- Detailed Engineering Phase 1\5- Deliverable\1- Design Report\1-WTP\653281-0001-40ES-0001_0_OMS WTP.pdf
	ASWTP OMM manual (in progress)	\\Cambfs01\groups\Environment\LICENSE & REGULATORY\LICENSES & PERMITS\NWB\Licences\Whale Tail\2AM-WTP1826\Part D Item 1\AsWTP\OMM AsWTP\01-Application\2AM-WTP1826 Operation_Maintenance Manuel Asenic Water Treatment Plan-reduced.pdf
As-built pumping infrastructure (to come 90 days after end of construction)	NA	NA

Table 3-11: Characteristic of permanent pumping setup

Pumping Location	Pump and pipe	Description
WRSF Pond to Attenuation Pond	3 Godwin CD103 pumps 8'' HDPE DR11 pipe (800 m) + 8'' HDPE DR17 pipe (6575 m)	Pumping at freshet, pumping rate : 150 m^3/h
Attenuation Pond to AsWTP – Summer	Godwin HL250 pump 8'' HDPE DR17 pipe (900 m)	Total Flow Required : 950 to 1600 m^3/h
AsWTP – Summer to Mammoth Lake	2 Warman FAH pumps 8'' HDPE DR17 pipe (7620 m)	Total Flow Required : 950 to 1600 m^3/h
Attenuation Pond to AsWTP - Winter	Godwin CD103 pump 6'' HDPE DR17 insulated pipe (450 m)	Total Flow Required : 84 to 105 m^3/h
AsWTP – Winter to Mammoth Lake	Godwin CD103 pump 6'' HDPE DR17 insulated pipe (3290 m)	Total Flow Required : 84 to 105 m^3/h
NE Pond to Mammoth Lake/Whale Tail North Basin	Godwin HL250 pump Mineflew O&G, Fibers with an abrasion-resistant Polyurethane material 14'' pipe (4900 m)	Total Flow Required : 500 to 800 m^3/h

3.6 INSTRUMENTATION

The water management infrastructure will be instrumented to continuously monitor performance. In-situ instrumentation is installed within the structure and their foundation (piezometers, thermistors, and inclinometer).

Water levels in the ponds will be monitored by means of a visible staff gauge installed at a strategic location, piezometers and periodic water survey. The staff gauge will show the operational and design flood levels for ease of routine inspection.

Reference document for the instrumentation installed on the water management infrastructure is summarized in Table 3-12. The summary of the instrument installed is summarised in Table 3-13

Table 3-12: Reference documents for instrumentation

Type of Information	Reference Document	Link to retrieve document
Instrumentation campaign as-built (to come 90 days after completion of instrumentation)	AEM	NA
Instruments database (to come 30 days after completion of instrumentation)	AEM	..\..\..\09- Instrumentation\2- Master Instrument List
Instrumentation sheet calibration (to come 30 days after completion of instrumentation)	AEM	\\Cambfs01\groups\Engineering\05- Geotechnic\14- Amaruq\09- Instrumentation\6- Technical Documentation\4- Instrument Sheets (calibration)
Manufacturer data sheet	GKM	\\Cambfs01\groups\Engineering\05- Geotechnic\14- Amaruq\09- Instrumentation\6- Technical Documentation\1- Datasheets (manufacturer spec)
Instrument map and cross-section (to come 30 days after completion of instrumentation)	AEM	\\Cambfs01\groups\Engineering\05- Geotechnic\14- Amaruq\09- Instrumentation\1- Instruments Map

Table 3-13: Instrumentation summary on the water management infrastructure

Structure	Piezometer	Thermistors	Inclinometer	Survey Monument	Staff Gauge
Whale Tail Dike	27	11	4	-	-
Mammoth Dike	-	3	-	-	-
WRSF Dike	-	3	-	-	-
NE Dike	-	-	-	-	-
WRSF Pond	-	-	-	-	1
Attenuation pond	-	-	-	-	1
NE Pond	-	-	-	-	-

SECTION 4 • DEWATERING

The following section outlines the key operational procedure that need to be observed and followed during dewatering in accordance with the performance objective of the dewatering structure. The dewatering phase begins once the pumps start in the whale Tail North and ends while the Whale Tail South seep into the South Whale Tail Diversion Channel.

This section only applies to Whale Tail Dike which separates the Whale Tail Lake into the South basin and the North Basin. The North Basin will be dewatered to allow mining of the Whale Tail pit.

Dewatering of the Whale Tail Basin will occur from February 2019 to May 2019.The approximate volume to be dewatered is 3 Mm³ (SNC, 2018a).

4.1 REFERENCES

Reference to key document for the dewatering of Whale Tail North is presented in Table 4-1.

Table 4-1: Reference documents for Dewatering of Whale Tail North

Type of information	Reference	Link to Retrieve Document
WTD commissioning criteria	SNC 2018	..\..\1 - Whale Tale Dike\4- Dewatering\4- WTD commissioning criteria
Management approval to start dewatering activity of Whale Tail North (to come)	AEM	..\..\1 - Whale Tale Dike\4- Dewatering\4- WTD commissioning criteria
Details Engineering of dewatering infrastructure	Whale Tail North Dewatering 60 days' notice (AEM, 2018)	..\..\..\04- Water Management\1- Engineering Study\2- Detailed Engineering Phase 1\5- Deliverable\1- Design Report\5- Dewatering\Part D Item 1 - 60 day notice - V0.pdf
Whale Tail North dewatering water level vs pumped volume	AEM	..\..\1 - Whale Tale Dike\4- Dewatering\3- Water level vs pumped volume\Whale Tail Dike Monitoring - Dewatering - (Piezo-Survey-Flowmeter).xlsx
Whale Tail North dewatering water movement tracking	AEM	..\..\..\04- Water Management\5- Water Movement\2019
Water Quality Monitoring and Management Plan for Dike Construction and dewatering	AEM 2018	..\..\..\04- Water Management\3- Management Plan\1- 2018\Appendix 8-A.2 Water Quality Monitoring and Management Plan for Dike Con....pdf
Whale Tail North dewatering as built report (to come 90 days after end of dewatering)	NA	NA

4.2 SUMMARY OF PERFORMANCE OBJECTIVE AND OPERATION CONTROL DURING DEWATERING

The performance objective and the operational criteria and control for the Whale Tail North Basin dewatering and the performance of Whale Tail Dike during the dewatering are summarized in Table 4-2.

Table 4-2: Performance objectives and operational criteria during dewatering of Whale Tail North

Ensure that Whale Tail Dike commissioning criteria are met before starting dewatering
• All dike construction activity on WTD has been finished (except the thermal cover that may be constructed after the initiation of the dewatering) and construction deviation have been reconciled • All required instrumentation have been installed and stabilized (SNC, 2019) • Management gave the approvals to start dewatering
Water Management During dewatering
• Freeboard is respected in Whale Tail South • Discharge location is based on established water quality criteria (South Whale Tail Basin or Mammoth Lake) (refer to 60 days' notice document) • Water quality at discharge (TSS) met the approved criteria (refer to water quality management plan and 60 days' notice document) • Water discharge volume is recorded (refer to water movement tracking and 60 days' notice document) • The dewatering system (pump, pipes, dewatering ramp) is operated and maintained as per the defined operating procedure (refer to Whale Tail North Operation procedure) • The water level of Whale Tail North and South is recorded and follow prediction taking into account pumping rate
Surveillance
• Proper surveillance (inspection and data review) of Whale Tail Dike performance occur by a qualified person and is documented during dewatering (refer to section 7) • The performance of Whale Tail Dike during dewatering is reviewed against the threshold for performance criteria and trigger pre-defined actions (refer to Table 4-2)
Other
• Prohibit access to all personnel on Whale Tail North ice during dewatering • Restrict access to the dewatering ramp and Whale Tail Dike to trained personnel only during dewatering activity

4.3 OPERATING PROCEDURE DURING WHALE TAIL NORTH DEWATERING

Table 4-3 below present performance indicator and the pre-defined action (TARP) to be taken if the associated performance criteria deviate from defined range.

Table 4-3: Threshold Criteria and pre-defined action during Dewatering

		Threshold Criteria During Dewatering			
		Green **Normal Operating Range**	**Yellow** **Areas of concern**	**Orange** **High Risk Situation**	**Red** **Emergency Situation**
Criteria and specific action (SA)	Commissioning Criteria of WTD	Required commissioning criteria have been met before initiating dewatering	Dewatering ongoing while required commissioning criteria were partially met but management gave go ahead for dewatering following deviation reconciliation	Dewatering ongoing while required commissioning criteria not met or partially met and no formal go ahead from management to initiate dewatering	NA
	Whale Tail South Elevation	< 153 masl	> 153 and < 154 masl	> 154 and < 157 masl	> 157 masl Core overtopping
	Whale Tail North Elevation	Water level decrease of WT North correlate with estimate level base on pumping	Minor discrepancy between WT North level and estimate level from pumping rate before freshet (<15%)	Significant discrepancy between WT North level and estimate level from pumping rate before freshet (>30 %)	Major discrepancy between WT North level and estimate level from pumping rate before freshet (>50 %) Dike cutoff integrity is compromised
	Water Quality (turbidity)	TSS level below discharge criteria without treatment No sign of turbidity from WTD Dike	TSS level above discharge criteria without treatment Minor sign of turbidity from WTD Dike SA : Discharge to Mammoth through WTP	TSS level above discharge criteria with treatment (non-compliance with Env commitment)	NA
	Sloughing along downstream rockfill embankment face	None visible	Single event observed	More than one events observed	Continued event(s) Dike stability or cutoff integrity is compromised
	Tension crack on the crest (outside cutoff area)	None visible	< 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 or cutoff integrity is compromised
	Tension crack within 3 m each side of the cutoff wall at crest	None visible	or < 0.1 m wide < 0.1 m	> 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 Dike stability or cutoff integrity is compromised
	Sinkhole on crest	None visible	Localised depression	Sinkhole identified	Development of sinkhole Dike stability or cutoff integrity is compromised
	Cut-off wall lateral cumulative deformation (based on inclinometer)	< 50 mm	Between 50 mm and 100 mm SA: Refer to 7.5.1	> 100 mm	NA
	Cumulative vertical crest movement	None visible	< 0.2 m SA: Apply step in case of instrument measurement outside normal range	> 0.2 m and < 1 m increasing rate of settlement	> 1 m increasing rate of settlement Dike stability or cutoff integrity is compromised
	Pore water pressure (based on piezometers)	Pore water pressure correlate with water level trend during dewatering	Unexplained piezometric trend observed SA: Refer to 7.5.1	Piezometric trends are explained and demonstrate an upset in the structure condition	NA
	Temperature variation along centreline (based on thermistors and piezometers)	Temperature measurement stable, seasonal trend observed	Unexplained thermal trend observed SA: Apply step in case of instrument measurement outside normal range	Thermal trends are explained and demonstrate an upset in the structure condition	NA
	Compliance to the surveillance program of the structure	Inspection done and reviewed at the frequency mentioned in Ch 7 And Instrument monitoring and analysis of data is done, documented and reviewed at the frequency mentioned in Ch 7	Dike inspection is done but not reviewed and documented at the frequency mentioned in Ch 7 Or Monitoring and analysis of data is done, but not documented and reviewed per the frequency mentioned in Ch 7	Dike inspection not done at the frequency mentioned in the OMS Or Monitoring and analysis of data is not done at the frequency mentioned in the OMS	NA
Action Required (general)		• Continue operation, maintenance, surveillance and monitoring as per standard operating procedure	• Identify potential cause • Develop mitigation plan and implement specific action. Use as reference contingency measures for different scenarios proposed (Appendix B) • Increase inspection and instrumentation monitoring frequency as Ch 7 • Implement engineering review	• Decision on stopping dewatering or not • Take appropriate corrective action based on mitigation plan and implement specific action • Increased inspection and instrumentation monitoring frequency as per Ch 7 • Reassess thresholds and conditions for red category (emergency situation)	• Stop dewatering • Implement emergency response plan • Emergency remedial work • Evacuate downstream area
		Take action and notify personnel as per decision framework of Figure 5-2			

SECTION 5 • OPERATIONS

The following section outlines the key operational procedure that need to be observed and followed during operation of the Amaruq water management infrastructure in accordance with the performance objective

5.1 REFERENCES

References to key documents for the operation of the Whale Tail water management infrastructure are presented in Table 5-1.

Table 5-1: Key reference documents for Operation of Whale Tail water management infrastructure

Type of information	Reference	Link to Retrieve Document
Whale Tail Pit – Mean Annual Water Balance	Golder (2018) 1789310_204_RPT_Phase2_waterbalance_Rev1	..\..\..\04- Water Management\2- Water Balance\1- 2018\Golder WB_Final\1789310_204_RPT_Phase2_WaterBalance_Rev1.pdf
Whale Tail Pit Water Management Plan	V3 – AEM (Oct 2018)	..\..\..\04- Water Management\3- Management Plan\2- 2019\655183-2000-40ER-001-00_WhaleTailPit_WaterMgmtPlan_V3.pdf
Whale Tail Pit Water Quality Model	Golder (2018) 1789310-R-Rev0_SiteWQmodel	\\Cambfs01\groups\Engineering\05-Geotechnic\14- Amaruq\04- Water Management\2- Water Balance\1-2018\Golder WB_Final\1789310-R-Rev 0_SiteWQModel_Nov2018.pdf

5.2 SUMMARY OF PERFORMANCE OBJECTIVE AND OPERATION CONTROL

The performance objective and the operational criteria for the Whale Tail water management infrastructure during operation are summarized in Table 5-2.

Table 5-2: Performance objectives and operational criteria of Whale Tail water management infrastructure

Water Management
• Operational freeboard of each water retention structure must be respected during operation (refer to section 5.2.1) • Water movement must respect the water balance for intake and discharge location (refer to water balance) • Water movement must be tracked and recorded on a monthly basis (volume, origin, destination) • The water management system (pump, pipes, WTP) must be operated and maintained as per the defined operating procedure • Any seepage must be captured by sump and pumped back to allowed location (or naturally report to an approved location)
Water Quality
• All water discharged in the environment must be through an approved diffuser • Water quality at discharge met the approved criteria (refer to water management plan) • Water quality forecast data is used to make informed water management strategy decision • Water quality and quantity of seepage water is monitored
Surveillance
• Proper surveillance (inspection and data review) of Whale Tail Dike performance occur and is documented during dewatering (refer to section 7) • The performance of Whale Tail Dike during dewatering is reviewed against the threshold for performance criteria and trigger pre-defined actions (refer to Table 5-4 to 5-8)

5.2.1 Freeboard

The minimum freeboards for the Whale Tail water management infrastructure are contained within the design report of each infrastructure and are summarized in Tables 5-3.

Note that AP-5 is related to underground water management which is out of scope of this manual. However as long as the water quality of AP-5 met criteria for discharge it will be discharged on an annual basis to Mammoth Lake through an approved diffuser.

Table 5-3: Water Elevation During Operation

Location	Maximum Water Level		
	Normal Operating level	Design Flood Event	Related water retaining structure Dike Crest Elevation (m)
Whale Tail South	156	157	159
Mammoth Lake	152.5	153.5	155
WRSF Pond	155.4	157.8	158.4
NE Pond	155.5	156.7	157.5
Whale Tail Attenuation Pond	142	145.5	NA
AP-5	153.5	155	NA

5.2.2 Seepage Management

If seepage is observed through a water management structure, a system of collection ditch and sump will be constructed at the downstream toe of the structure to capture the seepage into a contact water retention pond. The water quality will be monitored and it will be directed to the attenuation pond or pump back on the upstream side of the structure base on its quality.

If seepage is observed through a structure but this seepage naturally report to a contact water retention pond (i.e. seepage from Whale Tail Dike reporting to the attenuation pond) then a seepage collection system would not be required.

The quantity and quality of each seepage from a water management infrastructure has to be monitored as per the requirement of section 7.

5.3 WATER MANAGEMENT

The water management strategy for the Whale Tail Project can be found in the water balance. A schematic version of the water movement strategy is summarised in Figure 5-1.

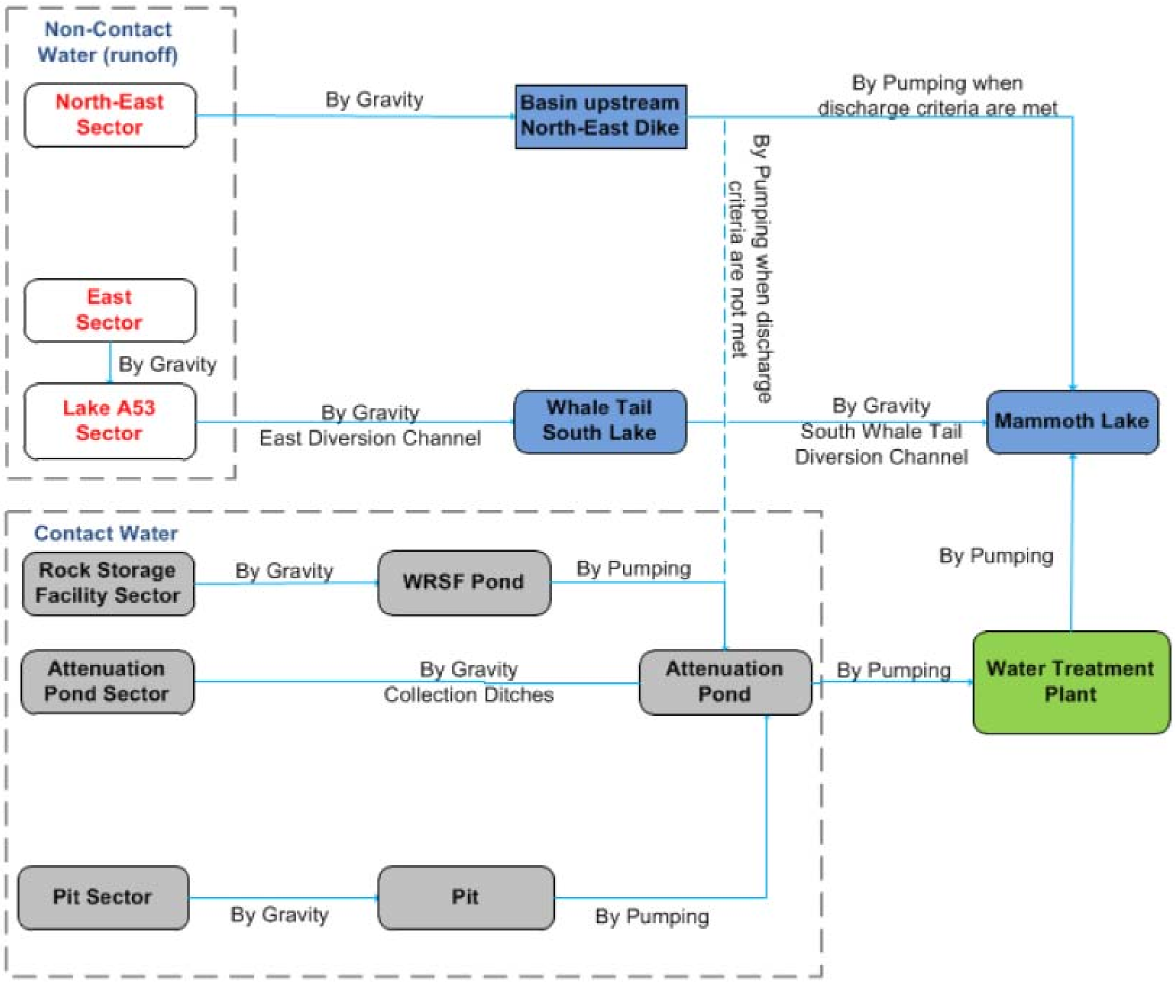

Figure 5-1: Flow Diagram of the Water Management Infrastructures (2019-2022)

5.4 OPERATING PROCEDURE DURING OPERATION OF WHALE TAIL WATER MANAGEMENT INFRASTRUCTURE

Table 5-4 to 5-8 below present performance indicator for each water management infrastructure and the Triger Action Response Plan (TARP) if the associated performance criteria deviate from defined range.

Table 5-4: Threshold Criteria and pre-defined action during operation of Whale Tail Dike

		Threshold Criteria During Operation			
		Green **Normal Operating Range**	**Yellow** **Areas of concern**	**Orange** **High Risk Situation**	**Red** **Emergency Situation**
Criteria and specific action (SA)	Whale Tail South Elevation (dike freeboard)	Normal operation range : < 156 masl	> 156 to < 156.5 m	> 156.5 to < 157 m	> 157 masl Core or crest overtopping
	Seepage to manage	Within design parameter < 2 000 m3 day and managed by pumping	Inflow higher than design parameter but manageable with a pumping capacity (FOS > 2) or Storage and discharge of this seepage is manageable without modifying water management strategy or Sudden or cumulative increase < 25 % in over 3 days	Inflow higher than design parameter and at the limit of the pumping capacity (FOS >1 and <2) or Storage and discharge of this seepage is manageable for the moment but cannot be sustained without modifying the water management strategy SA: increase pumping capacity & re-assess discharge and storage strategy	Inflow is unmanageable with pumping capacity (FOS < 1) or No more capacity on site for storage and discharge of this seepage water
	Seepage water quality (turbidity)	No observation of turbidity in seepage	Turbidity observed in seepage water (single TSS event of 30 mg/L)	Sustained high turbidity over 30 mg/l in seepage water	NA
	Sloughing along downstream rockfill embankment face and downstream toe	None visible	Single event observed	More than one events observed	Continued event(s) Dike stability or cutoff integrity is compromised
	Tension crack on the crest (outside cutoff area)	None visible	< 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
	Tension crack within 3 m each side of the cutoff wall at crest	None visible	or < 0.1 m wide < 0.1 m deep	> 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 Cutoff integrity is compromised
	Sinkhole on crest	None visible	Localised depression > 5 m outside from centreline	Sinkhole identified	Development of sinkhole Dike stability or cutoff integrity is compromised
	Cut-off wall lateral cumulative deformation (based on inclinometer)	< 50 mm	Between 50 mm and 100 mm SA: Refer to 7.5.1	> 100 mm	NA
	Cumulative vertical crest movement	None visible	< 1 m or Stable trend SA: Refer to 7.5.1	> 1 m with increasing rate of settlement	> 2 m with increasing rate of settlement Dike stability or cutoff integrity is compromised
	Pore water pressure (based on piezometers)	Pore water pressure correlate with water level trend during dewatering	Unexplained piezometric trend observed SA: Refer to 7.5.1	Piezometric trends are explained and demonstrate an upset in the structure condition	NA
	Temperature variation along centreline (based on thermistors and piezometers)	Temperature measurement stable, seasonal trend observed	Unexplained thermal trend observed SA: Apply step in case of instrument measurement outside normal range	Thermal trends are explained and demonstrate an upset in the structure condition	NA
	The surveillance program of the structure is followed	Inspection done and reviewed at the frequency mentioned in Ch 7 And Instrument monitoring and analysis of data is done, documented and reviewed at the frequency mentioned in Ch 7	Dike inspection is done but not reviewed and documented at the frequency mentioned in Ch 7 Or Monitoring and analysis of data is done, but not documented and reviewed per the frequency mentioned in Ch 7	Dike inspection not done at the frequency mentioned in the OMS Or Monitoring and analysis of data is not done at the frequency mentioned in the OMS	NA
Action Required (general)		• Continue operation, maintenance, surveillance and monitoring as per standard operating procedure	• Identify potential cause • Develop mitigation plan and implement specific action. Use as reference contingency measures for different scenarios proposed (See Appendix B) • Increase inspection and instrumentation monitoring frequency as per Ch 7 • Implement engineering review	• Restrict access to Whale Tail Dike crest • Take appropriate corrective action based on approved mitigation plan and specific action. • Increase inspection and instrumentation monitoring frequency as per Ch 7 • Reassess thresholds and conditions for red category (emergency situation) taking into account the changing conditions presently observed and interactions of various items.	• Evacuate Whale Tail Pit • Close access to Whale Tail Dike crest • Implement emergency response plan
		Take action and notify personnel as per decision framework of Figure 5-2			

Table 5-5: Threshold Criteria and pre-defined action during operation of Mammoth Dike

		Threshold Criteria During Operation			
		Green **Normal Operating Range**	**Yellow** **Areas of concern**	**Orange** **High Risk Situation**	**Red** **Emergency Situation**
Criteria and specific action (SA)	Mammoth Lake elevation (dike freeboard)	Normal operation range : < 152.5 masl	Design flood range : > 152.5 and < 153.5 masl	> 153.5 masl without crest overtopping	Crest overtopping
	Seepage through dike	Within design parameter < 300 m3 day and managed by pumping	Inflow higher than design parameter but manageable with current pumping capacity (FOS > 2) or Storage and discharge of this seepage is manageable without modifying water management strategy or Sudden or cumulative increase < 25 % in over 3 days	Inflow higher than design parameter and at the limit of the current pumping capacity (FOS >1 and <2) or Storage and discharge of this seepage is manageable for the moment but cannot be sustained without modifying the water management strategy SA: increase pumping capacity & re-assess discharge and storage strategy	Inflow is unmanageable with pumping capacity (FOS < 1) or No more capacity on site for storage and discharge of this seepage water
	Seepage water quality (turbidity)	No observation of turbidity in seepage	Turbidity observed in seepage water (single TSS event of 30 mg/L)	Sustained high turbidity over 30 mg/l in seepage water	NA
	Sloughing along downstream rockfill embankment face and downstream toe	None visible	Single event observed	More than one events observed	Continued event(s) Dike stability is compromised
	Tension crack on the crest	None visible	< 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
	Sinkhole on crest	None visible	Localised depression	Sinkhole identified	Development of sinkhole Dike stability is compromised
	Cumulative vertical crest movement	None visible	< 1 m or Stable trend SA: Refer to 7.5.1	> 1 m with increasing rate of settlement	> 2 m with increasing rate of settlement Dike stability is compromised
	Temperature variation (based on thermistors)	Temperature measurement stable, seasonal trend observed	Unexplained thermal trend observed SA: Apply step in case of instrument measurement outside normal range	Thermal trends are explained and demonstrate an upset in the structure condition	NA
	The surveillance program of the structure is followed	Inspection done and reviewed at the frequency mentioned in Ch 7 And Instrument monitoring and analysis of data is done, documented and reviewed at the frequency mentioned in Ch 7	Dike inspection is done but not reviewed and documented at the frequency mentioned in Ch 7 Or Monitoring and analysis of data is done, but not documented and reviewed per the frequency mentioned in Ch 7	Dike inspection not done at the frequency mentioned in the OMS Or Monitoring and analysis of data is not done at the frequency mentioned in the OMS	NA
Action Required (general)		• Continue operation, maintenance, surveillance and monitoring as per standard operating procedure	• Identify potential cause • Develop mitigation plan and implement specific action. Use as reference contingency measures for different scenarios proposed (See Appendix B) • Increase inspection and instrumentation monitoring frequency as Ch 7 • Implement engineering review	• Restrict access to Mammoth Dike crest • Take appropriate corrective action based on approved mitigation plan. • Increase inspection and instrumentation monitoring frequency as per Ch 7 • Reassess thresholds and conditions for red category (emergency situation) taking into account the changing conditions presently observed and interactions of various items.	• Evacuate Whale Tail Pit • Close access to Mammoth Dike crest • Implement emergency response plan
		Take action and notify personnel as per decision framework of Figure 5-2			

Table 5-6: Threshold Criteria and pre-defined action during operation of WRSF Dike

		Threshold Criteria During Operation			
		Green **Normal Operating Range**	**Yellow** **Areas of concern**	**Orange** **High Risk Situation**	**Red** **Emergency Situation**
Criteria and specific action (SA)	WRSF Pond elevation (dike freeboard)	Normal operation range : < 155.4 masl	Design flood range : > 155.4 and < 157.8 masl	> 157.8 masl without crest overtopping	Crest overtopping
	Seepage through dike	Within design parameter < 300 m3 day and managed by pumping	Inflow higher than design parameter but captured in sump and manageable with current pumping capacity (FOS > 2) or Storage and discharge of this seepage is manageable without modifying water management strategy or Sudden or cumulative increase < 25 % in over 3 days	Inflow higher than design parameter but captured in sump and managed with a limited pumping capacity (FOS >1 and <2) or Storage and discharge of this seepage is manageable for the moment but cannot be sustained without modifying the water management strategy SA: increase pumping capacity & re-assess discharge and storage strategy	Inflow is unmanageable with pumping capacity (FOS < 1) Or No more capacity on site for storage and discharge of this seepage water
	Seepage water quality (turbidity)	No observation of turbidity in seepage	Turbidity observed in seepage water (single TSS event of 30 mg/L)	Sustained high turbidity over 30 mg/l in seepage water	NA
	Sloughing along downstream rockfill embankment face and downstream toe	None visible	Single event observed	More than one events observed	Continued event(s) Dike stability is compromised
	Tension crack on the crest	None visible	< 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
	Sinkhole on crest	None visible	Localised depression	Sinkhole identified	Development of sinkhole Dike stability is compromised
	Cumulative vertical crest movement	None visible	< 1 m or Stable trend SA: Refer to 7.5.1	> 1 m with increasing rate of settlement	> 2 m with increasing rate of settlement Dike stability is compromised
	Temperature variation (based on thermistors)	Temperature measurement stable, seasonal trend observed	Unexplained thermal trend observed SA: Apply step in case of instrument measurement outside normal range	Thermal trends are explained and demonstrate an upset in the structure condition	NA
	The surveillance program of the structure is followed	Inspection done and reviewed at the frequency mentioned in Ch 7 And Instrument monitoring and analysis of data is done, documented and reviewed at the frequency mentioned in Ch 7	Dike inspection is done but not reviewed and documented at the frequency mentioned in Ch 7 Or Monitoring and analysis of data is done, but not documented and reviewed per the frequency mentioned in Ch 7	Dike inspection not done at the frequency mentioned in the OMS Or Monitoring and analysis of data is not done at the frequency mentioned in the OMS	NA
Action Required (general)		• Continue operation, maintenance, surveillance and monitoring as per standard operating procedure	• Identify potential cause • Develop mitigation plan and implement specific action. Use as reference contingency measures for different scenarios proposed (See Appendix B) • Increase inspection and instrumentation monitoring frequency as Ch 7 • Implement engineering review	• Restrict access to WRSF Dike crest • Take appropriate corrective action based on approved mitigation plan. • Increase inspection and instrumentation monitoring frequency as per Ch 7 • Reassess thresholds and conditions for red category (emergency situation) taking into account the changing conditions presently observed and interactions of various items.	• Implement emergency response plan
		Take action and notify personnel as per decision framework of Figure 5-2			

Table 5-7: Threshold Criteria and pre-defined action during operation of NE Dike

		Threshold Criteria During Operation			
		Green **Normal Operating Range**	**Yellow** **Areas of concern**	**Orange** **High Risk Situation**	**Red** **Emergency Situation**
Criteria and specific action (SA)	NE Pond elevation (dike freeboard)	Normal operation range : < 155.5	Design flood range :>155.5 and < 156.7 masl	> 156.7 masl without crest overtopping	Crest overtopping
	Seepage through dike	Within design parameter < 300 m3 day and managed by pumping	Inflow higher than design parameter but captured in sump and manageable with current pumping capacity (FOS > 2) or Storage and discharge of this seepage is manageable without modifying water management strategy or Sudden or cumulative increase < 25 % in over 3 days	Inflow higher than design parameter but captured in sump and managed with a limited pumping capacity (FOS >1 and <2) or Storage and discharge of this seepage is manageable for the moment but cannot be sustained without modifying the water management strategy SA: increase pumping capacity & re-assess discharge and storage strategy	Inflow is unmanageable with pumping capacity (FOS < 1) Or No more capacity on site for storage and discharge of this seepage water
	Seepage water quality (turbidity)	No observation of turbidity in seepage	Turbidity observed in seepage water (single TSS event of 30 mg/L)	Sustained high turbidity over 30 mg/l in seepage water	NA
	Sloughing along downstream rockfill embankment face and downstream toe	None visible	Single event observed	More than one events observed	Continued event(s) Dike stability is compromised
	Tension crack on the crest	None visible	< 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
	Sinkhole on crest	None visible	Localised depression	Sinkhole identified	Development of sinkhole Dike stability is compromised
	Cumulative vertical crest movement	None visible	< 1 m or Stable trend SA: Refer to 7.5.1	> 1 m with increasing rate of settlement	> 2 m with increasing rate of settlement Dike stability is compromised
	The surveillance program of the structure is followed	Inspection done and reviewed at the frequency mentioned in Ch 7 And Instrument monitoring and analysis of data is done, documented and reviewed at the frequency mentioned in Ch 7	Dike inspection is done but not reviewed and documented at the frequency mentioned in Ch 7 Or Monitoring and analysis of data is done, but not documented and reviewed per the frequency mentioned in Ch 7	Dike inspection not done at the frequency mentioned in the OMS Or Monitoring and analysis of data is not done at the frequency mentioned in the OMS	NA
Action Required (general)		• Continue operation, maintenance, surveillance and monitoring as per standard operating procedure	• Identify potential cause • Develop mitigation plan and implement specific action. Use as reference contingency measures for different scenarios proposed (See Appendix B) • Increase inspection and instrumentation monitoring frequency as Ch 7 • Implement engineering review	• Restrict access to NE Dike crest • Take appropriate corrective action based on approved mitigation plan. • Increase inspection and instrumentation monitoring frequency as per Ch 7 • Reassess thresholds and conditions for red category (emergency situation) taking into account the changing conditions presently observed and interactions of various items.	• Evacuate Whale Tail Pit • Implement emergency response plan
		Take action and notify personnel as per decision framework of Figure 5-2			

Table 5-8: Threshold Criteria and pre-defined action during operation of Attenuation Pond and Pumping Infrastructure

		Threshold Criteria During Operation			
		Green **Normal Operating Range**	**Yellow** **Areas of concern**	**Orange** **High Risk Situation**	**Red** **Emergency Situation**
Criteria and specific action (SA)	Attenuation Pond elevation (storage capacity)	Normal operation range : < 142	Maximum operating range :>142 and < 145 masl	> 145 masl without overflowing in pit	Pit crest overflow
	Tension cracks on the attenuation pond ramp	None visible	< 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 Ramp stability is compromised
	Cumulative vertical crest movement of attenuation pond ramp	None visible	< 0.2 m SA: Apply step in case of instrument measurement outside normal range	> 0.2 m and < 1 m increasing rate of settlement	> 1 m increasing rate of settlement Ramp stability is compromised
	Water movement (pumping) follow the Water Balance	Water movement (origin / destination) follow the current water balance and Elevation of each pumping point is within the predicted range of the water balance	The water management data show that the water balance strategy of the water balance is not sustainable from a storage / discharge point of view SA: Modify the water balance and re-assess water management strategy	Water movement (origin/destination) cannot follow water balance due to operational constraint (i.e. capacity, water quality, water treatment)	Water cannot be stored / discharge from the Whale Tail site. The water balance is not applicable SA : Flood underground ramp
	Water movement (pumping) are recorded for volume, origin and destination	Water movement data are read and recorded at the specified frequency of the OMS	Water movement data are read on a non-compliant frequency and there are gap in the data	Water movement data are not read or recorded at the specified frequency of the OMS	NA
	Water quality in the receiving environment and at discharge	Water quality at discharge met receiving environment criteria and Water quality of the receiving environment follow water quality forecast	Water quality at discharge met receiving environment criteria And Water quality of the receiving environment show a trend that water quality is deteriorating higher than the forecast SA : Review diffuser and WTP performance	Water quality at discharge does not met receiving environment criteria SA : stop discharge SA : Review WTP performance	Water quality of the receiving environment no longer allow discharge (no more discharge allowable) SA : Flood underground ramp
	Water quality data is used to make informed water management decision	Water quality data is integrated within the water balance to make informed water movement strategy	Water quality data is not taken into account while deciding water movement	NA	NA
Action Required (general)		• Continue operation, maintenance, surveillance and monitoring as per standard operating procedure	• Identify potential cause • Develop mitigation plan and implement specific action. Use as reference contingency measures for different scenarios proposed (See Appendix B) • Increase inspection and instrumentation monitoring frequency as Ch 7 • Implement engineering review	• Take appropriate corrective action based on approved mitigation plan. • Increase inspection and instrumentation monitoring frequency as per Ch 7 • Reassess thresholds and conditions for red category (emergency situation) taking into account the changing conditions presently observed and interactions of various items.	• Evacuate Whale Tail pit • Implement emergency response plan
		Take action and notify personnel as per decision framework of Figure 5-2			

5.5 COMMUNICATION AND DECISION MAKING

Figure 5-2 indicates the communication and decision process when the threshold criteria are met and when pre-defined action need to be implemented.

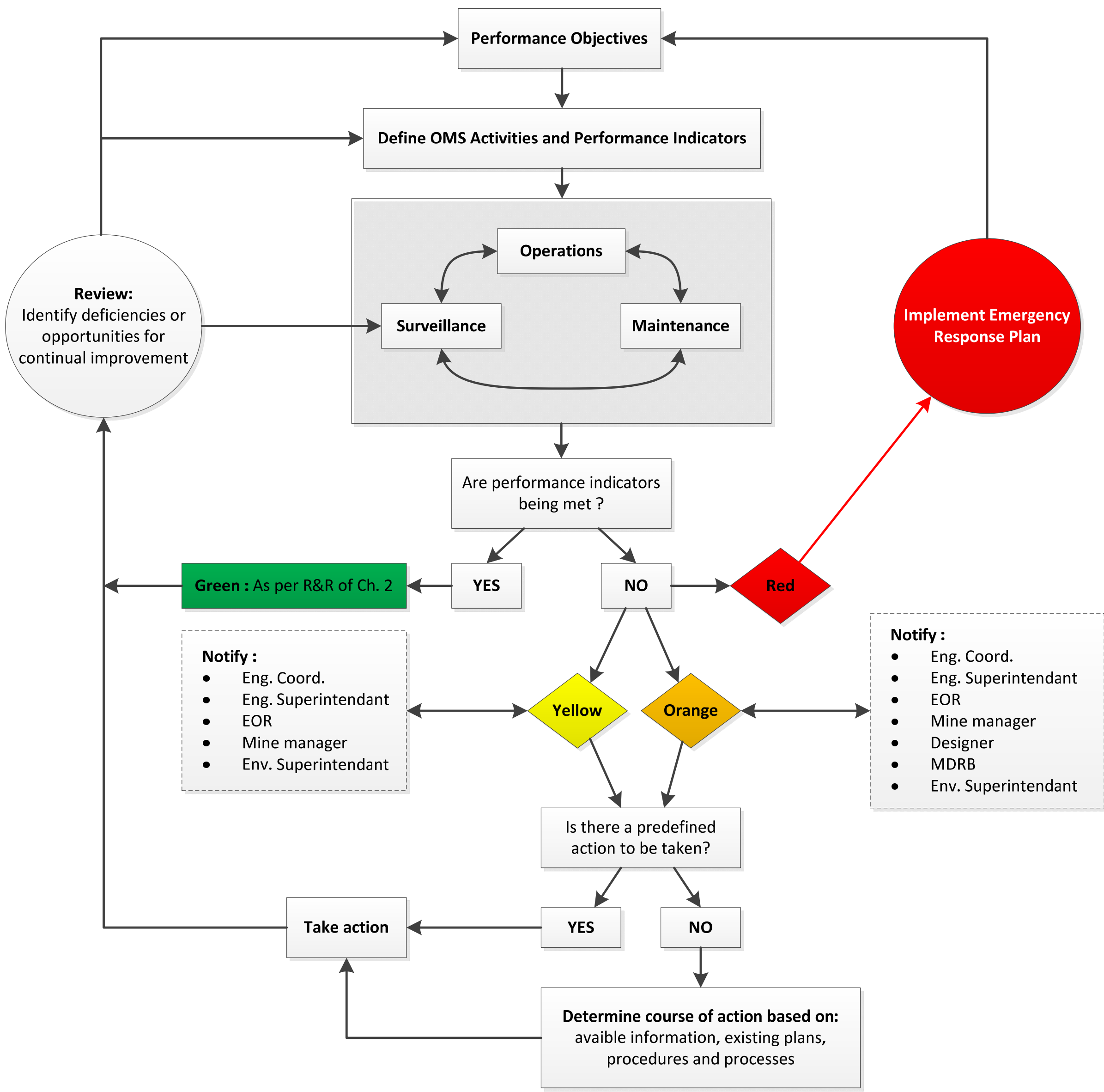

Figure 5-2: Communication and Decision Process for Water Management Infrastructure TARP

SECTION 6 • MAINTENANCE

This section identifies all infrastructures within the scope of this manual that has 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 maintenance is planned, recurring maintenance activities conducted at a fixed or approximate frequency and not typically arising from results of surveillance activities. Examples of such maintenance include calibration and maintenance of surveillance equipment or regularly changing oil on a pump as per manufacturer's requirement.

Predictive maintenance is pre-defined maintenance 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

Reference to key document for the maintenance of the Whale Tail water management infrastructure is presented in Table 6-1.

Table 6-1: Reference documents for Maintenance of Whale Tail water management infrastructure

Type of information	Link to Retrieve Information
Maintenance log of water management infrastructure (to come)	In progress
Maintenance log of pumping equipment	\\CAMBFS01\Public\MAINTENANCE\G dore\PWA-COM-LGT hrs reading.xlsx \\Cambfs01\groups\EnergyInfra\08-PowerHouse\2 EQUIPMENT\2 GENERATORS
Maintenance log of geotechnical instrumentation (to come)	In progress
Pump allocation tool	..\..\..\04- Water Management\4- Water Management Infrastucture\3- 2019\1 - Planning\9-Procurement\Pump Allocation\AMQ Pump Allocation 2019-2020.pptx
Geotechnical instrument & Datalogger inventory	In progress

6.3 COMPONENT OF THE WATER MANAGEMENT INFRASTRUCTURE REQUIRING MAINTENANCE

Table 6-2 indicates all the component of the Whale Tail water management infrastructure that requires maintenance.

Table 6-2: Component of the water management infrastructure requiring maintenance

Water Management Infrastructure
• Dike embankment (i.e. repair erosion) • Dike crest (i.e. fill inactive tension cracks) • Seepage collection sump (i.e., reprofile slope, increase sump volume) • Ditches and diversions (i.e. snow removal, repair erosion)
Pumping infrastructure
• Pumps (mechanical and electrical maintenance) • Pipes (steaming, drain line, repair leak)
Surveillance
• Geotechnical instruments (thermistors, piezometers, inclinometers, survey monument) • Data acquisition system • Flowmeter
Other
• Dike crest access road • Access to sump

6.3.1 Maintenance component that are 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 these maintenance can be contacted

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

6.4 DESCRIPTION OF MAINTENANCE ACTIVITIES

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

Table 6-3 :Description of maintenance activity for component of water management infrastructure

Component	Type of maintenance	Nature of the activity	Frequency of maintenance (preventative) OR Trigger of maintenance (predictive and corrective)	Responsible for the activity	Documentation Required	Reporting Requirement
Water Management Infrastructure						
Dike embankment Attenuation pond ramp repair erosion	Corrective	Gullies and depression to be filled with rockfill and re-sloped	Following a demand from engineering superintendent following a visual inspection showing erosion	Mine Superintendent (can use a contractor alternatively)	Photo of remediation work	Engineering to update the maintenance log of the structure
Dike crest / Attenuation pond ramp – fill inactive tension cracks	Corrective	Inactive tension cracks to be filled with bentonite to prevent widening due to water infiltration	Following a demand from engineering superintendent following a visual inspection showing inactive tension cracks	Geotechnical technician	Photo of remediation work	Engineering to update the maintenance log of the structure
Dike crest / Attenuation pond ramp compensate settlement	Corrective	Add rockfill to increase the height of the dike following observation of settlement	Following a demand from engineering superintendent following a visual inspection showing settlement that need to be compensated (i.e. loss of freeboard)	Mine Superintendent (can use a contractor alternatively)	Photo of remediation work Surveying of remediation work	Engineering to update the maintenance log of the structure and provide surveying
Seepage collection sump– increase volume	Predictive	Excavate an additional sump or increase the capacity of an existing sump	Following a demand from engineering superintendent following a re-assessment of the sump capacity	Mine Superintendent (can use a contractor alternatively)	Photo of remediation work Surveying of remediation work	Engineering to update the maintenance log of the structure and provide surveying
Seepage collection sump – reprofile sump	Corrective	Excavate flatter slope for the sump or add material against the slope to reprofile them	Following a demand from engineering superintendent following a visual inspection showing instable sump slope	Mine Superintendent (can use a contractor alternatively)	Photo of remediation work	Engineering to update the maintenance log of the structure and provide surveying
Ditches – snow removal	Predictive	Use an excavator to remove snow in the ditch	Every year prior to freshet to ensure that ditch is clear of snow obstruction. Demand will be formulated by the Engineering Superintendent	Energy & Infrastructure Superintendent	Photo of remediation work	Engineering to update the maintenance log of the structure
Ditches – clean debris and sediment accumulation	Corrective	Remove any debris and accumulation of sediment that can hinder flow	Following a demand from engineering superintendent following a visual inspection showing accumulation of debris and sediment	Energy & Infrastructure Superintendent	Photo of remediation work	Engineering to update the maintenance log of the structure
Ditches – repair erosion of granular layer	Corrective	Add granular material to repair erosion of the ditches	Following a demand from engineering superintendent following a visual inspection showing erosion of the ditches	Energy & Infrastructure Superintendent	Photo of remediation work	Engineering to update the maintenance log of the structure
Ditches – release of TSS from the ditches	Corrective	Corrective action to mitigate release of TSS from ditches. Can include placement of sill curtain or temporary by-passing the ditches using pump	Following a demand from the environment superintendent following sampling of a high turbidity event from the diches	Environment Superintendent	Water sample results Photo of remediation work	Engineering to update the maintenance log of the structure
Pumping infrastructure						
Pumps and Genset – maintenance as per manufacturer specification	Preventative	Do PM on the pumping unit as per manufacturer recommendation	As per manufacturer specification	Pump mechanics	Equipment log Maintenance record	Maintenance to update the pump maintenance log or Genset maintenance log
Pumps and Genset – maintenance when deficiencies are observed (cavitation, breakdown, electrical trouble)	Corrective	Troubleshoot the pump problem so that it is once again operational	When the E&I Superintendent ask that a pump be fixed following a visual inspection of deficiencies	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 new pump is received on site that will be used in winter	Maintenance superintendent	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	Energy & Infrastructure Superintendent	-	-
Pipe – unfreezing a line	Corrective	Steaming the line to unfreeze it in winter	When the E&I Superintendent ask that a line be unfroze following visual inspection of a frozen line	Energy & Infrastructure Superintendent	-	-
Pipe – maintenance when deficiencies are observed (leak, pipe burst)	Corrective	Replacing a deficient part of a line with new pipe	When the E&I Superintendent ask that a line be repaired following visual inspection of pipe deficiency	Energy & Infrastructure Superintendent	-	-
Surveillance						

Component	Type of maintenance	Nature of the activity	Frequency of maintenance (preventative) OR Trigger of maintenance (predictive and corrective)	Responsible for the activity	Documentation Required	Reporting Requirement
Geotechnical Instrument – loss of reading	Corrective	Investigate the status of an instrument who no longer gave data	When an instrument no longer gave data for an unknown reason	Geotechnical technician	Update status in instrument database	Update of the geotechnical instrument database by the geotechnical technician
Geotechnical instrument – unusual reading	Corrective	Investigate the status of an instrument who gave unusual data	When an instrument gave an unusual data	Geotechnical technician	Update status in instrument database	Update of the geotechnical instrument database by the geotechnical technician
Geotechnical instrument – replacement	Corrective	Replace an instrument that no longer work	When the engineering superintendent as for a geotechnical instrument to be replaced	Geotechnical technician	Instrument installation as-built report Update spare inventory Calibration sheet Initial instrument reading	Update of the geotechnical instrument database by the geotechnical technician
Geotechnical instrument –calibration of total station	Preventative	Send the total station to be calibrated	yearly	Geotechnical technician	Calibration sheet	Update of the geotechnical instrument database by the geotechnical technician
Geotechnical instrument –calibration of inclinometer probe	Preventative	Send the inclinometer probe to be calibrated	yearly	Geotechnical technician	Calibration sheet	Update of the geotechnical instrument database by the geotechnical technician
Datalogger – maintenance	Preventative	Do maintenance of datalogger as per manufacturer specification	yearly	Geotechnical technician	Maintenance report	Update of the geotechnical instrument maintenance log by the geotechnical technician
Datalogger – battery change	Predictive	Change battery when the battery level alarm get triggered	When the battery alarm is triggered in VDV	Geotechnical technician	Maintenance report	Update of the geotechnical instrument maintenance log by the geotechnical technician
Datalogger – troubleshooting	Corrective	Repair of a dataloger deficiency	When a dataloger is suspected of being deficient	Geotechnical technician	Update status in instrument database	Update of the geotechnical instrument maintenance log by the geotechnical technician
Flowmeter – calibration	Preventative	Send the flowmeter to be calibrated	yearly	Energy & Infrastructure Superintendent	Calibration sheet	Update of the geotechnical instrument maintenance log by the geotechnical technician
Flowmeter – deficient reading	Corrective	Repair of a flowmeter deficiency	When the Engineering Superintendent ask that a flowmeter be troubleshoot based on irregular data	Energy & Infrastructure Superintendent	Update status in instrument database	Update of the geotechnical instrument database by the geotechnical technician
Other						
Dike crest access	Predictive	Snow clearing, maintaining roadway, grading access	As required to maintain access	Mine Superintendent	-	-
Access to sump	Predictive	Snow clearing, maintaining roadway, grading access	As required to maintain access	Mine Superintendent	-	-

SECTION 7 • SURVEILLANCE

Surveillance Involves the inspection and monitoring (i.e. collection of qualitative and quantitative observation and data) of activities related to water management infrastructures. Surveillance also includes the timely documentation, analysis and communication of surveillance results, to inform decision making and verify whether performance objective including critical controls are being met.

There are two types of surveillances activities which are further discussed in this chapter:

- Site observation and inspection
- Instrument monitoring

7.1 REFERENCE

Reference to key document for site observation & inspection of the Whale Tail water management infrastructure is presented in Table 7-1. Reference to key document for instrument monitoring is presented in Table 7-2.

Table 7-1: Key reference documents for Inspection of Whale Tail water management infrastructure

Type of information	Document #	Document Title and link
Simplified inspection form Template	-	OMS manual - Appendix A
Detailed visual inspection form template	-	OMS manual – Appendix A
Whale Tail Dike Dewatering inspection report		..\..\1 - Whale Tale Dike\4- Dewatering\1- Dewatering Inspection
Whale Tail Dike inspection report	WTD-VIR	..\..\1 - Whale Tale Dike\5 - Operation\1- Inspection
Mammoth Dike inspection report	MD-VIR	..\..\2- Mammoth Dike\4-Operation\1- Inspection\2019
WRSF Dike inspection report	WRSF-VIR	..\..\3- WRSF Dike\3-Operation\1- Inspection
NE Dike inspection report	NED-VIR	..\..\4- North East dike\3-Operation\1- Inspection
Attenuation pond and piping infrastructure inspection report	Dewatering Infrastructure -VIR	..\..\..\04- Water Management\6- Inspection
Annual dike safety inspection (annual geotechnical inspection)	-	..\..\..\10- Audit & External Inspection\2- Annual Geotech Inspection

Table 7-2: Reference documents for Instrument monitoring of Whale Tail water management infrastructure

Type of information	Link to Retrieve Information
Surveillance signoff log of Whale Tail water management infrastructure	..\..\..\..\10-Inspection\Inspection Signoff
Dewatering monitoring Report	..\..\1 - Whale Tale Dike\4- Dewatering\2- Dewatering Report
Geotechnical Instruments map (to come 30 days after instrumentation campaign)	-
Access to instrument data (restricted access)	http://cambeng1/
Instrumentation Report	..\..\7 - Instrumentation Report
Water Quality Result database (restricted access)	https://gim.golder.com/Agnico/
Blast vibration log	\\Cambfs01\groups\Engineering\05-Geotechnic\14-Amaruq\01 - Dewatering Dikes\1 - Whale Tale Dike\7 - Instruments\2- Instrument Data

7.2 SITE OBSERVATIONS AND INSPECTIONS

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

Site observation and inspections are used to identify and track visible change in the condition of the water management infrastructure. Changes that may be observed throughout site observations and inspections are included in Table 7-3

Table 7-3: Changes that may be observed through site observation and inspection of Whale Tail water management infrastructure

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. bulge, cracks, sinkhole, sloughing, settlement) • Newly form 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 form or expanding areas of erosion • Newly form of obstruction to flow (i.e. boulder, sediments, snow) • Newly form of slope instability
Changes related to water storage and transport
• Change in sump level • Verify using the staff gauge that the pond is operated within its normal operating condition • Changes in the seepage quantity (pumping rate) and quality (turbidity) • Condition of pipe for water transport • Sign of leaks from water line • Condition of pumps
Change related to surveillance instrumentation
• Condition of surveillance instruments and associate protection around instruments (i.e. cover, barriers to prevent vehicle damage) • Condition of power supplies for instruments (i.e. solar panel) • Condition of communication infrastructure associated with instruments (i.e. antenna, datalogger)

7.2.1 Site observation

Site observation is conducted by personnel working on or adjacent to water management infrastructure as part of their daily activities, maintaining awareness of the facility in the course of carrying their duties. Trained personnel such as geotechnical technician should be on the lookout for sign of changing condition as indicated in Table7-3 as adverse condition can develop rapidly between inspections. A simplified visual observation form can be used to document such observations but they do not need to be documented unless a new condition has been observed. Any new observation should be documented by photograph and reported to the geotechnical personnel or Engineering Superintendent.

7.2.2 Inspection program

Inspections are conducted by the engineering department 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 inspection, dike safety inspection and dam safety review. The following sub-section describe in more details the scope, frequency and responsible for each type of inspection.

7.2.2.1 Routine Visual Inspection

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 water management infrastructure performance and therefore require follow-up. The inspection need to cover the aspect described in Table 7-2. Of particular significance are new occurrences or noted changed in seepage, erosion, sinkholes, boils, slope slumping, settlement, displacement, or cracking of structure components. These inspections are held during dewatering and operation.

There are two approved inspection form for inspection; a simplified one and a detailed one. The detailed form should be used for monthly inspection while the simplified one can be used when inspection are required at an increased frequency. All area of the form must be filled.

The person responsible for the inspection must:

- Do the inspection as per the required frequency
- Fill all information on the proper inspection form
- Take picture 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. Photos should be annotated or captioned and should include a date stamp.
- Store electronically all photo and inspection form
- Update the surveillance log
- Ensure that the reviewer is aware that the document is ready to be reviewed

During the review process, the reviewer must:

- Ensure that all require information is present
- Ensure that the observation does not trigger a change in alert level
- Sign the inspection form as a reviewer
- Update the surveillance log
- Distribute the inspection results

The frequency for inspection of a structure will vary based on its TARP level and need to be updated in the surveillance log.

Table 7-4 summarise the Routine & Special visual inspection R&R, suggested frequency and scope in function of the alert level of the structure

Table 7-4 : Summary of routine inspection requirements

Structure	TARP Level	Inspection Responsible	Scope of inspection	Inspection Frequency	Reporting	Inspection Reviewer	Distribution List
Whale Tail Dike – Dewatering	Green	Geotechnical Engineer	All of Table 7-2	Daily	Simplified inspection form	-	Engineering Geotechnical Team, EOR
			Physical risk and surveillance	Bi weekly	Detailed inspection form	Geotechnical Coordinator	
		Water & Tailings Engineer	Water Storage and transport	At startup and bi&weekly	Detailed inspection form	Geotechnical Coordinator	
	Yellow	Geotechnical Engineer	All of Table 7-2	Daily	Simplified inspection form	Geotechnical Coordinator	Engineering Geotechnical Team, EOR
				Weekly	Detailed inspection form		
	Orange	Geotechnical Engineer	All of Table 7-2	Daily	Simplified inspection form	EOR	Engineering Geotechnical Team, EOR, designer, Management
				Weekly	Detailed inspection form + report presenting instrumentation data + report on action taken		
Whale Tail Dike, Mammoth Dike, WRSF Dike, NE Dike - Operation	Green	Geotechnical Technician	Physical risk and surveillance	Monthly	Detailed inspection form	Geotechnical Engineer	Engineering Geotechnical Team, EOR
		Geotechnical Engineer		Bi-weekly (from May to October)	Simplified inspection form	-	
	Yellow	Geotechnical Technician	All of Table 7-2	Monthly	Detailed inspection form + presentation and analysis of instrumentation data	Geotechnical Engineer	Engineering Geotechnical Team, EOR
		Geotechnical Engineer		Weekly	Simplified inspection form	-	
	Orange	Geotechnical Technician	All of Table 7-2	Weekly	Report on summary of surveillance activity + status of mitigation action	Geotechnical Engineer	Engineering Geotechnical Team, EOR, designer, Management
				Monthly	Detailed inspection form + presentation and analysis of instrumentation data	Geotechnical Engineer	Engineering Geotechnical Team, EOR
		Geotechnical Engineer		Daily	Simplified inspection form	Geotechnical Coordinator	Engineering Geotechnical Team, EOR
Attenuation Pond and Pumping Infrastructure – Operation	Green	Water & Tailings Engineer	Water storage and transport + physical stability of ramp	Monthly	Detailed Inspection	Geotechnical Coordinator	Engineering Geotechnical Team, E&I, EOR,
		Geotechnical Engineer		Bi-weekly	Simplified inspection form		
	Yellow	Water & Tailings Engineer or Geotechnical Engineer	Water storage and transport + physical stability of ramp	Weekly in area of concern	Detailed Inspection	Geotechnical Coordinator	Engineering Geotechnical Team, E&I, EOR,
	Orange	Water & Tailings Engineer or Geotechnical Engineer	Water storage and transport + physical stability of ramp	Daily	Simplified inspection form	Geotechnical Coordinator	Engineering Geotechnical Team, EOR, designer, Management
				Weekly in area of concern	Detailed Inspection		

7.2.2.1 Special Visual Inspection

Special inspections are conducted during and after unusual or extreme events that may impact the facility. Special inspections are conducted by the geotechnical engineer or Engineer of Record using the detailed inspection form and using the same procedure for review and documentation. Special visual inspection must be done on each structure after each of these events:

- At the end of dewatering once downstream toe is exposed
- Following a blast that exceed the vibration limits of the structure
- After an earthquake
- After a high intensity rainfall event (higher than a 1:2 years recurrence)
- Immediately after a site observation notice a change in condition
- Prior or immediately after increasing or decreasing the TARP level of a structure

7.2.2.2 Dike Safety Inspection (annual geotechnical inspection)

A dike safety review is a more comprehensive technical inspection, integrating inspections and results of monitoring instrument. This type of inspection is conducted by an external geotechnical engineer and supported by the Engineer of Record to have a more complete understanding of the facility performance and identify deficiencies in performance or opportunity for improvement. This will provide information to be used to revise the OMS manual.

For Whale Tail water management infrastructure such inspection need to occur on an annual basis between the month of July and September. The following components need to be inspected during this review:

- Whale Tail Dike, Mammoth Dike, WRSF Dike, NE Dike
- Attenuation pond and pumping infrastructure
- Ditches and channel

In addition to field inspection done as part of the safety review the following point should be addressed during the review:

- Review of all inspections report performed since the last review
- Review of monitoring instruments data;
- Identify deficiencies in performance or opportunity for improvement
- Review OMS performance and operational criteria and confirm that these meet the performance objective of the design
- Review and provide recommendations regarding OMS for the following year.

After each safety inspection a report must be submitted to the Engineering Superintendent which includes the results of the inspection done and addressing all point above. These reports will be stored electronically

7.2.2.3 Independent Dam Safety Review

Independent dam safety review are carried out by an independent third party to review all aspects of the design, construction, operation, maintenance, processes and other systems affecting the dam's safety, including the dam safety management system. The review defines and encompasses all components of the "dam system" under evaluation including the dam, foundations, abutments, instrumentation and seepage collection works. The independent third party for the Whale Tail water management infrastructure is the Meadowbank Dike Review Board (MDRB).

Modification to the MDRB composition can only be made by the Engineer of Record.

The Meadowbank Dike Review Board (MDRB) is comprised of the following member.

- Anthony Rattue
- Don Haley

An annual MDRB meeting will be held every year at the Meadowbank site. Other events that could trigger a MDRB meeting are:

- Major modifications to the design or design criteria;
- Discovery of unusual conditions that can compromise the integrity the water management infrastructure;
- After extreme hydrological or seismic events; and
- Decommissioning.

During the annual MDRB meeting, a dam safety review will be carried out according to the recommendations laid out in the Dam Safety Guidelines (CDA, 2013).

This review will include, but is not limited to:

- Review of the dikes classification;
- Site inspection;
- Review of design and construction records;
- Review of monitoring practices and the instrumentation records
- Assessment of the operation of the facilities;
- Provide recommendation on operation, maintenance and surveillance based on the results of the instrumentation readings, construction records and site observations;

7.3 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 infrastructure against the performance objectives and indicators and the critical controls (refer to table 4-2 and 5-2). Instrument monitoring and inspections work together as a comprehensive data set to enable assessment of the water management infrastructure performance and provide a basis for informed decision. 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 3-6 of this OMS manual.

Table 7-5 indicate the type of information collected through instruments monitoring and how it is collected. Table 7-6 summarise the data acquisition program related to instrument monitoring

Table 7-5: 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 • In-situ shape array inclinometer (SAA) to provide information on deformation within the cut-off wall • Survey monument to provide information on settlement and deformation • Staff gauge to inform about water level of a pond versus its operating level • Blast monitor to inform on potential impact of blasting vibration on the structure • Flow meters and seepage monitoring station to inform on volume of water movement • Surveys conducted to measure ice cover, water level, 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 • Water quality analysis of water discharged through diffuser to inform on Environmental compliance • Water quality analysis of water stored in the various pond on site to inform on water movement decision
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 7-6: Summaries of data acquisition program related to instrument monitoring of Whale Tail water management infrastructure

Instrument monitoring	Location of monitoring (3)	Parameter measured	Acquisition Methodology	Standard Acquisition frequency	Acquisition Responsible	Documentation methodology	Documentation Responsible
Thermistors	Whale Tail Dike, WRSF Dike, Mammoth Dike	Temperature (C^0) 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	Geotechnical Technician	Data are exported from VDV into instrumentation report emitted at a predetermined frequency (1)(2)	Geotechnical Engineer
Piezometer	Whale Tail Dike, Whale Tail South, Attenuation Pond	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	Geotechnical Technician	Data are exported from VDV into instrumentation report emitted at a predetermined frequency (1)(2)	Geotechnical Engineer
Shape array accelerometer (SAA)	Whale Tail Dike	Displacement in mm	In-situ instrument connected to automatic data acquisition and transmission system	New data are acquired and transmitted to VDV every 3 hrs	Geotechnical Technician	Data are exported from VDV into instrumentation report emitted at a predetermined frequency (1)(2)	Geotechnical Engineer
Survey monument (4)	-	Elevation of monument which is then converted into mm of displacement (minimum precision of 3 mm required)	Data are acquired using a total station	Monthly in winter and bi-weekly from May to September	Geotechnical Technician	Data are exported into geoexplorer. Instrumentation report are emitted at predetermined frequency (1)(2)	Geotechnical Technician
Staff Gauge	Attenuation pond, WRSF pond, NE pond	Water level in pond	Take picture of the gauge	During each inspection	Inspection officer	Within inspection report	Inspection officer
Blast Monitor	Whale Tail Dike, WRSF Dike, Mammoth Dike, NE Dike	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 vicinity of the dike	Geotechnical Technician	Update the blast vibration log. Discussion on recorded vibration in instrumentation report	Geotechnical Technician
Flow meter	NE pond, WRSF pond,	Volume of water pump (m^3)	Pumpman operator will inscribe flowmeter value on a pumping sheet	Daily when pump is operating	E&I Pump crew supervisor	Data will be integrated in the water balance	Water & Tailings engineer
Seepage monitoring station (manual reading with a V notch)	Where unpumped seepage is observed	Seepage flow (m^3/s)	Using a bucket and a stopwatch	Weekly during period of flow	Geotechnical Technician	Documented within instrumentation	Geotechnical Engineer
Survey shot	Whale Tail South, Whale Tail North, WRSF Pond, NE Pond	Elevation of the water level (minimum precision of 3 mm required)	Surveyor will take a water/ice level at a predetermined area	Once per week	Surveyor Leader	Integrated in the water movement log	Water & Tailings engineer
Airborne survey	All water management infrastructure	Topographic aerial survey made using drone	Surveyor will take a drone survey	Once per year after freshet	Surveyor Leader	Within survey database	Surveyor Leader
Water quality	Mammoth Lake, WTP discharge, WRSF pond, NE pond, attenuation pond, sumps (5)	Parameter 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 7-5 for more information on reporting methodology and the frequency of reporting
(2) Refer to section 7-6 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) Survey monument are planned to be installed in 2020
(5) Location of water quality sampling point can be found in water management plan

7.4 ADDING INSTRUMENT TO THE MONITORING PROGRAM

Any addition to the monitoring program must be validated by the Engineering Superintendent or by the Environment Superintendent for aspect relating to water quality. In-situ instrument installation must be recorded in an as-built report 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 coordinate (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

7.5 ANALYSIS OF SURVEILLANCE RESULTS

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

For visual inspection the process of analysing the data and communicating the results is describe in section 7-4 and happen at the same time 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 review to the TARP criteria which will then inform the action to take if performance indicator is not met.

For the instrumentation monitoring to be effective the data must be reviewed, analysed and reported at the proper frequency. Table 7-7 summarise the requirement for review, analyses and reporting of instrumentation data.

The person responsible for instrumentation data review need to update the surveillance log each time an instruments results has been reviewed and analysed. The person responsible for review of reporting and distribution need to update the surveillance log once the report has been reviewed and distributed.

Instrumentation	TARP Level	Expected range of observation	Responsible for review & analyse	Frequency of review	Responsible for reporting	Reporting frequency	Responsible for review and distribution	Distribution List
Piezometer, thermistor, SAA, (**Dewatering**)	Green	Define in TARP for dewatering	Geotechnical Engineer	Daily	Geotechnical Engineer	Bi-weekly instrumentation report	Geotechnical Coordinator	Engineering geotechnical team, designer, EOR
	Yellow	Define in TARP for dewatering	Geotechnical Engineer	Twice a Day	Geotechnical Engineer	Weekly instrumentation report	Geotechnical Coordinator	Engineering geotechnical team, designer, EOR
	Orange	Define in TARP for dewatering	Geotechnical Engineer	Twice a Day	Geotechnical Engineer	Weekly instrumentation report	Geotechnical Coordinator	Engineering Geotechnical Team, EOR, designer, Management
Piezometer, thermistor, SAA, survey monument (**Operation**)	Green	Define in TARP of each structure	Geotechnical Engineer	Bi-Weekly	Geotechnical Technician	Quarterly instrumentation report	Geotechnical Engineer	Engineering geotechnical team, designer, EOR
			Geotechnical technician	Weekly				
	Yellow	Define in TARP of each structure	Geotechnical Engineer	Weekly	Geotechnical Technician	Instrumentation reporting included within monthly inspection report	Geotechnical Engineer	Engineering geotechnical team, designer, EOR
			Geotechnical technician	Every 3 days				
	Orange	Define in TARP of each structure	Geotechnical Engineer	Daily	Geotechnical Engineer	Instrumentation reporting included within weekly update report	Geotechnical Coordinator	Engineering Geotechnical Team, EOR, designer, Management
			Geotechnical technician	Daily				
Staff Gauge / Survey shot (freeboard)	Green	Define in TARP of each structure	Water & Tailings Engineer	Weekly	Water & Tailings Engineer	Within the monthly attenuation pond and pumping infrastructure inspection report	Geotechnical Coordinator	Engineering geotechnical team, designer, EOR
	Yellow	Define in TARP of each structure	Water & Tailings Engineer	Daily	Water & Tailings Engineer	Within the monthly attenuation pond and pumping infrastructure inspection report	Geotechnical Coordinator	Engineering geotechnical team, designer, EOR
	Orange	Define in TARP of each structure	Water & Tailings Engineer	Twice a day	Water & Tailings Engineer	Included within weekly update report	Geotechnical Coordinator	Engineering Geotechnical Team, EOR, designer, Management
Blast Monitor	-	PPV> 50 mm/s	Geotechnical Technician	After retrieving a blast monitor on a water management structure	Geotechnical Technician	In Quarterly instrumentation report	Geotechnical Engineer	Engineering geotechnical team, designer, EOR
Flow meter / Seepage monitoring	Green	Define in TARP of each structure	Water & Tailings Engineer	Weekly	Water & Tailings Engineer	During the monthly update of the water balance	Geotechnical Coordinator	Engineering geotechnical team, designer, EOR
	Yellow	Define in TARP of each structure	Water & Tailings Engineer	Daily	Water & Tailings Engineer	During the monthly update of the water balance	Geotechnical Coordinator	Engineering geotechnical team, designer, EOR
	Orange	Define in TARP of each structure	Water & Tailings Engineer	Twice a day	Water & Tailings Engineer	Included within weekly update report	Geotechnical Coordinator	Engineering Geotechnical Team, EOR, designer, Management
Water quality	Green	Define in TARP of each structure	Environment General Supervisor	As per water management plan	Environment General Supervisor	As per water management plan	Environment Superintendent	Engineering geotechnical team

	Yellow	Define in TARP of each structure	Environment General Supervisor	As per water management plan	Environment General Supervisor	As per water management plan	Environment Superintendent	Engineering geotechnical team
	Orange	Define in TARP of each structure	Environment General Supervisor	As per water management plan	Environment General Supervisor	As per water management plan	Environment Superintendent	Engineering geotechnical team

Table 7-7 :Requirement for review, analyses and reporting of instrument data

7.5.1 Procedure in case of data exceeding expected range of observation

If data exceeding the expected range of observation or anomalous data readings are observed, the following actions need to be taken:

- Re-read to check the reading (if the reading is from VDV, take a manual reading in the field);
- Check readout equipment to verify that it is functioning correctly;
- Verify calibration;
- If instrument has stopped functioning, notify the Engineering Superintendent immediately. If considered critical, a replacement instrument should be installed;
- If 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 Engineering Superintendent. Any malfunctioning instrument or frozen piezometer must be documented.
- In the case of valid data that would exceed the TARP level do a special inspection if possible.

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

7.5.1.1 Blast Monitor

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 changing condition.

If more than one occurrence of blast vibration exceeding the limit are observed within a 2 weeks period the Engineering Superintendent needs to be notified of the situation.

7.5.2 Anomalous Instrumentation Data

Anomalous instrumentation data includes the following as presented in Table 7-7. These anomalies could happen without triggering a TARP level change and need to be investigated and recorded:

Table 7-8: Example of anomalous data and some common cause

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 or a sheared cable)
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); • Sharp increase in reading (verify that the instrument is not frozen) • Loss of data (could be a transmission error, faulty hardware or a sheared cable)
SAA
• 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)
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 seem to not reflect the probable water elevation. This could be due to a settlement or displacement of the staff gauge. • Increase or decrease in 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 taken at the good location, wave actions or daily variances in GPS signal

7.6 SURVEILLANCE DOCUMENTATION & REPORTING

One visual inspection report per structure needs to be completed, reviewed and distributed per the frequency in Table 7-4.

An instrumentation report need to prepare at predetermined frequency to present all instrumentation monitoring data as described in Table 7-8.
Table 7-9 describe how instrumentation data should be reported.

Instrumentation reports need to include the following information:

- Table presenting all the instruments installed on each structure, their status and pertinent installation information
- Graph of all instruments for all structure covered by the report. The graph need to present data for a minimum period of 1 year. Higher recurrence should be presented if clarity of the presented information allows it. The graph need to be presented in a way that allow for data interpretation without referring to other document
- Analyses of all instruments data presented highlighting specific trend
- Discussion on anomalous trend

For the structure having a yellow Tarp level the instrumentation data relevant to the cause of the alert need to be included with each visual inspection report.

For the structure having an orange Tarp level the instrumentation data relevant to the alert level need to be included with each inspection report. In addition the weekly update reports need 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
- What is the mitigation plan and what action have been taken since the last update report
- Discussion on the result of the instrumentation data

Table 7-9: How data should be presented in report for instrumentation monitoring

Thermistance
• Temperature vs. depth plots over time. • The plot should indicate the thermistor string reference number and date of each measurements presented • The plot need to indicate relevant stratigraphy and their depth • Plot need to be presented with a cross-section of the installation (if on a structure) as well as a plan view showing the instrument location
Piezometer
• Plots of total head as elevation versus time; and • Plot need 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 need to indicate the instrument number, the dates of each measurement and a mention if the temperature read by the instrument is less than 0 degree
SAA
• Cumulative displacement plots (to view total displacement); • Incremental displacement plots (to present increasing or accelerating movements between readings); • Cumulative displacement at crest versus time; and • Time plots at zones of identified displacement. • The plot need 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 need to be included showing the instrument location
Survey Monument
• Total net movement plots (to present total displacement); • Vertical displacement plots; and • Lateral displacement plots parallel and perpendicular to the dike axis • The plot need to indicate the survey monument number, what is considered positive and negative displacement and the dates of each measurement • A plan view need to be included showing the instrument location

7.7 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. The following will be stored in the hard copy and/or electronic format. Section 7.1 indicates where each of these items can be found electronically:

- Instrumentation report
- Visual inspection report
- Weekly report for structure in orange Tarp level
- Dike safety inspection (annual geotechnical inspection)
- Dam Safety Review report;
- Surveillance log
- Instruments database and map
- Maintenance log of geotechnical instrument
- Maintenance log of water management infrastructure
- Pump maintenance record

Appendix A

Simplified Inspection Form

Detailed Inspection Forms Template

Simplified Surveillance Form

Structure :	Date :
Surveillance done by :	

Item		Changing condition ? Yes	No	NA	Comments
1	Freeboard and pond level				
2	Tension Cracks				
3	Sinkhole				
4	Settlement				
5	Sloughing				
6	Erosion				
7	Debris & Obstruction (ditches, sump)				
8	Seepage				
9	Turbidity				
10	Instrumentation Condition				
11	Piezometric reading				
12	Thermistor reading				
13	SAA reading				
14	Flowmeter				
15	Condition of pipe and pump				

Recomendation

This simplified form is to be used as per the OMS manual instruction. The surveillance log must be updated after this surveillance report is filed. All condition deviating from normal operating threshold must be described in the comments section. Picture of changing condition should be attached to this document. Any changing condition must be reported to the geotechnical engineer. Any chaning condition trigering a change in threshold level must be communicated to the Engineering Coordinator or Superintendant

DIKE VISUAL INSPECTION REPORT

AGNICO EAGLE
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The instrumentation data is treated separately in the instrumentation quarterly report.

Inspecting Officer	Choose an item.
Report No.	Dike-VIR-
Inspection Date	

Dike name	

Last Inspection Date						
Weather during the current inspection		Sunny ☐	Overcast ☐	Rain ☐	Snow ☐	Wind ☐
	Comments:					
Main changes since the last inspection						

Tarp level (Based on OMS manual revision from March 2018)	

General Condition Summary

-

Inspecting Officer: ________________ Review Officer: ________________ Date Reviewed: ________________
(YY/MM/DD)

DIKE VISUAL INSPECTION REPORT

AGNICO EAGLE
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Field observations

Location	Observations	Recommendations
Downstream slope and berm	▪	▪
Upstream slope and berm	▪	▪
Crest	▪	▪

Seepage Report

Location	Observations	Recommendations
	▪	▪

Methodology: For the visual inspection, any anomaly or change since the last inspection must be reported. These anomalies include cracks, erosion, settlements, sink holes, bulging, sloughing, seepage signs, snow/ice, rutting, mud, ponds/puddles, signs of saturated soil and any damage on the liner or objects/water over the liner.

DIKE VISUAL INSPECTION REPORT

Aerial view of the Dike

DIKE VISUAL INSPECTION REPORT

Map of the Dike

DIKE VISUAL INSPECTION REPORT

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Downstream slope and berm

DS1: Downstream slope and berm.	Location and orientation of DS1.

DS2: Downstream slope and berm.	Location and orientation of DS2.

DIKE VISUAL INSPECTION REPORT

Upstream slope and berm

US1: Upstream slope. Lake is frozen.	Location and orientation of US1.

US2: Upstream slope.	Location and orientation of US2.

DIKE VISUAL INSPECTION REPORT

Crest surface

CR1: Rolling surface.	Location and orientation of **CR1**

Appendix B

Potential Mitigation for Upset Condition

Potential Mitigation Plan for Upset Condition on Water Management Infrastructures

Upset Condition	Area / Cause		Comments/Monitoring	Contingency or Corrective Action
Overtopping and Subsidence	1a	Water level rise / storm event	Lake levels and crest elevations is 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 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 comprises of coarse rockfill. Significant damage to the dike is not credible, based on performance of other rockfill structures subjected to overtopping or flow through events Rockfill from the mining operations can be placed to raise the dike crest and compensate settlement. Mining operations 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 makes this a low concern	Rip-rap can be added and/or 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 is 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 mining.	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 in to a large inflow, and could lead to the undermining of the dike if no action was taken. This is a credible catastrophic mode if increased seepage is not detected in time. No particular instrumentation is needed as this failure mode will show itself as localized and increasing seepage. It could be detected by walk-over inspection by an experienced engineer or technician.	Remedial action could comprise a reverse filter and rockfill buttress depending on location of the flow and configuration of the foundation, freezing or grouting, if identified in time. In the worst case, the pit may be deliberately flooded in a controlled manner, the cut-off repaired and the pit dewatered. Build additional dike downstream increasing pumping.

Upset 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 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 stabilising 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 and which would extend into the overlying dike. Sliding failure is considered unlikely given the low horizontal forces generated by the water and ice relative to the normal frictional force due to the weight of the dikes and the frictional angles of foundational materials. This mechanism should develop during construction or dewatering, due to the increase in load and associated pore water pressure development. Initial stages of failure should be observable as tension cracks in the dike crest. Walk-over inspection of the dike by trained inspector is an appropriate monitoring strategy in addition the instrumentation. Survey of crest face and toe is conducted.	Re-assess stability (numerical modelling) and construct a stabilising berm if required Fill inactive tension cracks with bentonite
	4b	Earthquake Induced: Slope Failure	Site is located in a low seismic zone. Dam consisting of massive rock zone has a low sensitivity to seismic motion.	Do 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 self-weight of the dike versus ice loads and water pressure. Large inflows through the breach may occur as a consequence if the cut-off wall breached. Pit would flood requiring suspension of mining activities. Potential for loss of life of workers inside dikes. Inclinometer, settlement prism and monument monitoring is done routinely.	Repair the cutoff wall
Subsidence	6	Foundation Soils	Unexpected foundation soils consolidated during dike construction or dewatering. A significant quantity of clay would be required to generate settlement resulting in a water release event. Prism 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. Soil conditions will be observed during dewatering to accommodate actual conditions.
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

Upset Condition	Area / Cause		Comments/Monitoring	Contingency or Corrective Action
Pump and Pipeline Failure	8	Pumping infrastructures	Freezing protection is provided by heat tracing and insulation. Pipelines monitored pump pressures at plant and frequent site inspection.	Replace defect in pipeline Repair the pump and use another pump in the meantime

Water Quality and Flow Monitoring Plan, Version 6

AGNICO EAGLE

MEADOWBANK DIVISION

WHALE TAIL PIT

Water Quality and Flow Monitoring Plan

MARCH 2019

VERSION 6

EXECUTIVE SUMMARY

The purpose of this Water Quality and Flow Monitoring Plan is to establish the program to be implemented and followed by Agnico Eagle's environmental management team to monitor the performance of the waste and water management systems at the Whale Tail Pit Project.

The Plan is one component of the *Aquatic Effects Management Program* (AEMP) and is closely associated with the *Water Management Plan* and the *Core Receiving Environment Management Plan* (CREMP). The Water Quality and Flow Monitoring Plan summarizes the monitoring locations, sampling frequency, monitoring parameters, compliance discharge criteria and an adaptive management plan for water quality at the Whale Tail Pit.

Section 2 in this Plan includes an overview of the monitoring programs and mine development schedule. Section 3 provides specific details (including sampling locations and parameters to be measured) for the compliance monitoring program, along with general guidance for the event monitoring program. An adaptive management program is described for both regulated discharges and non-regulated discharges in Section 3 as well. Requirements of the flow monitoring program are described in Section 4, and an overview of the reporting requirements is described in Section 5.

This Plan has been updated to meet terms and conditions 17 and 18 in Project Certificate No. 008 and Type A Water License 2AM-WTP1826.

IMPLEMENTATION SCHEDULE

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

DISTRIBUTION LIST

Environmental Superintendent
Environmental General Supervisor
Environmental Coordinators
Environmental Technicians
Engineering Superintendent
Geotechnical Coordinator
Water Engineer

DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
1	January 2017			Comprehensive plan for Whale Tail Pit project.
2	May 2017	1.0	1	Updated to include sampling station during post-closure (based on Commitment #2 from the Technical Meeting April 28-May 2, 2017; Agnico Eagle 2017)
	May 2017	Figure 2.4	-	Updated to include sampling station during post-closure (based on Commitment #2 from the Technical Meeting April 28-May 2, 2017; Agnico Eagle 2017)
	May 2017	Table 3-1	-	Updated to include sampling station during post-closure (based on Commitment #2 from the Technical Meeting April 28-May 2, 2017; Agnico Eagle 2017)
3	May 2018	All	multiple	Updated to meet Nunavut Impact Review Board Project Certificate Number 008, Term and Conditions 17 and 18.
4	August 2018	All	multiple	Updated to align with NWB Water Licence 2AM-WTP1826
5	October 2018	2.3, 3.1	multiple	Updated to align with recommendations issued by CIRNAC and ECCC in October 2018 Updated to align with recommendations issued by CIRNAC and ECCC in October 2018
6	March 2019	All	multiple	Updated to add the NWB Schedule 1 modification

Prepared by:

Agnico Eagle Mines Limited - Meadowbank Division

Plan approved by:

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Meadowbank Environment General Supervisor

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SECTION 1. INTRODUCTION

The Water Quality and Flow Monitoring Plan (the Plan) has been prepared to meet Type A water Licence requirements (Water Licence 2AM-WTP1826, including modified Schedule I as approved by the Nunavut Water Board (NWB) through Board Motion NO. 2018-A1-023, dated December 6, 2018, as required by Part G, Item 2 of the Licence), and Project Certificate No.008. This Plan is one component of the Aquatic Effects Management Program (AEMP) and is closely associated with the Water Management Plan and the Core Receiving Environment Management Plan (CREMP). The Plan summarizes the monitoring locations, sampling frequency, monitoring parameters, compliance discharge criteria and an adaptive management plan for water quality at the Whale Tail Pit.

The purpose of this Water Quality and Flow Monitoring Plan is to establish the program to be implemented and followed by Agnico Eagle's environmental management team to monitor the performance of the waste and water management systems for the Project. The program includes:

- A Plan to verify and validate the results of predictive water quality modelling with empirical measurements of the mine site water quality and flows;
- An assessment of the effects of project activities and infrastructure on surface water quality conditions;
- A comparison of measured water quality data to compliance requirements;
- A monitoring plan with documentation to track the quantity of water that contacts mine ore and wastes, management of contact water to protect aquatic resources, and water conservation and recycling; and
- A framework for adaptive management that allows the identification and rectification, where necessary, of unexpected trends or non-compliance in water quality and flows.

The Plan provides information on the locations of the monitoring stations at the various stages of mining. These monitoring locations are used to evaluate the performance of the mine waste and water management system.

The objectives of the monitoring program are:

1) to track the chemistry of the contact and non-contact water prior to and during discharge;
2) to assist in identifying if water treatment is required prior to discharge;
3) to minimize the potential impacts of mining activities on the surrounding environment;
4) to confirm that non-contact water is clean; and
5) to demonstrate contact water is being captured and managed accordingly.

Additional locations outside the footprint of the Amaruq property (and outside the scope of this Plan) are monitored under the Aquatic Effects Management Program and the Core Receiving Environmental Monitoring Plan (Azimuth 2015, 2016, 2018a, 2018b).

There are three main surface water quality monitoring programs designed for the monitoring and protection of the receiving environment:

- Water Quality Monitoring and Management Plan for Dike Construction Dewatering
- Water Quality and Flow Monitoring Plan

- Core Receiving Environment Monitoring Program

Through these combined programs, water quality will be monitored at various locations (including two reference lakes), at least annually, and during all phases of the project.

SECTION 2. BACKGROUND

2.1 OVERVIEW OF SITE WATER MANAGEMENT PLAN

Details of overall water management are discussed in the Whale Tail Pit Water Management Plan which is updated as needed to reflect changes in operation and/or technology or as otherwise required by a Water Licence. All contact water from the mine facilities including the waste rock storage facilities (WRSF), Whale Tail open pit, and other disturbed areas will be directed by pumping or berms and other surface diversions to either of the following:

- Sumps from which the water will be pumped to the Whale Tail Attenuation Pond; or
- The open pits during re-flooding and after mining activity has ceased.

As specified in the Water Management Plan: All contact water will be intercepted, contained, analyzed, treated, if required, and discharged to the receiving environment only when water quality meets the discharge criteria. The Water Management Plan is intended to ensure appropriate destination and treatment of contact water as well as water conservation and recycling to minimize the use of natural water.

2.2 MONITORING PROGRAMS

The Water Quality and Flow Monitoring Plan has been divided into two levels of monitoring to characterize the range of potential effects between the sources of contact water in the individual mine facilities and the point of discharge or release to the receiving environment. The two levels of monitoring include:

1) compliance monitoring; and
2) event monitoring.

2.2.1 Compliance Monitoring Program (CM)

The compliance monitoring (CM) sites are those stipulated in a water Licence; these sites vary from contact water collection ditches and attenuation ponds to sampling in areas prior to discharge to the receiving environment. The requirements of the Water Licence 2AM-WTP1826 including water quality limits will be applied at the applicable mine discharge points identified in the CM program.

The CM program provides a mechanism to assess water quality at specified sites, to confirm and to document compliance of discharge with regulatory requirements. As part of adaptive water management, these internal monitoring stations provide protection to the receiving water environment, provide data to predict pit re-flooding water quality and ensure exceedances of predicted or regulated levels are appropriately managed or mitigated to reduce impacts.

The water quality and flow monitoring program was designed as a complimentary plan to the Core Receiving Environment Monitoring Program – Whale Tail Pit Addendum (CREMP; Azimuth 2016), the Groundwater Monitoring Plan and the Water Quality Monitoring and Management Plan for Dike Construction Dewatering.

2.2.2 Event Monitoring Program (EM)

The EM sites result from unexpected events such as spills, accidents, and malfunctions. The response programs for such events are discussed in greater detail in the following documents:

- Spill Contingency Plan;
- Emergency Response Plan; and
- Whale Tail Pit Water Management Plan.

Each accidental release will require mobilization of site equipment to stabilize the release, procedures to contain, neutralize, and dispose of the discharge, and recommendations for monitoring the site following the incident.

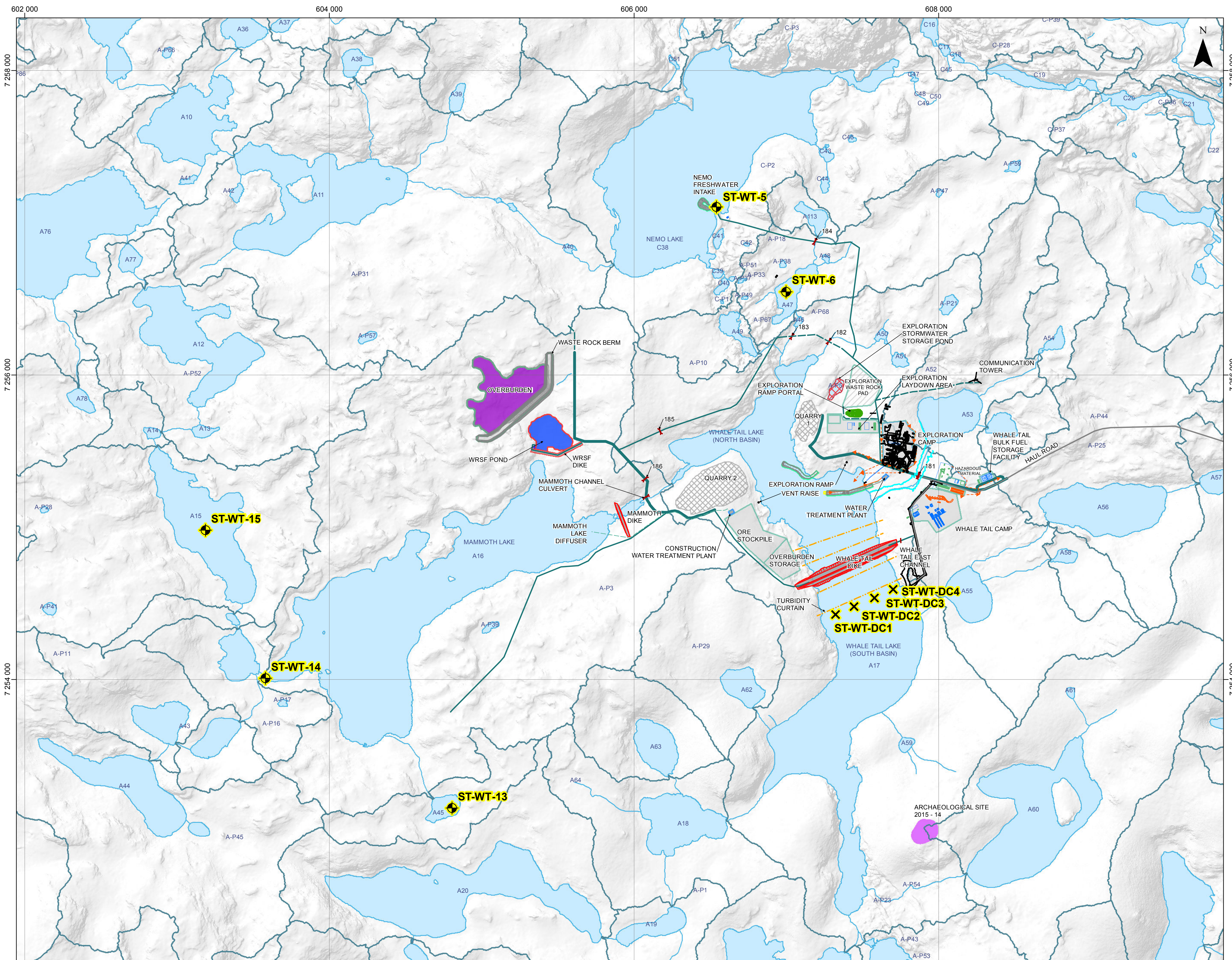
2.3 OVERVIEW OF MINE DEVELOPMENT SCHEDULE

The Project is a satellite deposit located on the Amaruq property, to extend mine operation and milling at the Meadowbank Mine. The open pit mine, mined by truck-and-shovel operation, will produce 8.3 million tons (Mt) of ore, 68.2 Mt of waste rock and overburden material between 2018 and 2022. Figures 2-1, 2-2, 2-3 and 2-4 show the sequence of staged development of Whale Tail Pit, from the pre-development and construction, operations, closure, and post-closure phases, respectively. These figures show the water quality monitoring location by mine phase. The actual configuration of the pit may change as mining progresses. As a result, the monitoring program (Section 3.0) accommodates changes in the pit design.

The staged development of the mine facilities has been divided into four phases for monitoring purposes. The four phases include:

- Construction phase (illustrated on Figure 2-1);
- Operations phase (illustrated on Figure 2-2);
- Closure phase (illustrated on Figure 2-3); and
- Post-closure phase (illustrated on Figure 2-4).

A summary of site activities and water quality monitoring issues during these phases is provided below.



MONITORING PLAN

- Turbidity monitoring station
- Water quality monitoring station

PROJECT COMPONENTS

- Road
- Temporary road
- Collection channel
- Culvert
- Contact water pipe
- Freshwater pipe
- Turbidity curtain
- Dike
- Overburden
- Quarry
- Storm water storage pond
- Pond/sump

HYDROGRAPHY

- Watercourse
- Lake
- Natural watershed

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AMARUQ GOLD MINING PROJECT
Water Quality and Flow Monitoring Plan

Site Layout and Monitoring Plan
Year -1: 2018

Sources:
Topography, PhotoSat, 2015
CanVec, NRCan, 2016
Project components : May 2018

Project: 655183
File: snc655183_f2-1_MonitPlan_Year-1_180730.mxd

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UTM projection, Zone 14, NAD83 (CSRS)

July 30, 2018 **Figure 2-1**

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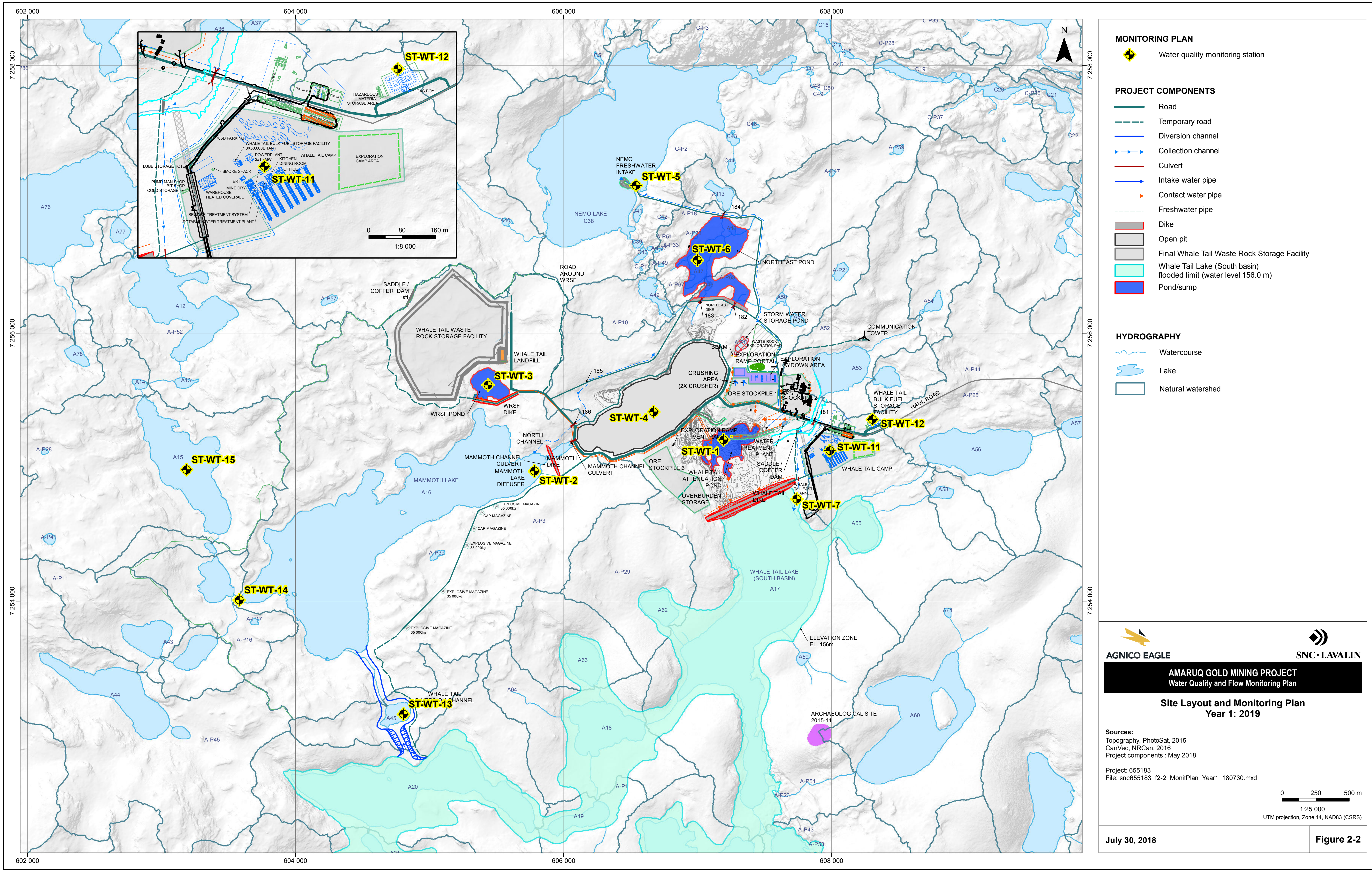
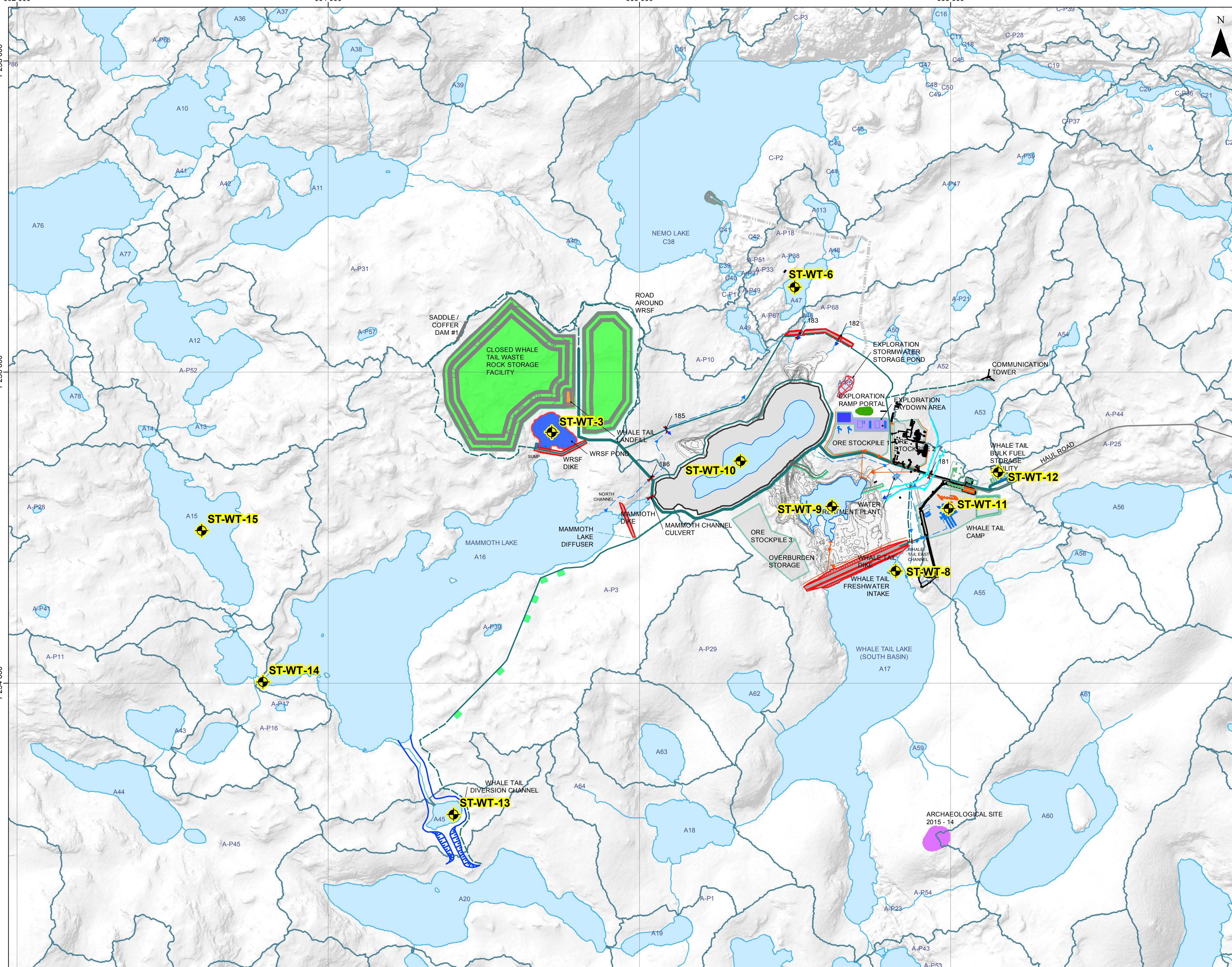


AMARUQ GOLD MINING PROJECT
Water Quality and Flow Monitoring Plan

Site Layout and Monitoring Plan
Year 1: 2019

July 30, 2018

Figure 2-2



MONITORING PLAN

- Water quality monitoring station

PROJECT COMPONENTS

- Road
- Temporary road
- Scarified road and access
- Diversion channel
- Collection channel
- Culvert
- Contact water pipe
- Freshwater pipe
- Dike
- Open pit
- Closed facility
- Exploration laydown area
- Storm water storage pond
- Pond/sump

HYDROGRAPHY

- Watercourse
- Lake
- Natural watershed

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AMARUQ GOLD MINING PROJECT
Water Quality and Flow Monitoring Plan

Site Layout and Monitoring Plan
Year 4: 2022

Sources:
Topography, PhotoSat, 2015
CanVec, NRCan, 2016
Project components : May 2018

Project: 655183
File: snc655183_f2-3_MonitPlan_Year4_180730.mxd

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UTM projection, Zone 14, NAD83 (CSRS)

July 30, 2018

Figure 2-3

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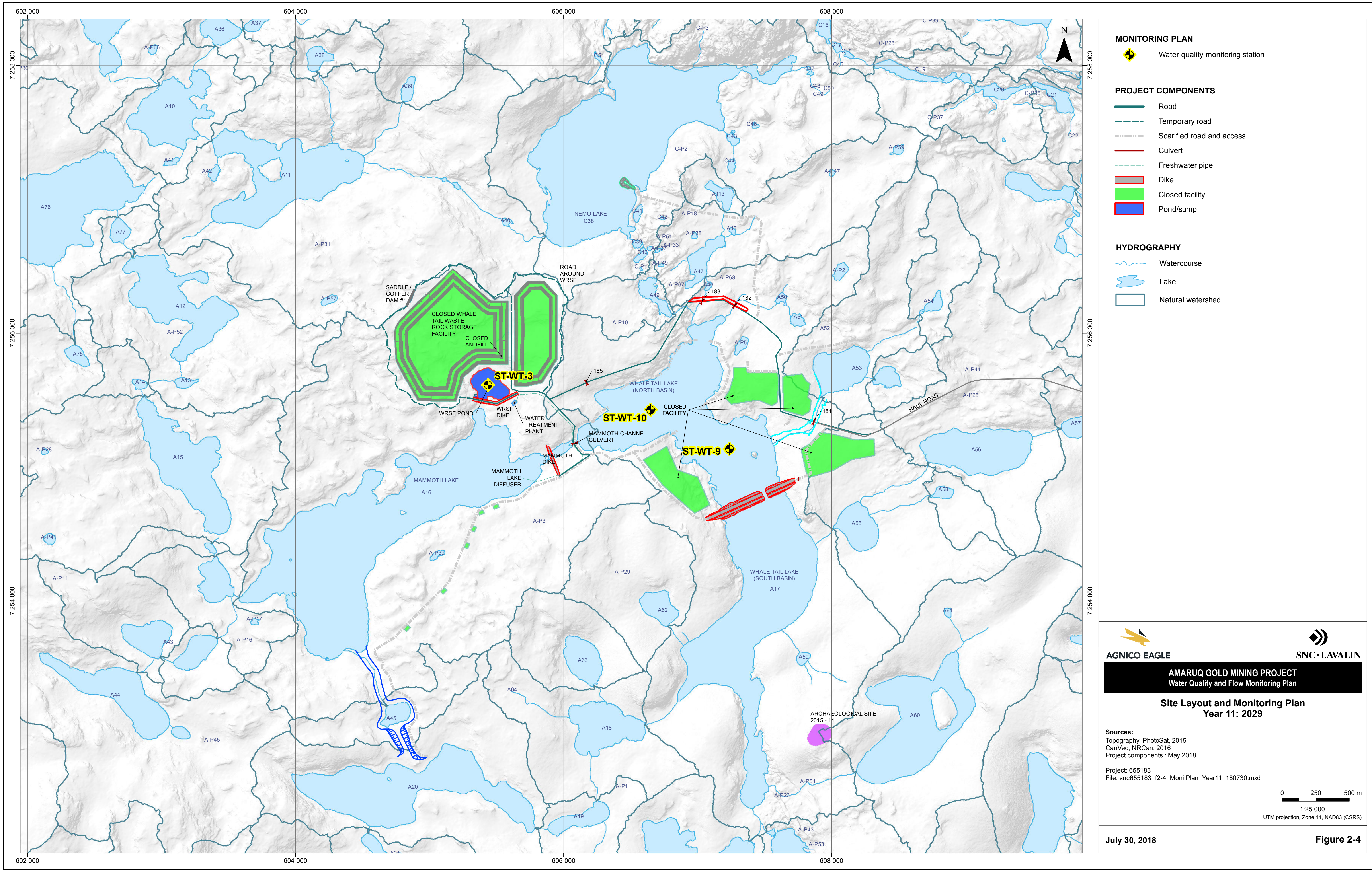

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2.3.1 Pre-development and Construction Phase

The principal impacts resulting from construction activities may be the increase in turbidity and TSS from the release of particulates during dike construction, surface runoff, the disturbance of lake sediments and the dewatering of future mining zones. Management and monitoring of these impacts are discussed in the AEMP and the Water Quality Monitoring and Management Plan for Dike Construction and Dewatering. Construction of the Whale Tail Pit site has commenced.

2.3.2 Operations Phase

During the operations phase, mining will occur in the Whale Tail Pit. Most of the waste rock generated from the pit will be deposited in the waste rock storage facility (WRSF), however some NPAG waste rock may be used for construction of mine infrastructure (roads, dikes), and potentially some for fish habitat structures. Milling and tailings will be regulated under the 2AM-WTP1826 Type A Water Licence. During the early operations phase, mine water from the individual pit sumps including dike seepage will be pumped to the Attenuation Pond. Water from the Attenuation Pond will be discharged to Mammoth Lake during the open water period on an annual basis through a diffusor. This water will be treated as required (e.g., TSS arsenic, and phosphorus) prior to being discharged.

The operations phase will span three to four years, from Year 1 (2019) to Year 4 (2022).

2.3.3 Closure Phase

Mining activities are currently expected to end during Year 4 (2022). Closure will occur from Year 4 (2022) to Year 11 (2029) after the completion of mining and will include removal of the nonessential site infrastructure and flooding of the mined-out open pit, as well as reestablishment of the natural Whale Tail Lake water level.

The Dikes will be decommissioned once water quality within the pit lake meets discharge criteria. Activities during the late closure phase will be primarily monitoring of selected mine facilities including flooded pit lakes and the reclaimed WRSF areas.

Further details about closure is covered in the Interim Whale Tail Closure and Reclamation Plan.

2.3.4 Post-closure Phase

Activities during the post-closure phase will be primarily monitoring of selected mine facilities including flooded pit lakes and the reclaimed WRSF area. The Dikes will be breached once water quality within the pit lake meets discharge criteria – CCME guideline for the Protection of Aquatic Life and background levels for parameters not listed in the CCME guideline.

Post-closure monitoring to confirm physical and chemical stability is planned until 2046.

SECTION 3. MONITORING PROGRAM

The monitoring program is presented in three sections; requirements of the compliance monitoring (CM) program, an overview of the event monitoring program (i.e., monitoring that occurs after spills or emergencies), and details of the adaptive management program for monitoring results.

3.1 COMPLIANCE MONITORING PROGRAM

The CM program monitors the chemistry of mine contact water and diverted water at specified locations prior to the release into the receiving water environment in order to confirm and document compliance with regulatory requirements. The types of water and the timing of the CM program include:

- non-contact water discharged from diversion ditches during operations, and closure phases of the mine and eventually non-contact water from dike seepage;
- mine contact water directed to and discharged from the Attenuation Pond during the operations phase of the mine;
- monitoring points located within the pit lakes and the flooded Whale Tail Attenuation Pond before and after the dikes have been breached during the late-closure phase of the mine life; and
- runoff from Whale Tail WRSF prior to discharge to Mammoth Lake.

The CM sampling program has multiple monitoring stations across the project site, with sampling at different stages of the mine life. All of the CM stations, a description of their location, parameters to be monitored and sampling frequency are listed in Table 3-1. Specific details for the monitoring parameter groups are provided in Table 3-2 and are the same as presented in 2AM-WTP1826 Water Licence. In summary, 6 groups of parameters include:

- Group 1 – mine site monitoring parameters;
- Group 2 – receiving environment parameters consistent with the CREMP and applied to all AEMP stations (including ground water monitoring); includes dissolved metals for hydrogeological monitoring and to be protective of the aquatic environment;
- Group 3 – sampling prior to discharge; includes MDMER parameters plus sulphate, turbidity and Aluminum;
- Group 4 – sampling prior to discharge at secondary containment fuel storage areas;
- Group 5 – MDMER; and
- Group 6 – Field Measurements

Figures 2-1 and 2-4 show the approximate location of the sampling sites at the Whale Tail Pit area. The actual location of each sampling site is determined by access and safety considerations and will be marked by a stake (where appropriate) that defines the exact location of the collection point for sampling events with appropriate attached signage in English, Inuktitut, and French.

GPS coordinates for all compliance monitoring stations will be confirmed with the Water Resources Officer.

Table 3-1: Monitoring Program

Station	Description	Phase	Monitoring Parameters or Group	Frequency
ST-DC-1 to TBD	Monitoring stations during dike construction as defined in the Whale Tail Water Quality Monitoring and Management Plan for Dike Construction and Dewatering	Construction	As defined in Water Quality Monitoring and Management Plan for Dike Construction and Dewatering referred to in Part D, Item 5	As defined in Water Quality Monitoring and Management Plan for Dike Construction and Dewatering referred to in Part D, Item 5
ST-DD-1 to TBD	Monitoring Program stations during dike dewatering as defined in the Whale Tail Water Quality Monitoring and Management Plan for Dike Construction and Dewatering	Construction	As defined in Water Quality Monitoring and Management Plan for Dike Construction and Dewatering referred to in Part D, Item 5	As defined in Final Water Quality Monitoring and Management Plan for Dike Construction and Dewatering referred to in Part D, Item 5
ST-S-1 to TBD	Seeps (to be determined)	Operations	Group 1	Monthly or as found
		Closure	Group 1	Monthly or as found
ST-GW-1 to TBD	Groundwater wells (to be determined) as required under Groundwater Monitoring Plan	Operations	Group 2	Annually
		Closure	Group 2	Annually
ST-WT-1	Attenuation Pond, pre-treatment	Operations	Group 1	Four times per calendar year
ST-WT-2	Attenuation Pond, post treatment; last point of control before discharge	Operations	Volume (m^3)	Daily during periods of discharge
			Field Measurements	Weekly during periods of discharge
			Group 2	Weekly during periods of discharge
			Group1-MDMER Effluent characterization	Four times per calendar year
			Group 3-MDMER Acute Toxicity	Once prior to discharge and Monthly thereafter
			3-MDMER sub-lethal toxicity	Two times per calendar year
ST-WT-3	Waste Rock Storage Facility (WRSF) Pond prior to pumping to Attenuation Pond	Operations	Group 1	Four times per calendar year, when water is present.
		Closure	Group 1	Four times per calendar year, when water is present.
	Waste Rock Storage Facility (WRSF) Pond prior to discharge to Mammoth Lake	Post-closure	Group 1	Four times per calendar year, when water is present.
ST-WT-4	Whale Tail Pit or pit sump	Operations	Group 1	Four times per calendar year
ST-WT-5	Water intake from Nemo Lake	Construction	Volume (m^3)	Monthly
		Operations	Volume (m^3)	Monthly
ST-WT-6	Lake A47	Construction	Group 2	Monthly during open-water
		Operations	Group 2	Monthly during open-water
		Closure	Group 2	Monthly during open-water
ST-WT-7	East diversion channel	Operations	Group 3	Three times (freshet, summer, fall) per calendar year
ST-WT-8	Water intake from Whale Tail Lake	Closure	Volume (m^3)	Monthly

Station	Description	Phase	Monitoring Parameters or Group	Frequency
ST-WT-9	North Whale Tail Lake (as the basin fills and when it is connected to the south basin and prior to or when connected to the downstream environment)	Closure	Group 1	Four times per calendar year
		Post-closure	Group 2	Four times per calendar year
ST-WT-10	Pit Lake (as the pit fills)	Closure	Group 2	Four times per calendar year
		Post-closure	Group 2	Four times per calendar year
ST-WT-11	Sewage treatment plant	Operations	Group 1	Four times per calendar year
		Closure	Group 1	Four times per calendar year
ST-WT-12	Secondary containment at Whale Tail Bulk Fuel Storage Facility	Operations	Group 4	Prior to discharge or transfer of effluent
		Closure	Group 4	Prior to discharge or transfer of effluent
ST-WT-13	Lake A45	Operations	Group 3	Flow, Monthly during open-water
		Closure	Group 3	Flow, Monthly during open-water until water level have returned to baseline level
ST-WT-14	Lake A16 outlet	Construction	Group 2	Monthly during open-water
		Operations	Group 2	Monthly during open-water
		Closure	Group 2	Monthly during open-water
ST-WT-15	Lake A15	Construction	Group 2	Monthly during open-water
		Operations	Group 2	Monthly during open-water
		Closure	Group 2	Monthly during open-water

Table 3-2: Monitoring Parameters

Group	Parameters
1	pH, turbidity, hardness, alkalinity, chloride, fluoride, sulphate, total dissolved solids (TDS), total suspended solids (TSS), ammonia nitrogen, nitrite, nitrate, orthophosphate, total phosphorus, total metals (aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium and zinc).
2	**Total and Dissolved metals:** aluminum, antimony, arsenic, boron, barium, beryllium, cadmium, copper, chromium, iron, lithium, manganese, mercury, molybdenum, nickel, lead, selenium, tin, strontium, titanium, thallium, uranium, vanadium and zinc. **Nutrients:** Ammonia-nitrogen, total Kjeldahl nitrogen, nitrate nitrogen, nitrite-nitrogen, orthophosphate, total phosphorous, total organic carbon, total dissolved organic carbon and reactive silica. **Conventional Parameters:** bicarbonate alkalinity, chloride, carbonate alkalinity, conductivity, hardness, calcium, potassium, magnesium, sodium, sulphate, pH, total alkalinity, TDS, TSS and turbidity.
3	MDMER parameters (arsenic, copper, lead, nickel, zinc, TSS, pH), sulphate, turbidity and total aluminum.
4	Total Arsenic, Total Copper, Total Lead, Total Nickel, TSS, Benzene, Toluene, Ethylbenzene, Xylene, TPH, pH.
MDMER	Arsenic, copper, lead, nickel, zinc, TSS, pH, effluent volumes and flow rate of discharge, acute lethality (Rainbow Trout and *Daphnia magna*) and environmental effects monitoring (EEM).
Field Measurements	pH, specific conductivity, dissolved oxygen (DO) and temperature

3.1.1 General Sampling and Analysis Program

Samples are collected in clean laboratory-supplied containers and preserved as directed by the analytical laboratory. During all phases, samples are analyzed offsite at an accredited commercial lab (e.g., ALS in Burnaby BC, Maxxam Analytics in Montreal or H2lab in Val d'Or).

Table 3-3 summarizes the minimum sample volumes, container, preservation, and holding times for each analyze. This information is from the *USEPA Methods for Chemical Analysis of Water and Waste Water* (*EPA-600/4-79-020, 1979*). Note, these bottle types and volumes may change if the laboratories make a change in procedure.

Table 3-3: Summary of Sampling Requirements for each Analyte

Parameter	Minimum Volume (mL)	Bottle Type	Preservation	Holding Time
pH	250	250 mL, glass or plastic, filled to the top	4˚C	Analyze immediately
Conductivity	125	250 mL, glass or plastic	4˚C	28 days
Hardness	250	250 mL plastic, filled to the top	4˚C, HNO_3	6 months
Oil and Grease (total)	1000	1 L amber glass	4˚C, H_2SO_4	28 days
Turbidity	125	250 mL, glass or plastic	4˚C	48 hours
Total Dissolved Solids (TDS)	125	250 mL glass	4˚C	7 days
Total Suspended Solids (TSS)	125	250 mL glass	4˚C	7 days
Total Alkalinity	250	250 mL, glass or plastic, filled to the top	4˚C	14 days
Bicarbonate Alkalinity	250	250 mL, glass or plastic, filled to the top	4˚C	14 days
Carbonate Alkalinity	250	250 mL, glass or plastic, filled to the top	4˚C	14 days
Total Cyanide	125	250 mL, glass or plastic	4˚C, NaOH	14 days
Free Cyanide	125	250 mL, glass or plastic	4˚C, NaOH	14 days
Benzene, Toluene, Ethylbenzene & Xylene (BTEX)	40 (per vial)	3 X 40 mL, glass, filled to the top	4˚C	7 days
Total Petroleum Hydrocarbons(TPH)	1000	1L, glass	4˚C, H_2SO_4	28 days
Total Metals (ICP-MS) (Aluminum, Antimony, Arsenic, Boron, Barium, Beryllium, Cadmium, Cobalt, Copper, Chromium, Iron, Lithium, Manganese, Mercury, Molybdenum, Nickel, Lead, Selenium, Tin, Strontium, Titanium, Thallium, Uranium, Vanadium, Zinc, Potassium, Magnesium, Sodium)	125	250 mL plastic	4˚C, HNO_3	6 months
Dissolved Metals (Aluminum, Antimony, Arsenic, Boron, Barium, Beryllium, Cadmium, Cobalt, Copper, Chromium, Iron, Lithium, Manganese, Mercury, Molybdenum, Nickel, Lead, Selenium, Tin, Strontium, Titanium, Thallium, Uranium, Vanadium, Zinc)	125	250 mL plastic	4˚C, Filtered on-site, HNO_3	6 months
Ammonia-nitrogen	250	250 mL, glass or plastic, filled to the top	4˚C, H_2SO_4	28 days
Total kjeldahl nitrogen	250	250 mL, glass or plastic, filled to the top	4˚C, H_2SO_4	28 days
Nitrate nitrogen	125	250 mL, glass or plastic	4˚C	48 hours
Nitrite nitrogen	125	250 mL, glass or plastic	4˚C	48 hours
Ortho-phosphate	125	250 mL, glass or plastic	4˚C	14 days
Total phosphorous	125	250 mL, glass or plastic	4˚C, H_2SO_4	28 days
Total organic carbon	125	250 mL glass	4˚C, H_2SO_4	28 days
Dissolved organic carbon	125	250 mL glass	4˚C, H_2SO_4	28 days
Chloride	125	250 mL, glass or plastic	4˚C	28 days
Fluoride	125	250 mL plastic	4˚C	28 days
Sulphate	125	250 mL, glass or plastic	4˚C	28 days
Radium 226	500	1L plastic	4˚C, HNO_3	1 month
Reactive Silica	250	500 mL, plastic	4˚C	28 days

Note: The bottle types and preservation method may change at the discretion of the laboratory.

3.1.2 Compliance Monitoring Stations and Discharge Criteria

Consistent with similar mining operation (i.e., Meadowbank Mine) further details of the specific CM stations and discharge criteria are established for Whale Tail Pit Project according to the Nunavut Water Board Type A Water Licence 2AM-WTP1826.

3.1.2.1 *Construction and Dewatering Activities*

To mine the Whale Tail Pit, a series of dikes will be built to isolate the pit from the surrounding water bodies. The document "*Whale Tail Pit Project Water Quality Monitoring and Management Plan for Dike Construction and Dewatering*" (January 2016) will be followed for the Approved Project to specifically address the monitoring requirements for these activities (Refer to Section 3 of that plan).

3.1.2.2 *Visual Inspections and Seepage Monitoring*

The Plan includes visual inspections to be conducted regularly to monitor for potential issues such as erosion (see Section 3.1.2.3 for more details), spills and leaks (see Section 3.2 for more details), or unanticipated seepage (e.g., from the WRSF, haul road). Where seepage is observed, sampling will be conducted (Table 3-1 for details) and appropriate follow-up (e.g., collection and transport to the Attenuation Pond) will be conducted.

Regular inspections and seepage monitoring (where water is observed) is required to document that the seepage is appropriately contained, managed and will not enter the receiving environment. Inspections will be conducted on a monthly basis at the WRSF during open water season or after a major rain event occurs. Seepages identified at the Whale Tail WRSF will be pumped to the WRSF collection pond. . Results of the inspections and seepage monitoring data are also used for comparisons to the FEIS predictions (see Section 5.0 for more details).

3.1.2.3 *Water Collection System (Diversions and Effluent)*

A water collection system comprised of ditches, sumps, water management ponds, and open pits is proposed to control surface water for the Project. Water that may potentially come into contact with waste rock or contaminated material is segregated from non-contact water and collected in water management ponds and treated, if necessary, prior to discharge into the receiving environment.

Regular monitoring during freshet (the snowmelt, thawing) and during heavy or prolonged rainfall to identify any erosional or stability issues with regards to:

- The configuration or structure of channels, due to localized thawing, local ground instabilities, subsidence and transport of fine particles;
- The free flow of water, due to an accumulation of ice, sediments and other debris; and
- Potential damage to retention structures and monitoring of seepage.

Maintenance operations consist of cleaning accumulated sediments and debris from the ditches and culverts, and repairing damaged areas as soon as possible.

During pit flooding, samples will be taken in representative locations of the pit that is being re-flooded. It is likely that the sampling sites will change based on mine sequencing and as the water level in the pits rise in response to flooding.

The following is a list of the various areas of the water collection system where samples for the internal compliance monitoring program will be collected:

- Whale Tail/ Pit area ditches, sumps, ponds, and pit lake (ST-WT-1, ST-WT-3, ST-WT-4, ST-WT-7, ST-WT-10).

Effluent discharged from the Attenuation Ponds at CM station ST-WT-2 is directed to Mammoth Lake through a diffuser. Discharge to the receiving environment shall not exceed effluent quality limits stipulated in Table 3-4 and based on criteria established in Whale Tail Pit Type A Water Licence 2AM-WTP1826.

Table 3-4: Effluent Criteria – Discharge from Mammoth Lake Diffuser

Parameter	Maximum Average Concentration	Maximum Allowable Grab Sample Concentration
Conventional Parameters		
pH	6.0 to 9.5	6.0 to 9.5
Total Suspended Solids (mg/L)	15	30
Total Dissolved Solids (mg/L)	1400	1400
Nutrients		
Total Ammonia (mg-N/L)	16	32
T-Phosphorus (mg-P/L)	0.3	0.6
Metals		
Total Aluminium (mg/L)	0.5	1.0
Total Arsenic (mg/L)	0.1	0.2
Total Cadmium (mg/L)	0.002	0.004
Total Chromium (mg/L)	0.02	0.04
Total Copper (mg/L)	0.1	0.2
Total Iron (mg/L)	1.0	2.0
Total Lead (mg/L)	0.05	0.10
Total Mercury (mg/L)	0.004	0.008
Total Nickel (mg/L)	0.25	0.5
Total Zinc (mg/L)	0.1	0.2
Other		
Total Petroleum Hydrocarbons (mg/L)	3.0	6.0

Effluent discharged from CM station ST-WT-2 shall be demonstrated to be acutely non-lethal, as stipulated in Water Licence 2AM-WTP1826 Modified Schedule 1. The following are the toxicity tests that are performed:

- Reference Method for Determining Acute lethality of Effluents to Rainbow Trout EPS 1/RM/13 Second Edition December 2000 (with May 2007 amendments); and
- Biological Test Method; Acute Lethality Test Using Daphnia spp. EPS 1/RM/11 July 1990 (with May 1996 amendments).

All water collected within the non-contact water diversion system during operations at CM stations ST-WT-7, ST-WT-13 and Whale Tail Seepage Monitoring Program Stations ST-S-1 to –TBB shall not exceed the effluent quality limits presented in Table 3-5.

Table 3-5: TSS Criteria at CM Stations ST-WT-7 and ST-WT-13

Parameter	Maximum Average Concentration (mg/L)	Maximum Allowable Grab Sample Concentration (mg/L)
TSS	15	30

3.1.2.4 *Waste Rock Storage Facility*

Waste rock from the open pits not used for site development purposes will be trucked to the Whale Tail WRSF. Samples will be collected at the WRSF Pond (ST-WT-3), and if seepage is observed, for the compliance monitoring program. Frequency of collection will be as described in Table 3-1.

In addition, there will be regular inspections of the WRSF to determine the presence of any seepage or uncontrolled runoff. Where seepage or runoff is observed, water quality samples will be collected and facilities will be constructed to divert water to a collection system. Results of these inspections are reported in the Agnico Eagle annual report.

Further details about waste rock monitoring is covered in the Acid Rock Drainage/Metal Leaching Plan.

3.1.2.5 *Support Facilities*

<u>Whale Tail Pit Camp and Site</u>

A sewage treatment plant will be in operation at the Whale Tail Camp. Discharge from the plant will be directed to the Whale Tail attenuation pond and then discharged through a diffuser to the receiving environment. Water quality monitoring for this facility is included in the CM water collection system.

Construction debris and domestic waste generated on-site to be disposed of to the on-site landfill located in the Whale Tail WRSF.

The Whale Tail Bulk Fuel Storage Facility will be located east of the Whale Tail Camp adjacent to the mine operations haul road. Water collected within the fuel containment facilities will be discharged to land, when necessary, in a controlled manner. It is proposed that Effluent from the fuel containment facilities being discharged to land (sampled as ST-WT-12) shall not exceed the effluent quality limits presented, as stipulated in the Whale Tail Type A Water Licence 2AM-WTP1826 (Table 3-6).

Table 3-6: Effluent Criteria – Whale Tail Bulk Fuel Storage Facility at Monitoring Station ST-WT-12

Parameter	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Grab sample
Conventional Parameters		
pH	6.0 to 9.5	6.0 to 9.5
Total Suspended Solids (mg/L)	15*	30
Metals		
Total Arsenic (mg/L)	0.5*	1.0
Total Copper (mg/L)	0.3*	0.6
Total Nickel (mg/L)	0.5*	1.0
Total Zinc (mg/L)	0.5*	1.0
Lead (mg/L)	0.1	0.1
Other		
Oil and Grease (mg/L)	5 and no visible sheen	5 and no visible sheen
Ammonia (mg/L)	6.0	6.0
Benzene (µg/L)	370	370
Toluene(µg/L)	2	2
Ethylbenzene (µg/L)	90	90

*Metal and Diamond Mines Effluent Regulations (MDMER)

3.1.2.6 *Whale Tail Pit Haul Road and Quarries*

Whale Tail Pit Haul Road and Quarries

The 64.1 km long exploration access road from Vault to the Amaruq exploration camp site was expanded in width (from 6.5 m to 9.5 m) and upgraded to a haul road. Road surfacing was constructed using non-potentially acid generating (NPAG) Vault waste rock and aggregates from the quarry sites and esker material. Approved borrow sources was used for construction; some of these will remain open for the duration of the mine to service the road.

Monitoring procedures along the Whale Tail Pit Haul Road and quarries include visual inspections of infrastructure and water quality sampling.

As per the quarry leases requirements (Item 17 of Quarry Permit KVCA15Q02, Item 17 of Quarry Permit KVCA15Q01, Item 18 of Quarry Permit KVCA17Q01 and Item 18 of Quarry Permit KVCA18Q01), a water monitoring plan will be prepared for quarries in which explosives are in use. The water will be monthly sampled and analyzed for a full suite of water quality parameters[1]. Prior to the tenth day of each month, a report will be submitted to the KIA indicating the water quality results. Water results shall be tabulated and compared to applicable guidelines.

[1] Physical Parameters: pH (field and laboratory), temperature (field), alkalinity, bicarbonate, carbonate, electrical conductivity, hardness, hydroxide, ion balance, total dissolved solids, total suspended sediments
Nutrients: NH_4, NO_3, NO_2, PO_4
Major Ions: Ca, Cl, Mg, K, Na, SO_4
Trace Metals: Al, Sb, As, Ba, Be, B, Cd, Cr, Cu, Fe, Pb, Li, Mn, Hg, Mo, Ni, Se, Ag, Sr, Sn, Ti, U, V, Zn

Visual Inspections

The watercourse crossing visual inspection and maintenance program is designed to identify issues relating to watercourse crossings structural integrity and hydraulic function. It has two main objectives:

1) Visual inspection of its infrastructure to identify defects, cracks or any other risks to structural integrity. Particular attention will be paid to the inlet and outlet structures of culverts, and to bridge abutments and their foundations, as required. This inspection is conducted annually by a geotechnical engineer.

2) Visual inspection to identify sediment or other debris accumulation impeding the free flow of water through the crossings. Maintenance operations will consist of hand removal of accumulated debris and repairing damages as soon as possible. Visual inspection of upstream and downstream channels to identify bed erosion or scour around the watercourse crossing structure. Particular attention is to be paid to bridge abutments and abutment foundations as they are vulnerable to scour and erosion. This inspection is conducted weekly during freshet and post freshet season, by a member of the environmental team.

Results of these inspections are reported in the Agnico Eagle annual report.

Water Quality Monitoring

Geochemical characterization studies were carried out in 2015 to 2018 on esker and quarries material from potential borrow source locations between Vault and Whale Tail Pit, as well as NPAG waste rock from the Vault WRSF. The results indicate that the materials tested are suitable for construction use and are not expected to cause any adverse water quality issues.

If issues are observed or a spill occurred near a water course during the winter a full suite of water quality sampling is conducted along the Whale Tail Pit Haul Road at areas of concern. This includes:

- Any significant water seeps and/or water ponded in contact with the road. Other criteria for selecting a sampling location include: areas of evident rock staining (rust color particularly) and areas where an accidental spill has previously occurred.
- Upstream and downstream from the major road stream crossings in order to confirm there are no water quality issues resulting from these crossings or the adjacent road rock fill.

Should the results indicate a significant change in water quality from previous years or elevated risks to aquatic life, further water quality monitoring will be conducted at those specific locations to determine the cause and notification will be provided to regulatory authorities. An action plan will be developed and implemented should the results indicate issues. The results for all access road water quality monitoring are reported in the Agnico Eagle Annual Report to regulators.

3.1.2.7 *Groundwater*

The *Groundwater Monitoring Plan* describes the groundwater monitoring plan for the Project.

3.1.2.8 *Receiving Environment*

Receiving water quality monitoring is discussed in Section 1A of the A*quatic Effects Management Program (AEMP) (November 2015*). Within the AEMP are numerous monitoring programs: of greatest emphasis for the protection of the aquatic environment are the core receiving environment monitoring program (CREMP), Environmental Effects Monitoring studies and targeted monitoring programs (Azimuth 2015, 2016, 2018a, 2018b).

The core monitoring program includes three areas of sampling stations that surround each of the mine developments (near field, mid field and far field) for early detection of mine-related impacts, as well as two reference lake areas. The monitoring program is summarized in Table 2-2 of the CREMP and includes: water quality, sediment chemistry, benthos, periphyton, phytoplankton, and fish monitoring (as part of EEM and fish habitat compensation monitoring), the parameters to be measured, sampling locations, sampling frequency, sampling methods, and criteria for data evaluation. Targeted studies are limited in scope and intended to address “specific questions related to particular components of mine development during construction and operation.”

Monitoring locations for the effluent diffuser in the receiving environment will be located at the edge of the diffuser mixing zone either within the CREMP core near-field sampling zones or as separate monitoring locations, depending upon the final location of the diffuser.

Lakes not sampled under the CREMP (ST-WT-13 and ST-WT-15) are included in this monitoring plan and are listed in Table 3-1. Data collected from these sampling stations during the operations phase will be compared to the water quality model predictions.

3.2 EVENT MONITORING

The Event Monitoring (EM) program addresses the site-specific monitoring that is required following any accidental release. A “release” may be caused by:

- Spills, including unidentified seepage (Spill Contingency Plan); and
- Emergencies (Emergency Response Plan).

The EM program is designed to verify whether contamination of the surface soil, nearby receiving environment and active zone has occurred as a result of an accidental release of a hazardous material or contaminated water, through monitoring of surface runoff and nearby receiving environment following remediation of any release. It is anticipated that owing to the presence of permafrost beneath most of the mine footprint, there will be minimum impact to groundwater. A complete list of hazardous materials use during operations of the mine is provided in the *Hazardous Materials Management Plan.*

The EM plan is developed on a site-specific basis subsequent to a spill or other incident, and considers the type of product spilled, the potential receptors and the potential for any remaining contamination after clean-up. The plan is done in coordination with the Environmental Superintendent as described in the *Spill Contingency Plan.*

In the event of an accidental release, the water quality of the downstream receptor and possibly upstream of the receiving point, if any, is to be sampled (during the ice-free season) and analyzed. Should the spill have happened over snow cover, water and possibly soil sampling is to take place at the earliest feasible time after thaw to verify if there has been any impact to the receiving water or soil quality. The specific parameters monitored as part of the EM program will depend on the nature of the spill, and will be determined for the specific hazardous material released.

EM monitoring will occur following the clean-up of a release and the frequency of sampling will depend on the type of material spilled (wet or dry spill), the environment into which the chemical was released (surface water body or soil; frozen or thawed), the quantity of spill material and the status of remediation/clean up measures that were initiated. The EM program for a particular spill will cease upon obtaining satisfactory analytical results (within 20% of background level, to accommodate for analytical accuracy) from the potentially affected areas or as required by regulators.

3.3 ADAPTIVE MANAGEMENT PROGRAM

Results of the water quality monitoring are to be reviewed by the Environmental Department of the mine and chemical trends of constituents of interest are tracked for mine site monitoring and in the AEMP data (including the CREMP) to allow early detection of significant changes in water quality within the mine site prior to discharge, or if thresholds and triggers are exceeded in the receiving environment. Action plans are then to be implemented to ensure that environmental protection objectives are met.

Results of the annual monitoring are compared to the FEIS water quality predictions to determine if conditions are similar to predicted. If site data shows a negative trend that differs from predicted concentrations by a significant amount, the adaptive management program designed for the Project provides a framework for action, if necessary. This program is consistent with the program in use at the Meadowbank Mine. The program has two levels - a trigger level to compare the monitoring data, and an action plan of mitigative measures for identified exceedances to these triggers.

The adaptive management program is divided into two sections, one for parameters with regulated discharge criteria at specific monitoring locations, as specified in the Water Licence 2AM-WTP1826 and by the MDMER. The second section is for measured parameters for which no discharge limits have been identified in the water Licence (i.e. CREMP monitoring).

3.3.1 Adaptive Management Program for Regulated Discharge

3.3.1.1 *Action Plan*

In the case of an exceedance of a NWB Licence limit or MDMER discharge limit an action plan will be implemented. The adaptive management program requires that if one or more of the key monitored parameters exceed the respective limits, a staged sequence of responses will follow. Table 3-7 summarizes the staged adaptive action plan for the CM program for regulated discharge. Figure 3-1 is a logic diagram showing the decision path for evaluating analytical results for regulated discharge.

Should the TSS value (measured value or calculated from turbidity measurements) of non-contact water at any time during the construction, operation, or closure phases exceed regulatory guidelines, the water will be discharged to the Attenuation Pond until the cause of the exceedance can be identified and the situation rectified.

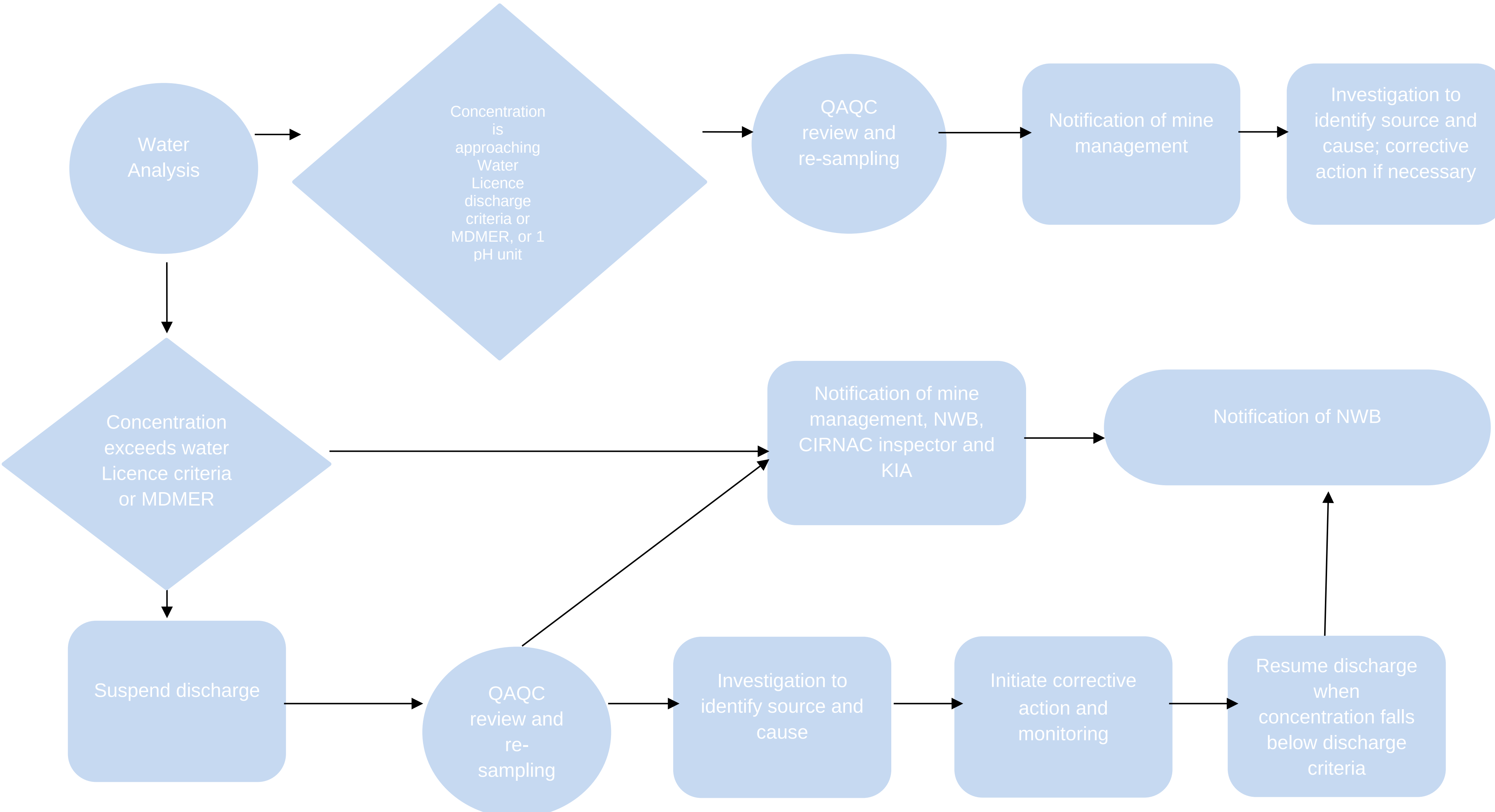
In addition to the mitigative measures listed above, a number of other possible alternatives are available to reduce or treat contaminants. These mitigation measures include:

- Best management practices for sediment and erosion control would be employed to reduce TSS concentrations, i.e. flow control, sedimentation basin construction, etc.;
- Addition of a coagulant for the reduction of TSS in pond water;
- Use of geotextile or re-armoring of banks to filter and reduce TSS in pond/ditch water;
- Deployment of absorbent booms and/or barriers within ponds to isolate surface petroleum hydrocarbon films for removal and/or treatment;
- Adjustments to on-site sewage treatment for the reduction of BOD and E. coli concentrations;
- Injection of oxygen or aeration for the reduction of ammonia;
- Addition of lime to increase a low pH value or reduce metal concentrations; and/or
- Removal of the offending source rock or the prevention of surface waters coming into contact with the offending source rock.
- Development and Implementation of a Whale Tail Pit-specific *Freshet Action Plan* to proactively identify any additional seeps around areas of concern; conduct additional monitoring, and control and contain seepage on site.

Table 3-7: Action Plan for Regulated Discharge

Example	Action Plan
Exceeds water Licence discharge criteria or MDMER	- Suspension of discharge activities; - QA/QC review and analysis, and re-sample water at the particular location if necessary; - Notification of mine management (General Mine Manager and Environment Superintendent) and the Nunavut Water Board, the CIRNAC Water Resources water Licence inspector and the Kivalliq Inuit Association; - Investigation to identify possible source(s) and cause(s) of the exceedance; - Initiation of corrective actions or water treatment, and follow up monitoring; and - Resumption of discharge when concentrations are below the discharge criteria

Figure 3-1: Logic Diagram for Regulated Discharge



3.3.2 Adaptive Management Program for Non-Regulated Discharge

Aside from targeted monitoring studies (i.e. “Effects Assessment Studies”) such as those commissioned following dike construction, the CREMP is the main program aimed at measuring and assessing potential impacts of contaminants in the receiving aquatic environment that are not regulated under MDMER or NWB.

This program was designed to take an integrated, ecosystem-based approach that links mitigation and monitoring of physical/chemical effects on key ecological receptors in the receiving environment. It addresses key issues identified in the Environment Assessment (i.e., mining-related activities with the potential to affect water quality, fish habitat and fish populations). Monitoring results are intended to inform the “adaptive management” process, supporting the early identification of potential problems and development of mitigation options to address them by comparing results to established threshold and trigger levels.

3.3.2.1 *CREMP Threshold and Trigger Levels*

As described in the CREMP Design Document (Azimuth 2015, 2016) trigger levels were developed to facilitate adaptive management of potential water quality issues in the receiving environment. These criteria were developed with the assumption that action will be considered before certain monitored parameters reach levels that cause or have the potential to cause adverse effects to aquatic biota. The criteria for action provide an early warning framework under which management responses may be considered, taking into account findings from other AEMP component programs. Two types of criteria were developed:

- Thresholds are legal requirements, regulatory guidelines (e.g., CCME), or other discrete benchmarks, below which unacceptable adverse effects are not expected and above which adverse effects may occur. If effects-based thresholds do not exist or are not warranted for a particular variable, then early warning triggers (based on statistical criteria) will be developed without thresholds.
- Triggers are early warning criteria that may lead to action. Exceedance of a trigger value does not necessarily imply that an adverse effect may be expected. For variables with a threshold, the trigger was set as the maximum of either the value halfway between: the baseline median and the threshold, or the 95th centile of the baseline data. For variables without thresholds, triggers were set equal to the 95th centile of the baseline data except in cases where less than 5% of the data exceeded the current detection limit (DL), in which case the trigger was set to two times the DL.

Water chemistry data is collected up to six months per year (March, May, July, August, September and November/December) for the annual period of paired sampling to support Before/After Control/Impact statistical analyses, recognizing that in any given year the actual number of samples collected may range from four to six depending on logistical constraints (e.g. snow and ice). Two randomly located subsamples are collected at each station each month and all samples are 3 m from the surface. In addition, basic water quality data is collected at key near-field areas at least once mid-winter to reduce uncertainty regarding the potential occurrence of change over winter.

Annual average concentrations (6-month mean) are compared to trigger values to determine need for action (rather than results from individual sampling events).

Further information on the development of thresholds and triggers is provided in the CREMP Design Document (Azimuth, 2016).

3.3.2.2 *Action Plan*

A management response plan (MRP) has been developed for the AEMP (Azimuth 2015, 2016), of which the CREMP is one component. The general MRP for the AEMP is shown in Figure 3.2. Following the integration of the results from each independent program, the response actions are based on the cumulative results of all programs. Therefore, while we expect management actions to be taken in cases where criteria for action are exceeded, the specific actions are not linked to outcomes of the CREMP alone because the CREMP is only one of the monitoring programs under the AEMP. In other words, it is not possible or appropriate to describe the specific management actions that will be taken when CREMP triggers or thresholds are exceeded.

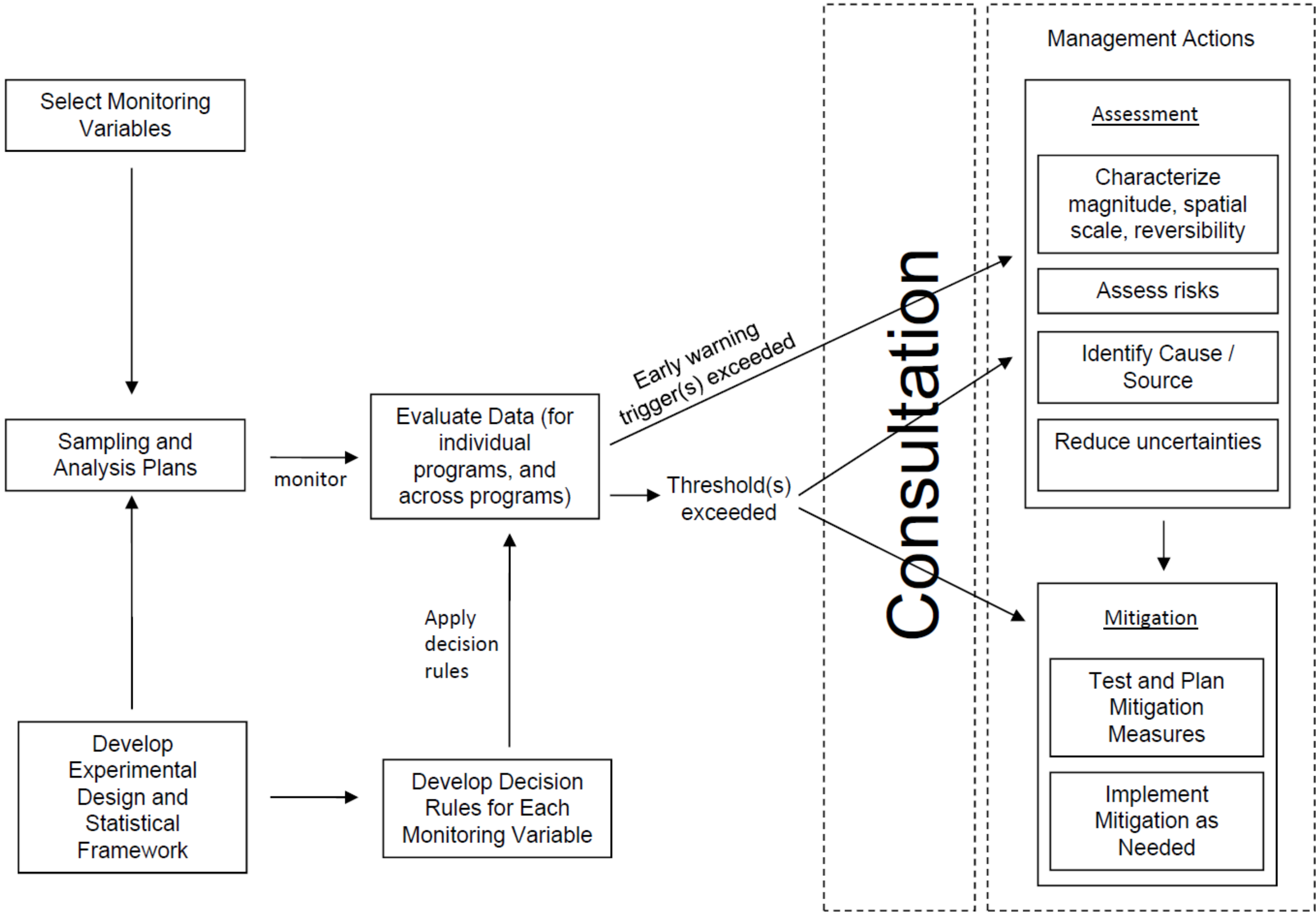
Nevertheless, there are two general classes of management actions – those aimed at further assessment and those aimed at mitigation. In general, exceedance of early warning triggers will trigger further assessment, which may then lead to mitigation, whereas exceedances of thresholds could possibly lead directly to mitigation. It is expected that CREMP triggers will be exceeded occasionally due to chance (given the large number of variables that are monitored, particularly for water chemistry), therefore further assessment will almost always be important.

The specific management action that would be appropriate in a given case depends on the underlying cause. For example, if a metal becomes elevated in receiving water, the identification of options for further assessment and/or mitigation options would be different if the source of the metal is groundwater versus effluent versus dust. The timing of management actions is also case-specific. In cases where further assessment is warranted, that assessment should begin as soon as practically possible. In cases where mitigation is considered, mitigation should begin as soon as the weight of evidence indicates that mitigation is warranted, and the benefits of commencing mitigation immediately outweigh the disadvantages of waiting for further information. Consultation with regulators and stakeholders is important for determining management actions (see Azimuth, 2015).

Further details on the integrated aquatic effects action plan are provided in Azimuth, 2015.

The general staged sequence of responses for triggered parameters is summarized in Figure 3.2 below.

Figure 3-2: Logic Diagram for Non-Regulated Discharge



SECTION 4. FLOW VOLUMES

Flow volumes within the mine footprint will be measured daily during periods of discharge. Flow volume measurements will be conducted using volumetric flow meters attached to applicable pumps. For permanent pumping arrangements, these flows will be measured using permanent in-line flow meters, such as fresh and reclaim water pumping systems. For periodic batch discharges, such as secondary containment sumps, portable flow meters or calculated pump time and capacity methods will be used. If needed, seepage collection ditch flows may be measured using either flow measuring weirs or using stream gauging methods.

Detailed pump records are maintained including date, pond/sump number, receiving location of pumped water, pump ID, duration of pumping, and total volume pumped. The average flow rates, total discharge per event and total cumulative discharge will be reported annually. The flow volumes monitoring is intended to help in the water management by ensuring the appropriate destination for contact water and discharges, and to track water conservation and recycling.

In accordance with Water Licence 2AM-WTP1826, monitoring locations of the Whale Tail Pit area for water flow volumes include:

- The volume of fresh water obtained from any source for domestic, industrial, or re-flooding (ST-WT-5);
- The volume of effluent (ST-WT-11) and fresh water (Whale Tail Lake South Basin, ST-WT-8) transferred to the pit lake; and
- The volume of water discharged from the Attenuation Ponds to a diffuser (ST-WT-2).

Details on the intervals of pumping for contact water are provided in the Water Management Plan.

SECTION 5. REPORTING

5.1 Monthly Reporting

All water quality monitoring results and flow measures will be compiled into a brief monthly report, and sent to the NWB, Crown-Indigenous and Northern Affairs Canada (CIRNAC), Water Resource Inspector and to the Kivalliq Inuit Association (KIA). These reports are due within 30 days of the end of the month being reported on.

5.2 ANNUAL REPORTING

An annual report is to be submitted to the NWB, KIA, Department of Fisheries and Oceans, CIRNAC, NIRB, Government of Nunavut, and other interested parties by March 31st of the following year. The report is to summarize the following:

- Monitoring results for each sampling station during the year and for the life of mine (construction to end of closure); activities during the year at each station; and any exceedances at stations, the action plan applied to the exceedance, and the results of the action plan;
- Annual seep water chemistry results; including location of the samples, sources of the water collected, and results of chemical analyses of the samples;
- Annual groundwater monitoring results; activities during the year at each well site and record of well operations, well replacement, and proposed drilling for the next year; and installation details of new wells and identification of any abandoned or destroyed wells.
- Receiving water monitoring results;
- Spills and any accidental releases; event monitoring activities conducted following containment, remediation, and reclamation; and the results of EM program, any exceedance in EM results, and the action plan following the exceedance;
- Compare monitoring results to predictions in the Environmental Assessment (EA) and identify significant discrepancies;
- Measured flow volumes;
- Effluent flow rates, volumes and calculated chemical loadings following the requirements of MDMER; and
- Results of QA/QC analytical data.

5.3 EXCEEDANCE REPORTING

Any measured concentration at a CM station exceeding a regulated discharge criterion stipulated in the Water Licence 2AM-WTP1826 or MDMER will be reported to the NWB and Environment and Climate Change Canada upon receipt of the analysis. In addition, results of the action plan will be reported and, where necessary, mitigation options identified within 90 days after receipt of the analyses.

Exceedances in the concentration of a parameter in receiving water will be reported as specified in the AEMP and EEM – MDMER accordingly.

SECTION 6. REFERENCES

Agnico Eagle. 2017. Whale Tail Pit Final Technical Comment Responses. April 2017. http://www.nirb.ca/app/dms/script/dms_download.php?fileid=309317&applicationid=124683&sessionid=7ge0bjmft6458r8co9v5b639g4

Agnico Eagle 2018b. Whale Tail Pit – Waste Rock Management Plan. Version 3. September 2018.

Azimuth (Azimuth Consulting Group). 2015. Aquatic Effects Management Program (AEMP), Meadowbank Mine. Report prepared by Azimuth Consulting Group, Vancouver, BC for Agnico Eagle Mines Ltd., Baker Lake, NU. November 2015.

Azimuth. 2016. Core Receiving Environment Monitoring Program (CREMP): 2015 Plan Update – Whale Tail Pit Addendum. Report prepared by Azimuth Consulting Group, Vancouver, BC for Agnico Eagle Mines Ltd., Baker Lake, NU. May, 2016.

Azimuth. 2018a. Whale Tail Pit Core Receiving Environment Monitoring Program (CREMP): 2014-2017 Baseline Studies. Prepared for Agnico Eagle Mines Ltd. February 2018.

Azimuth. 2018b. Whale Tail Pit Project: Mercury Data Compendium and Memorandum. Report prepared by Azimuth Consulting Group, Vancouver, BC for Agnico-Eagle Mines Ltd., Baker Lake, NU. June 2018.

Nunavut Impact Review Board. Project Certificate No. 008. March 2018

Nunavut Water Board. 2018. Water Licence 2AM-WTP1826. May 2018.

Waste Rock Management Plan, Version 4

AGNICO EAGLE

Meadowbank Division

Whale Tail Pit – Waste Rock Management Plan

OCTOBER 2018

VERSION 4

EXECUTIVE SUMMARY

Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle) will develop the Whale Tail Pit and Haul Road Project (Project), a satellite deposit located on the Amaruq property, to continue mine operations and milling at Meadowbank Mine.

The proposed open pit mine, mined by truck-and-shovel operation, will produce 8.3 million tonnes (Mt) of ore, 61.3Mt of waste rock, and 6.0 Mt of overburden waste. There are four phases to the development: 1 year of construction, 3 years of mine operations, 8 years of closure, and the post-closure period. According to the Whale Tail Pit Life of Mine (LOM) calculation, the addition of the Whale Tail Pit to the actual Meadowbank LOM (LOM 2015) will generate an addition of approximately 8.3 Mt (dry) of tailings to the Meadowbank Tailings Storage Facility (TSF) for a total of 35.4 Mt.

Project mining facilities include accommodation buildings; two ore stockpiles; one overburden stockpile; one waste rock storage facility (WRSF) area planned to receive waste rock and waste overburden; a water management system that includes collection ponds, water diversion channels, and retention dikes/berms; and a Water Treatment Plant.

One area, located north-west of the open pit, has been identified as the Whale Tail WRSF for waste rock placement. Waste rock and overburden will be trucked to the Whale Tail WRSF until the end of mine operations, with distribution according to the operations schedule. Waste rock and overburden will be co-disposed together in one of the two piles constituting the Whale Tail WRSF area. All waste rock material will be sampled and tested during operations to confirm their ARD and ML potential in support of waste segregation. Waste rock and overburden produced during mining will be used in the construction of the mine site infrastructure, while some of the non-potentially acid generator (NPAG) and non-metal leaching (NML) waste rock will be put aside for capping at closure. Because of the large material requirement for construction and NPAG/NML rock cover, as well as the importance for adequate disposal to meet closure objectives, waste rock management will be a key component of the mining planning for the Whale Tail Project.

Tailings from the Project will be stored in the Meadowbank TSF. The management operation and monitoring of the TSF is regulated under Agnico Eagles existing Type A Water Licence 2AM-MEA1526. Updates to the Meadowbank Mine Waste Rock and Tailings Management Plan have been provided in support of the application and amendment needed to the Type A Water Licence to reflect changes in the Meadowbank operations. In summary, the TSF consists of a North Cell and South Cell located within the basin of the former north-west arm of Second Portage Lake previously dewatered to allow mining in the Portage Pit. To store the full volume of tailings from processing of the Whale Tail Pit ore, Agnico Eagle will maximize storage in South cell through the deposition of approximately 5.3 Mt of tailings, and is proposing to construct internal dike structures to store the remaining 3 Mt within the current footprint of the North Cell.

The generation of metal leachate in acidic drainage is a concern for mining projects. Climate control strategies rely on cold temperatures to reduce the rate at which oxidation occurs. The low net precipitation in permafrost regions limits infiltration of water into waste rock and tailings disposal areas. Consequently, the climate of the Whale Tail Pit will act as a natural control to reduce the production of acid mine drainage and metal leachate. Climate control strategies are best applied to materials placed at a low moisture content to reduce the need for additional controls on seepage and infiltration. This strategy is considered to be effective for waste rock in arid climate such as the one of Whale Tail Pit.

The Whale Tail WRSF and the ore stockpiles were designed to minimize the impact on the environment and to consider geotechnical and geochemical stability. The surface runoff and seepage water from these facilities will be collected in water collection ponds as part of the water management strategy. If water quality does not meet the discharge criteria as per the Whale Tail Water Licence requirement, the collected water will be treated prior to being discharged to the outside environment during operation and closure.

Closure of the Whale Tail WRSF will begin when practical as part of the progressive reclamation program. The Whale Tail WRSF will be covered with non-potentially acid generating and non-metal leaching waste rock to promote freezing as a control strategy against acid generation and migration of contaminants. Thermistors will be installed within the Whale Tail WRSF to monitor permafrost development. Thermal and water quality monitoring will be carried out during all stages of the mine life to demonstrate geotechnical stability and the safe environmental performance of the facilities. If any non-compliant conditions are identified, then maintenance and planning for corrective measures will be completed in a timely manner to ensure successful completion of the Whale Tail Interim Closure and Reclamation Plan.

DOCUMENT CONTROL

Version	Date (YM)	Section	Page	Revision
1	January 2017	ALL	-	Comprehensive plan for Whale Tail Pit project
2	May 2018	ALL	-	Comprehensive review of the plan for Whale Tail Pit project
3	September 2018	ALL	-	Comprehensive review of the plan for Whale Tail Pit project
4	October 2018	2.5, 3.2, 9.3	7, 11, 29	Updated to align with recommendations issued by CIRNAC and ECCC in October 2018

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ACRONYMS

Agnico Eagle	Agnico Eagle Mines Limited – Meadowbank Division
ARD	Acid Rock Drainage
CCME	Canadian Council of Ministers of the Environment
FEIS	Final Environmental Impact Statement
IPCC	Intergovernmental Panel on Climate Change
LOM	Life of Mine
ML	Metal Leaching
NML	Non-Metal Leaching
NPAG	Non-Potentially Acid Generating
NWB	Nunavut Water Board
PAG	Potentially Acid Generating
PGA	peak ground acceleration
Project	Whale Tail Pit and Haul Road Project
SWD	Stormwater Dike
TSF	Tailings Storage Facility
WRSF	Waste Rock Storage Facility
WTP	Water Treatment Plant

UNITS

%	percent
°C	degrees Celsius
°C/m	degrees Celsius per metre
g	gram
ha	hectare
km	kilometre(s)
km^2	square kilometre(s)
m	metre
masl	metre above sea level
mm	millimetre
m^3	cubic metre(s)
m^3/hr	cubic metre(s) per hour
Mm^3	million cubic metre(s)
Mt	million tonne(s)
t	tonne
t/day	tonne(s) per day
t/m^3	tonne(s) per cubic metre

SECTION 1 • INTRODUCTION

Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle) will develop the Whale Tail Pit and Haul Road Project (Project), a satellite deposit located on the Amaruq property, to continue mine operations and milling at Meadowbank Mine.

The Amaruq property is a 408 square kilometre (km^2) site located on Inuit Owned Land approximately 150 kilometres (km) north of the hamlet of Baker Lake and approximately 50 km northwest of Meadowbank Mine in the Kivalliq Region of Nunavut. The deposit will be mined as an open pit (i.e., Whale Tail Pit), and ore will be hauled to the approved infrastructure at Meadowbank Mine for milling.

The proposed open pit mine, mined by truck-and-shovel operation, will produce 8.3 million tonnes (Mt) of ore, 61.3Mt of waste rock, and 6.0Mt of overburden waste. There are four phases to the development: 1 year of construction, 3 years of mine operations, 8 years of closure, and the post-closure period.

The general mine site location for the Project is shown in Figure 1.1. The mine development will include the following major infrastructure:

- industrial area (camp and garage);
- crusher;
- ore stockpiles;
- rock and overburden storage facilities;
- landfill;
- haul and access roads;
- open pit mine; and
- water dewatering dikes.

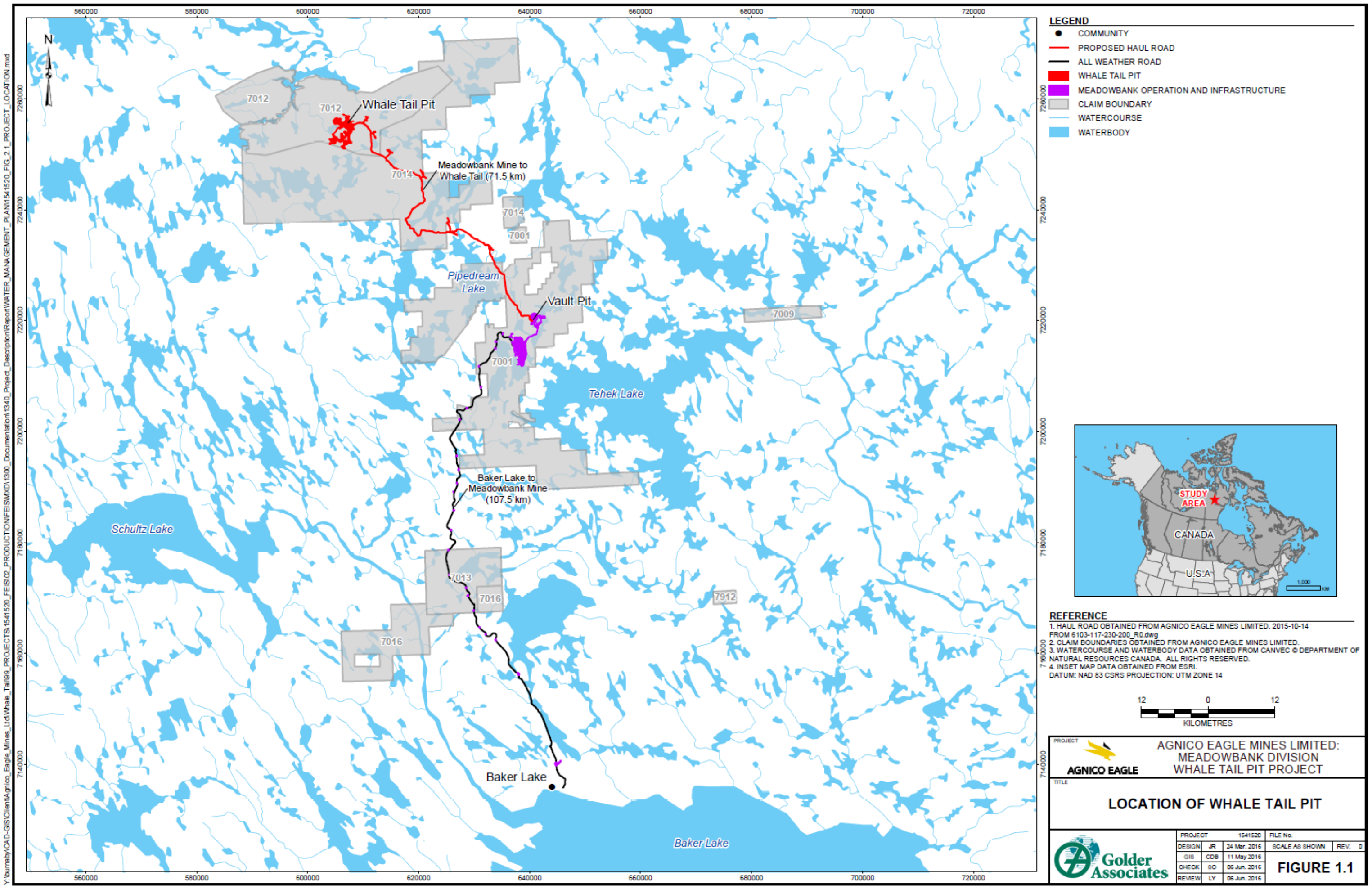

Figure 1.1 Location of Whale Tail Pit

This document presents the Waste Rock Management Plan (the Plan) and is submitted as per Part B, conditions 14 and 15 of the NWB Whale Tail Type A Water License 2AM-WTP1826. The purpose of the Plan is to provide consolidated information on the management ore stockpiled on site, waste rock and overburden, including strategies for runoff and dust control and monitoring programs for the storage facilities. The management operation and monitoring of the tailings storage facilities (TSF) (refer to Figure 1.2) is regulated under Agnico Eagles existing Type A Water Licence 2AM-MEA1526. Updates to the Meadowbank Mine Waste Rock and Tailings Management Plan have been provided in support of the application and amendment needed to the Type A Water Licence to reflect changes in the Meadowbank operations.

As per the Nunavut Impact Review Board (NIRB) Whale Tail Project Certificate No.008, term and condition 7, the Whale Tail Waste Rock Management Plan is submitted to the NIRB at least 60 days prior to the start of construction of the Waste Rock Storage Facility, with subsequent updates or revisions to the Plan submitted annually thereafter or as may otherwise be required by the NIRB for the life of the Project.

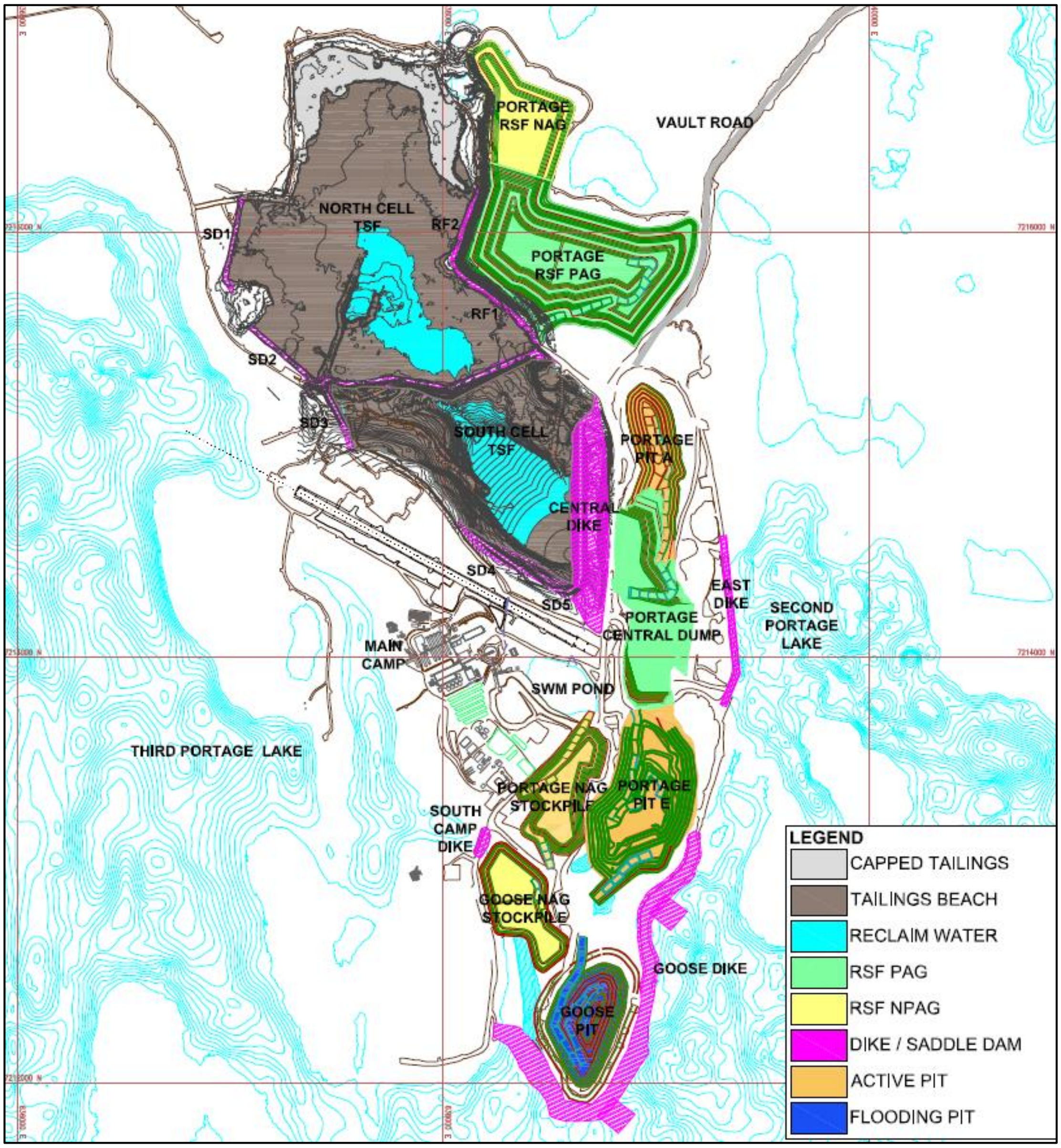

Figure 1.2 Meadowbank Tailings Storage Facility

SECTION 2 • BACKGROUND INFORMATION

2.1 Whale Tail Pit Mine Operations

The construction phase is anticipated to start in at the beginning of the third quarter of Year -1 (2018) and focus on site preparation and the construction of infrastructure, with the start of the open pit development to produce construction material. The operations (mining and ore processing) will continue approximately 3 years, from Year 1 (2019) to Year 4 (2022), with a rate of extraction targeted between 9,000 and 12,000 tonnes per day (t/day) of ore at an average stripping ratio of 8.1. Mining activities are expected to end in Year 3 (2021) and ore processing with stockpiled material is expected to end during the first quarter of Year 4 (2022). Closure will occur from Year 4 (2022) to Year 11 (2029) after the completion of mining and will include removal of the non-essential site infrastructure and flooding of the mined-out open pit, as well as reestablishment of the natural Whale Tail Lake level. Post-closure and monitoring phases will commence as closure is completed in Year 11 (2029) and will continue until approximately Year 28 (2047) or until it is shown that the site and water quality meets regulatory closure objectives. Table 2.1 summarizes the Project timeline and general activities.

Table 2.1 Overview of Timeline and General Activities

Phase	Year	General Activities
Construction	Year -1	• Construct site infrastructure • Develop open pit mine • Stockpile ore
Operations	Year 1 to 3	• Open pit operations • Transport ore to Meadowbank Mine • Stockpile ore • Discharge Tailings in Meadowbank TSF
	Year 4	• Complete transportation of ore to Meadowbank Mine • Complete discharge tailings in Meadowbank TSF
Closure	Year 4 to 11	• Remove non-essential site infrastructure • Flood mined-out open pit • Re-establish natural Whale Tail Lake level
Post-Closure	Year 11 forwards	• Site and surrounding environment monitoring

TSF = Tailings Storage Facility

2.2 Meadowbank Mine Operations

As a requirement of the Type A Water Licence, any modifications to the dewatering process, life of mine (LOM), tailings storage facilities (TSF), and any other aspect associated to the water management at Meadowbank are adhered to and updated in the annual submission of the Meadowbank Water Management Plan and associated water balance.

2.3 Whale Tail Pit Site Layout

Site layouts are presented in Appendix A.

2.4 Climate

Climate characteristics presented herein were extracted from the permitting level engineering report (SNC, 2015).

The Project is located in an arid arctic environment that experiences extreme winter conditions, with an annual mean temperature of -11.3 degrees Celsius (°C). The monthly mean temperature ranges from -31.3°C in January to 11.6°C in June, with above-freezing mean temperatures from June to September. The annual mean total precipitation at the Project is 249 millimetres (mm), with 59 percent (%) of precipitation falling as rain, and 41% falling as snow. Mean annual losses were estimated to be 248 mm for lake evaporation, 80 mm for evapotranspiration, and 72 mm for sublimation. Mean annual temperature, precipitation, and losses characteristics are presented in Table 2.2.

Short-duration rainfall events representative of the Project are presented in Table 2.3, based on intensity-duration-frequency curves available from the Baker Lake A meteorological station (Station ID 2300500) operated by the Government of Canada (2015).

Table 2.2 Estimated Mine Site Monthly Mean Climate Characteristics

Month[a]	Mean Air Temperature (°C) [a]	Monthly Precipitation (mm) [a]			Losses [a]		
		Rainfall (mm)	Snowfall Water Equivalent (mm)	Total Precipitation (mm)	Lake Evaporation (mm)	Evapo-transpiration (mm)	Snow Sublimation (mm)
January	-31.3	0	7	7	0	0	9
February	-31.1	0	6	6	0	0	9
March	-26.3	0	9	9	0	0	9
April	-17.0	0	13	13	0	0	9
May	-6.4	5	8	13	0	0	9
June	4.9	18	3	21	9	3	0
July	11.6	39	0	39	99	32	0
August	9.8	42	1	43	100	32	0
September	3.1	35	7	42	40	13	0
October	-6.5	6	22	28	0	0	9
November	-19.3	0	17	17	0	0	9
December	-26.8	0	10	10	0	0	9
Annual	**-11.3**	**146**	**103**	**249**	**248**	**80**	**72**

[a] SNC (2015). mm = millimetre; °C = degrees Celsius.

Table 2.3 Estimated Mine Site Extreme 24-Hour Rainfall Events

Return Period (Years) [a]	24-hour Precipitation (mm) [a]
2	27
5	40
10	48
25	57
50	67
100	75
1000	101

[a] SNC (2015). mm = millimetre.

2.5 Climate Change

Climate change information presented herein was extracted from the Final Environmental Impact Statement (FEIS) Amendment, Volume 4, Section 4.2 (Agnico Eagle, 2016).

The climate in the Arctic is changing faster than at mid-latitudes (IPCC, 2014). The most recent set of climate model projections (CMIP5) predict an Arctic-wide year 2100 multi-model mean temperature increase of +13°C in late fall and +5°C in late spring under the Intergovernmental Panel on Climate Change (IPCC)'s "business as usual scenario" (RCP8.5). IPCC climate change mitigation scenario RCP4.5 results in a year 2100 multi-model Arctic wide prediction of +7°C in late fall and +3°C in late spring (Overland et al., 2013). The effects of changes of this magnitude to terrestrial, aquatic and marine ecosystems, and social and economic systems of the Arctic are an active area of research. However, due to the short duration of the proposed Project, climate change related effects to the Project are likely negligible. The WRSF, which will be a permanent infrastructure, was design using the appropriate climate change model scenario to mitigate potential climate change related effects (Golder, 2018).

2.6 Permafrost

The mine site is located in an area of continuous permafrost, as shown on Figure 2.1. Based on measurements of ground temperatures (Knight Piésold, 2015), the depth of permafrost at the mine site is estimated to be in the order of 425 metres (m) outside of the influence of waterbodies. The depth of the permafrost and active layer will vary based on proximity to the lakes, overburden thickness, vegetation, climate conditions, and slope direction. The typical depth of the active layer is 2 m in this region of Canada. The typical permafrost ground temperatures at the depths of zero annual amplitude (typically at the depth of below 15 m) is approximately -8.0 °C in areas away from lakes and streams. The geothermal gradient measured is 0.02 degrees Celsius per metre (°C/m) (Knight Piésold, 2015). Late-winter ice thickness on freshwater lakes is approximately 2.0 m. Ice covers usually appear by the end of October and are completely formed in early November. The spring ice melt typically begins in mid-June and is complete by early July.

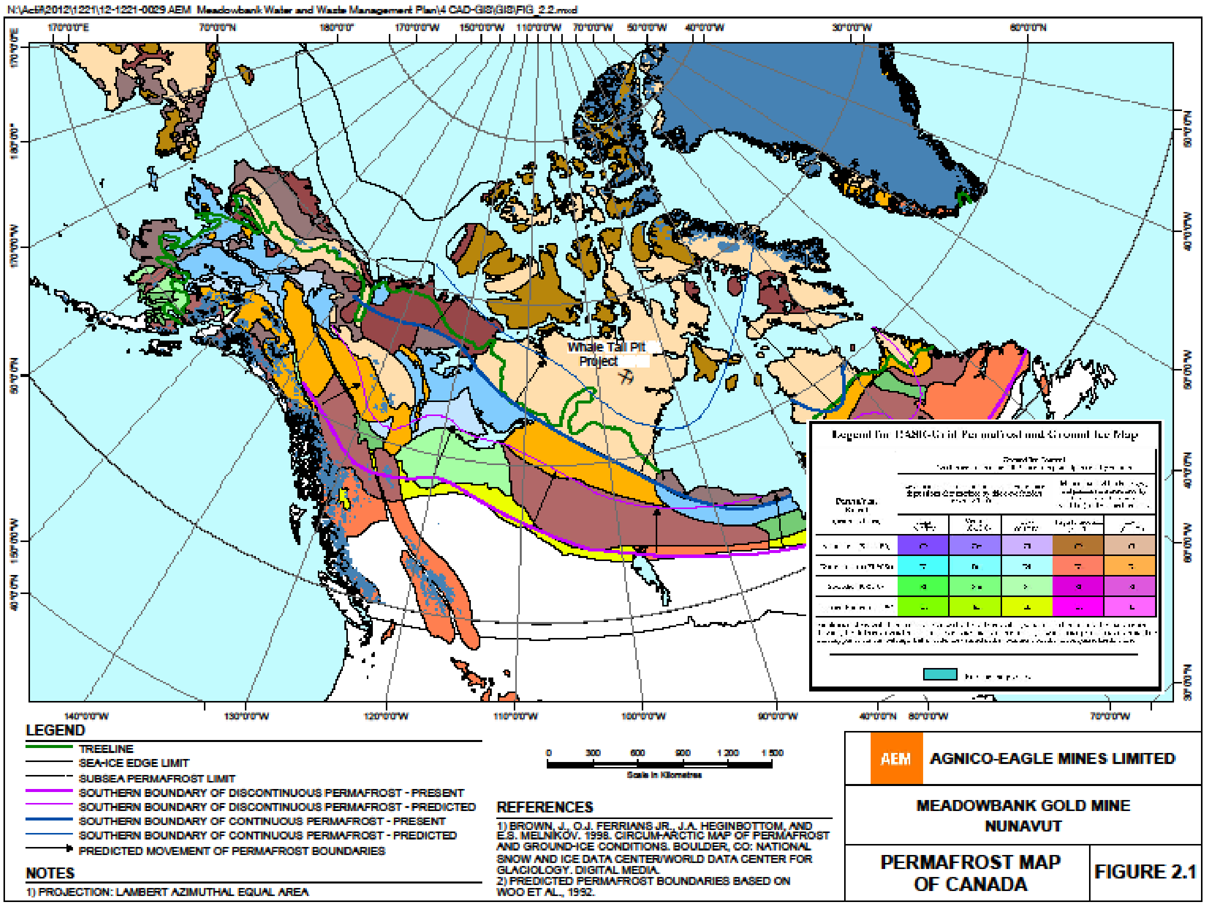

Figure 2.1 Permafrost Map of canada

2.7 Seismic Zone

The mine site is situated in an area of low seismic risk. The peak ground acceleration (PGA) for the area was estimated using the seismic hazard calculator from the 2010 National Building Code of Canada website (http://www.earthquakescanada.nrcan.gc.ca/hazard-alea/interpolat/index_2010-eng.php). The estimated PGA is 0.019 grams (g) for a 5% in 50-year probability of exceedance (0.001 per annum or 1 in 1,000 year return) and 0.036 g for a 2% in 50-year probability of exceedance (0.000404 per annum or 1 in 2,475 year return) for the area.

AGNICO EAGLE

SECTION 3 • WHALE TAIL PIT DEVELOPMENT PLAN

3.1 Whale Tail Pit Life of Mine

Several LOM scenarios were analysed by Agnico Eagle, which ultimately retained the best one based on economic viability of the Project. The chosen scenario is not expected to change significantly from that existing at Meadowbank, and will remain on average 9,000 t/day and up to a peak mill throughput of 12,000 t/day (which is the current rate capacity at Meadowbank Mill). Milling will end as the maximum capacity of the current TSF at Meadowbank is reached (8.3 Mt). Table 3.1 summarizes the Whale Tail Pit LOM.

Table 3.1 Projected Whale Tail Pit Mined Tonnages

Year	Period	Ore Mined (t)	Ore Processed in Mill (t)	Production Days
2018		160,020	-	-
2019	Q1	366,229	-	184
	Q2	610,012	-	
	Q3	418,663	821,250	
	Q4	895,072	821,250	
2020	Q1	800,463	821,250	366
	Q2	931,458	821,250	
	Q3	763,882	821,250	
	Q4	856,512	821,250	
2021		2,476,834	3,285,000	365
2022		0	66,644	8
Total		**8,279,144**	**8,279,144**	**923**

t = tonne.

The Whale Tail Pit deposition plan is proposed to be a continuation of the current Meadowbank deposition plan according to the Whale Tail Pit production rates and mill feed presented in Table 3.1. Completion of the Meadowbank LOM milling activities will occur in Q3 2018.

For additional information, refer to the Mine Waste Rock and Tailings Management Plan submitted under Water Licence 2AM-MEA1526.

3.2 Mine Waste Production Sequence

Two mine waste streams will be produced at Whale Tail Pit, waste rock and overburden. A third mine waste stream, tailings, will be produced at Meadowbank Mine (Refer to the Mine Waste Rock and Tailings Management Plan, submitted under Water Licence 2AM-MEA1526). Approximately 61.3Mt of waste rock and 6.0Mt of overburden will be generated by the Project as presented in Tables 3.2 and 3.3. The operation management and monitoring of the TSF is regulated under Agnico Eagle Type A Water Licence 2AM-MEA1526.

The term “waste rock” designates all fragmented rock mass that has no economic value and needs to be stored separately. Waste rock is also commonly referred to as “mine rock” in the mining industry. Typically, waste rock is produced during the initial stripping phase and during the subsequent development of open pits and underground workings.

The term “overburden” designates all soils above the bedrock that needs to be stripped at surface prior to developing the open pits. Generally, the overburden at the site consists of a thin layer of organic material overlying a layer of non-cohesive soil with variable amounts of silt, sand, and gravel.

Table 3.2 Projected Mined Tonnages and Ore Stockpile Balance (2018 – 2022)

Year	Period	Ore Mined (t)	Waste Rock Excavated (t)	Overburden Excavated (t)	Total Material Excavated (t)	Total Material Excavated (t/day)	Strip ratio	Ore Stockpile Balance (t)
2018	June to Sept.	0	1 356 408	0	1 356 408	11 303		0
	Q4	160 020	851 428	0	1 011 448	10 994	5.3	126 417
	Sub-total	**160 020**	**2 207 836**	**0**	**2 367 856**	**11 169**	**13.8**	**160 020**
2019	Q1	366 229	517 007	2 750 378	3 633 613	40 373	8.9	140 664
	Q2	610 012	2 153 610	931 456	3 695 079	40 605	5.1	222 710
	Q3	418 663	6 170 599	1 710 536	8 299 798	90 215	18.8	0
	Q4	895 072	7 141 907	649 578	8 686 557	94 419	8.7	0
	Sub-total	**2 289 976**	**15 983 122**	**6 041 948**	**24 315 047**	**66 617**	**9.6**	**0**
2020	Q1	800 463	8 044 059	0	8 844 522	97 193	10.0	0
	Q2	931 458	7 676 901	0	8 608 359	94 597	8.2	0
	Q3	763 882	7 837 460	0	8 601 342	93 493	10.3	0
	Q4	856 512	6 609 431	0	7 465 943	81 152	7.7	0
	Sub-total	**3 352 314**	**30 167 851**	**0**	**33 520 165**	**91 585**	**9.0**	**0**
2021		**2 476 834**	**12 974 910**	**0**	**15 451 744**	**42 334**	**5.2**	**0**
2022		**0**	**0**	**0**	**0**	**0**	**-**	**0**
Total		**8 279 144**	**61 333 719**	**6 041 948**	**75 654 811**		**8.1**	**0**

t = tonne; t/day = tonnes per day.

The proposed usage or destination of the two mine waste materials is presented in Table 3.3. Further details on the management of the mine waste materials are presented in Section 5 of this Plan.

The site layouts presented in Appendix A show the evolution of the site in 2018, 2019, 2022, and 2029. Most of the waste rock excavated in 2018 at the start of the open pit development will be used for the construction of the water management structures, the infrastructures pads, and the access roads (Table 3.4). During the Year 1 (2019) and the Year 2 (2020), the remaining required facilities for the operations will be completed.

Table 3.3 Summary of Mine Waste Tonnage and Destination

Mine Waste Stream	Estimated Quantities	Waste Destination
Overburden	6.0Mt	• Temporary storage West of Whale Tail Lake (~ 0.1 Mt for operations) • Co-disposed with waste rock in Whale Tail WRSF
Waste Rock	61.3Mt	• Construction material • Whale Tail WRSF • Closure and site reclamation

Mt = million tonnes; WRSF = Waste Rock Storage Facility.

Table 3.4 Projected Waste Rock Tonnages Used for Construction (2018 – 2022)

Year	Period	Waste Rock and Overburden Excavated (t)	Waste Rock Used for Pad and Road Construction (t)	Waste Rock Used for Water Management Structures (t)	Waste Rock and Overburden Stored in Whale Tail WRSF (t)
2018	June to Sept.	1 356 408	654 044	514 655	187 709
	Q4	851 428	0	75 970	775 458
	Sub-total	**2 207 836**	**654 044**	**590 625**	**963 167**
2019	Q1	3 267 384	185 970	153 600	2 927 814
	Q2	3 085 067	470 772	0	2 614 295
	Q3	7 881 135	0	96 120	7 785 015
	Q4	7 791 485	0	0	7 791 485
	Sub-total	**22 025 071**	**656 742**	**203 306**	**21 165 023**
2020	Q1	8 044 059	0	0	8 044 059
	Q2	7 676 901	0	0	7 676 901
	Q3	7 837 460	0	0	7 837 460
	Q4	6 609 431	0	0	6 609 431
	Sub-total	**30 167 851**	**0**	**3 624**	**30 164 227**
2021		**12 974 910**	**0**	**0**	**12 974 910**
2022		**0**	**0**	**0**	**0**
Total		**67 375 667**	**1 310 786**	**797 555**	**65 267 327**

t = tonne; WRSF = Waste Rock Storage Facility.

Over the LOM, non-potentially acid generating (NPAG)/non-metal leaching (NML) and potentially acid generating (PAG)/metal leaching (ML) waste rock will be segregated according to the requirement for construction (refer to the Operational Acid Rock Drainage (ARD)/Metal Leaching (ML) Testing and Sampling Plan) and capping of the Whale Tail WRSF (refer to Sections 5 and 9). The NPAG waste rock tonnage required for the construction of the Whale Tail WRSF for the 4.7 m thermal cover is 8,883,000 tonnes.

SECTION 4 • WHALE TAIL PIT OVERBURDEN MATERIALS

A detailed description of soils in the Project footprint is presented in FEIS Volume 5, Section 5.3 - Terrain, Permafrost, and Soils (Agnico Eagle, 2016). Soils in the Project footprint are predominantly coarse to moderately coarse-textured glacial till and colluvium with high coarse fragment content commonly overlying bedrock at shallow depths (less than 1 m). Soils are dominated by Cryosols which develop on till dominated landscapes. Saturated soil layers overlying frozen layers have been observed on site. Other soils identified include Brunisols which are most prevalent on glaciofluvial material (e.g., eskers), Gleysols which develop on till in transition areas between upland and depressional landscape positions, and Regosols which are poorly developed soils. Organic Cryosolic soils have been found in wetlands.

Field results suggest that the mineral soils are predominantly acidic to neutral, ranging from pH 5.14 to 6.96, with pH tending to increase with soil depth (FEIS Amendment Volume 5, Appendix 5-A, Appendix E). Due to their mineralogy, the mineral soils in the Project area are increasingly sensitive to adverse effects due to acid deposition with decreasing baseline pH. Soils in the Project footprint are generally not susceptible to compaction. Soils prone to compaction are limited to low-lying, imperfectly and poorly drained areas where the clay content of soils is slightly higher.

Most soils in the Project area are rated as having moderate erosion potential, with the exception of areas with morainal blankets or colluvial deposits on slopes greater than 60%, and areas containing glaciofluvial soils. In areas of gullied or dissected terrain, the erosion potential would increase.

There is a level of uncertainty associated with the location of ice-rich permafrost within the Project footprint as no detailed permafrost studies regarding the thickness of the active layer or the ice content of the soils were completed for this area. It is assumed that ground ice content is between 0 and 10% as suggested by Heginbottom et al. (1995). Conditions are considered to be similar to Meadowbank, with ice lenses and ice wedges present locally on land, as indicated by permafrost features such as frost mounds. These areas of local ground ice are generally associated with low-lying areas of poor drainage.

A chemical characterization program investigated the geo-environmental properties of surficial overburden and Whale Tail Lake sediments. Static geochemistry tests, mineralogy and kinetic leaching tests were carried out to investigate the reactivity of these materials with respect to their potential to generate ARD and to release metals (metal leaching or ML) to the receiving environment. The surficial overburden, as described in FEIS Amendment Volume 5, Appendix 5-E, is NPAG and has low leachability but the fines portion of the material could be amenable to erosion and transport as suspended solids in contact water.

The overburden expected to be excavated over the LOM is presented in the Table 3.2. According to Meadowbank Mine experience, lakebeds will consist of water saturated and soft soils. The remainder of the overburden materials will consist of till excavated on land. Some of the till or till-like material (approximately 100,000 t) is expected to be used during operations and will be temporarily stockpiled on the Overburden Storage pad (having approximate footprint of 3.2 hectares (ha)) near Whale Tail Dike and where the contact runoff will naturally flow into the Whale Tail Attenuation Pond. The remaining 5.9 Mt of overburden will be piled at the base of the Whale Tail WRSF and surrounded with waste rock to stabilize the material (see Figure A.1 in Appendix A). All the overburden stockpiled in the Whale Tail WRSF will be eventually covered with NPAG/NML waste rock if deemed required. Further details on mine site closure and reclamation can be found in the Whale Tail Interim Closure and Reclamation Plan.

SECTION 5 • WHALE TAIL PIT WASTE ROCK

The location of the Whale Tail WRSF took into consideration the following environmental, social, economic, and technical aspects of waste rock management:

- minimize the overall footprint of the Whale Tail WRSF to the extent practicable while maintaining the short-term and long-term stability of the facilities;
- avoid or minimize impact to adjacent fish bearing lakes;
- minimize the haul distance from the open pit to the Whale Tail WRSF;
- minimize the number of the water catchment areas potentially affected by drainage from the Whale Tail WRSF;
- when feasible, divert upstream clean natural non-contact run-on water away from the Whale Tail WRSF; and
- facilitate the collection and management of the contact water from the Whale Tail WRSF during mine operations to avoid potentially negative impacts on the surrounding environment.

The area selected for the storage of waste rock and overburden materials is shown in Figures A.1 to A.4 of Appendix A. This area has an approximate footprint of 110 ha. Waste rock and overburden from the Whale Tail Pit not used for site development purposes will be trucked to the Whale Tail WRSF until the end of mine operations.

Waste rock will be managed in accordance with the Plan, as per Part F, condition 19 of the Water License 2AM-WTP1826.

5.1 Waste Rock Properties

A chemical characterization program investigated the geo-environmental properties of waste rock and ore at the Project (Golder, 2018b). Static geochemistry tests, mineralogy and kinetic leaching tests were carried out to investigate the reactivity of these materials with respect to their potential to generate ARD (potentially acid generating, or PAG) and to release metals (ML) to the receiving environment.

The Whale Tail deposit mineralization is low sulphur but the sulphur carries arsenic which is enriched in many waste rock types, while other rock types are PAG. Arsenic, sulphur, and carbonate-buffering capacity are the parameters of environmental interest present in mining wastes. Mine waste will be segregated during operations, such that all PAG and/or ML material will be managed within the Whale Tail WRSF, and all material that is NPAG and NML will be used for site construction and WRSF closure. Table 5.1 below summarizes the various waste rock types and their ARD/ML potential.

Table 5.1 Anticipated ARD/ML Potential of Waste Rock Types at Whale Tail (Golder, 2018b)

Waste Type	Rock Unit Code	ARD Potential	ML Potential[1]
Komatiite North	V4a – 0a	No	High
Komatiite South	V4a – 0b	No	Moderate
Greywacke Central	S3C – 3b	Yes	Variable
Greywacke South	S3S – 3b	No	Low
Greywacke North	S3N-3b	Variable	Variable
Chert	S10 – 3b	Yes	Variable
Iron Formation	S9E – 3b	No	High
Basalt	V3 – 1b	No	Moderate
Diorite	I2 – 8b	No	Low
Overburden	n.a.	No	Low[2]
Lake sediment	n.a.	Yes	High[2]

n.a. not applicable

[1] based on large column kinetic test results

[2] based on Shake Flask Extraction results

Most of the waste rock lithologies to be disturbed by mining are NPAG including komatiite, iron formation, basalt, southern greywacke and diorite units. Together, these lithologies comprise approximately 68% of the waste rock (41.8 Mt). These units will not require means to control ARD. Of these, however, the basalt, komatiite and iron formation units, which account for 51% of waste rock (31.3 Mt), as well as some of the lake sediments, leach arsenic in static and kinetic leaching tests at concentrations that exceed the Effluent Quality Criterion (EQC) developed for the site. The south greywacke and the diorite within the open pit have low leachability in addition to being NPAG and represent approximately 17% of the waste rock (10.5 Mt). The north greywacke has variable ARD and arsenic leaching potential and represents 11% of waste rock (6.8 Mt).

The ore and waste rock from the central greywacke and chert units are PAG. Chert and central greywacke represent 21% of waste rock to be generated by mining (19.1 Mt). They are silicified and, compared with the other greywacke waste rock, have a lower buffering capacity and/or a slightly higher sulphur content which results in a PAG classification of this material. The PAG waste rock also leaches arsenic but at concentrations that are well below the EQC. Kinetic leaching tests, mineral depletion calculations and consideration of the scale and site differences between laboratory tests and field conditions suggest a time lag to possible ARD development at site of more than a decade. Upper tier ARD materials (high sulphur/low buffering capacity greywacke or chert waste rock) generated acidic drainage earlier under laboratory conditions but without the benefit of added buffering capacity from mixing with other NPAG rock piles. The delay to onset of ARD from the bulk of PAG waste rock and ore is expected to be substantially longer than the four years of mine construction and operations. Further, ARD control mechanisms for PAG materials will be implemented during operations as PAG/ML material will be in placed in the center of the WRSF and progressively covered with NPAG material.

All waste material will be sampled and tested during operations to confirm their ARD and ML potential in support of waste segregation. Based on results to date, a sulphur content of 0.1 wt% appears to be a suitable threshold to identify PAG material. Arsenic leaching material will be evaluated based on a strong correlation between total and leachable arsenic in the current results, which indicates that material below 75 mg/kg is not expected to result in waste rock contact water quality above the EQC. The diorite and south greywacke material, which are both NPAG/NML, as well as other material below these threshold values, can be used as construction materials on site, as cover material for the Whale Tail WRSF and as reclamation material. All material above these thresholds, as well as the lake sediments, will require long-term management and will be stored in the Whale Tail WRSF.

5.2 Waste Rock and Waste Rock Storage Facility Management

5.2.1 Waste Rock Storage Facility Water Management

Seepage and runoff water from the Whale Tail WRSF will be managed by a combination of water retention dikes and water collection ponds (Whale Tail WRSF Pond and Whale Tail Attenuation Pond). Water quality will be monitored as per the Whale Tail Water License requirements. If water quality does not meet discharge criteria, contact water in the water collection ponds will be treated at the Whale Tail water treatment plant (WTP) prior to discharge to the outside environment.

The Whale Tail WRSF was located considering advantageous topography in the form of a gentle valley presenting one low topographic point near Mammoth Lake where a contact water pond will be built. Only one low topographic point is observed north of the Whale Tail WRSF where potential runoff could escape from the Whale Tail WRSF footprint. As part of the surrounding road, a saddle dam will be constructed at this location to avoid contamination of the sub-watershed located northward of the Whale Tail WRSF.

As mentioned in the document Amaruq Stage 1 WRSF, Ore Stockpile 1 and Starter Pit Design Report and Drawings (Agnico Eagle, 2018), while awaiting the construction of the Whale Tail WRSF dike expected in winter 2019, a Stage 1 WRSF will be initiated. The Stage 1 WRSF, located within the footprint of the final location of the WRSF, will be positioned as to be able to control the watershed using the topography in combination with temporary water management structures in order to prevent potentially contaminated contact water from seeping into the environment. The duration of this Stage 1 WRSF will be during the second half of 2018 until the aforementioned WRSF dike is constructed or when weather conditions are sufficiently cold that no thawing or water runoff can occur.

To avoid any potential contact water from entering the environment, a low-permability access road built of overburden will be established first to reach the Stage 1 WRSF location and will act as a barrier to any water not naturally diverted towards a containment sump that will be established once the access road is completed and prior to any placement of PAG / ML material. The location of the Stage 1 WRSF was chosen as to use the topography to control water runoff, in combination with the access road and collection sump designed to sustain a 1:100 year rain event. All water collected in the sump will be directed towards Quarry 1 in a closed circuit. Refer to Figure A.5 of Appendix A.

The construction of Whale Tail WRSF Pond (Whale Tail WRSF Dike) and Whale Tail Attenuation Pond (Whale Tail Dike) are among the most important water management infrastructure for the Project Construction of Whale Tail Dike will be initiated in the third quarter of 2018 and the construction of the Whale Tail WRSF Dike will start in 2019. The source of construction material for these facilities will be the first development of the open pit where NPAG/NML rocks are located. The overburden will be removed and stockpiled in the Whale Tail WRSF. During the construction, berms and sumps will be built inside the footprint of the Whale Tail WRSF area if required to limit seepage and runoff from overburden and waste rock. As soon as waste rock material will be available from the open pit, the overburden will be surrounded with waste rock material (see Figure A.1 in Appendix A) to control the stability of the pile. If deemed necessary, turbidity barriers in Mammoth Lake will also be installed.

During the operations of the mine, seepage and runoff from the Whale Tail WRSF will be captured by the Whale Tail WRSF Pond and pumped to the Whale Tail Attenuation Pond where the contact water will be treated in the Whale Tail WTP prior to discharge to the outside environment.

The Whale Tail WRSF water management infrastructure will remain in place until mine closure activities are completed and monitoring results demonstrate that the contact water quality from the Whale Tail WRSF meets discharge criteria (refer to Section 9.1).

Refer to the Whale Tail Pit Water Management Report for additional details on water management of the Whale Tail WRSF.

5.2.2 Waste Rock Management Planning

Waste rock and overburden produced during mining will be used in the construction of the mine site infrastructure, while some of the NPAG/NML waste rock will be put aside for capping at closure and for underwater structures for fish habitat compensation if required. The balance of the PAG or NPAG waste rock that will not be used will be placed in the Whale Tail WRSF and will remain in the dedicated rock storage facility areas for PAG or NPAG material.

As a first step in waste rock management planning, options are developed to define the main use and destination for each rock type based on the results of geochemical testing. The second step required accounting of the quantity and timing of extraction of each waste rock type on an annual basis. This included further refinement of the quantity, type and timing of construction material requirements for each infrastructure of the project. The lithology of waste rock is added to the geological block model for each deposit and a detailed account of construction requirements is made, based on the most advanced infrastructure designs available at the moment of planning. The Waste Rock Management Plan is updated annually with current production quantities and actual LOM, dictating the production and mining schedule. Planning of the placement of waste rock material is reviewed for each LOM exercise, considering the different waste rock facility locations and capacity, as well as the closure NPAG/NML cover requirements.

Waste rock management is also part of the day to day planning of the mine operation. Part of the mining planning includes the management of waste rock, to ensure the plan established with the LOM is followed, to ensure material required for construction or closure purposes are properly stored, and also to plan for adequate and permitted storage areas. Because of the material requirement for construction and NPAG/NML rock cover, as well as the importance for adequate disposal to meet closure objectives, waste rock management will be a key component of the mining planning for the Whale Tail Project.

5.2.3 Waste Rock Management Execution

Segregation of ore, waste rock as potentially acid generating (PAG) or non-potentially acid generating material (NPAG), as well as metal leaching (ML) and non-metal leaching material (NML), is based on operational testing during mining activity to differentiate waste rock type. Sampling and testing of waste materials for acid rock drainage (ARD) and metal leaching will be conducted during mine operation in order to segregate PAG/ML waste rock from NPAG/NML waste rock material, so that waste material can be assigned to specific locations or use. This practice has been ongoing since the beginning of the mining operations at Meadowbank, and will continue during the operation period at Whale Tail Pit.

Operational sampling and analysis will be completed at the laboratory on site, at specified frequency during mining activities, in order to identified and delineate the material type in the pits during mining. The results from these analyses will be used to differentiate the PAG/ML and NPAG/NML materials. Once characterized, the waste rock material will be segregated and placed in appropriate locations.

The geochemical properties of all Whale Tail mining wastes will also be confirmed by certified laboratory, through both static and kinetic testing on numerous representative samples, by various test methods and through multiple Project development stages. These data will be used to update the Waste Rock Management Plan and implement adaptive management strategies to adequately ensure the protection of the environment and meet regulatory requirements.

The dispatch system is a computer system used to manage and control surface mining equipment. This system has been implemented at Meadowbank and will be used also at the Whale Tail Pit. The system offers real time fleet management and machine guidance technology that records data related to mining equipment activity, location, time, production, and maintenance. This information is also displayed to machine operators and other mining personnel. The system connects with mobile computers on field equipment such as excavators and haul trucks. For example, operators of loading equipment in the pit have information on screens about the type of material they are excavating. The haul truck drivers also have access to information in their equipment, about what type of material they are hauling and where is the appropriate disposal destination for the material. Information regarding the waste rock characterization is also managed and recorded by the mine dispatch system, tracking in real time loads of material, including waste rock, and their respective destination. The system and the dispatcher in charge guide the operators and ensure the ore and waste rock material are transported to the appropriate destination.

As part of the planning and execution of the waste rock management strategy, waste rock presenting geological characteristics leading to metal leaching such as arsenic will be managed in the Whale Tail WRSF in order to ensure their encapsulation and geochemical stability. Certain type of waste rock material or lithology will be placed in specific locations within the WRSF in order to provide sufficient cover of NPAG/NML waste rock material to prevent metal leaching and ensure geochemical stability.

5.2.4 Waste Rock Facility Monitoring

Monitoring will be carried out during all stages of the operation to demonstrate geotechnical stability, safe environmental performance of the facility and efficiency of the waste management procedures. If any non-compliant conditions are identified, adaptive management including modification of waste management practices and planning for corrective measures will be completed in a timely manner to ensure the environmental performance of the Whale Tail WRSF, the protection of the environment and that regulatory requirements are met.

In order to assess and monitor the performance of the waste rock management procedure, a number of methods can be put in place during the operation, such as:

- QA/QC laboratory analysis program with an accredited commercial laboratory to validate the procedure and results of the onsite laboratory for determination of PAG/NPAG and ML/NML waste rock;
- Mine dispatch data base, ensuring tracking and location of all waste rock material at any locations on site. With the information in the system, recovery of waste rock material disposed in an inappropriate location will be possible in a timely manner;
- Clear indication and marking of the PAG/ML zones, NPAG/NML zones and NPAG/NML cover within the waste rock storage facility, to provide visual guidance for the operators and during environmental inspection;

- Survey of the WRSF to provide a record plan of the waste rock material placement within the facility;
- Thermal monitoring of the WRSF to observe freezeback with thermistors installed at strategic locations. The purpose of the thermistors is to monitor the temperature within the facility as freezing progresses. The thermistors will be monitored regularly throughout the operational period, as presented in the Thermal Monitoring Plan, to verify and validate the WRSF thermal model with operational data from site.
- Water quality monitoring will be completed as per the Water Quality Flow and Monitoring Plan and the Water License requirements.

A specific set of procedures for segregation and monitoring of the waste rock material at the Whale Tail Project is presented in the Operational Acid Rock Drainage (ARD)/ Metal Leaching (ML) Testing and Sampling Plan.

5.3 Whale Tail Waste Rock Storage Facility Dimensions

The evolution of the Whale Tail WRSF is shown in Figures A.1 to A.4 of Appendix A. At completion, the crest elevation of the Whale Tail WRSF will be approximately at 250 m (maximum height of approximately 95 m) in an environment where the adjacent topography elevation varies between 154 and 170 m.

The Whale Tail WRSF is designed to minimize the impact on the environment and consider both the physical and geochemical stability of the stored waste rock and overburden. The design criteria are presented in FEIS Amendment Volume 2, Appendix 2-J (Agnico Eagle, 2016). Final design details for the Whale Tail WRSF will be provided to the regulators for approval at least 60 days prior to construction. The Whale Tail WRSF is designed considering the placement of the waste rock and overburden in layers spread using a dozer to minimize the footprint and the dust. Each bench of 20 m maximum height is going to be composed of 4 layers of 5 m thickness, and where the bench toe will start at a setback distance of 20 m from the crest of the previous bench. The current design and overall sideslope angle of the Whale Tail WRSF will be 2.5V:1V, an angle generally considered stable for such a facility (see Figure 5.1 for a typical cross section). However, slope stability analyses will be performed during the next engineering phases to determine the final design so that it is consistent with approved Portage and Vault Waste Rock facilities at Meadowbank Mine. If needed, the Whale Tail WRSF could be expended for additional capacity, within the approved limits of the Project and upon regulatory approval.

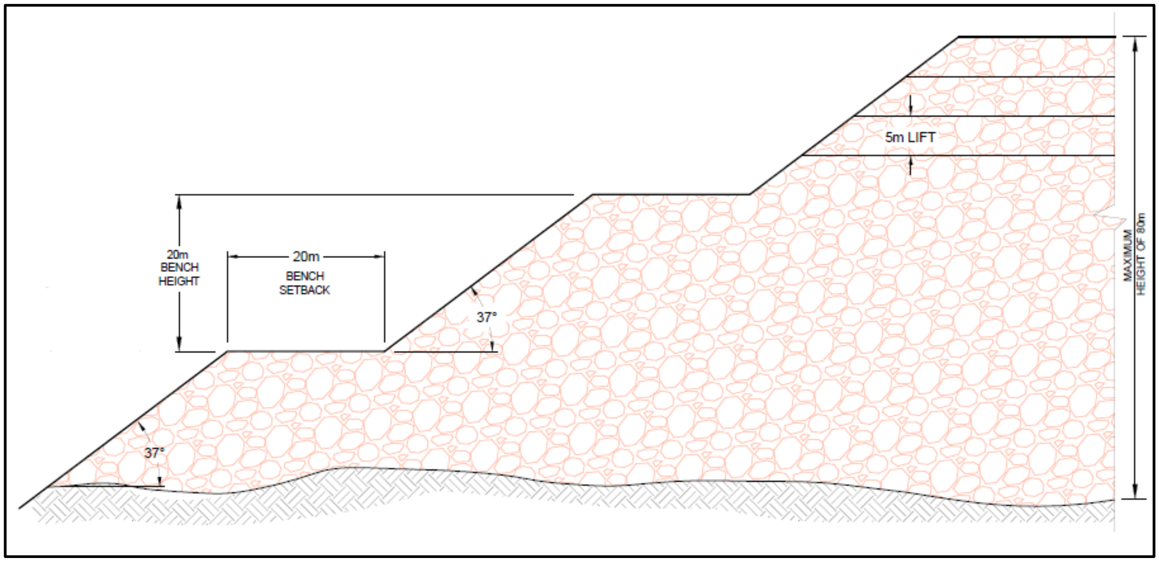

Figure 5.1 Typical Cross Section of the Whale Tail Waste Rock Storage Facility

Source: SNC (2015).

SECTION 6 • WHALE TAIL PIT ORE STOCKPILES

The three areas selected for stockpiling of ore are identified as Ore Stockpile 1, Ore Stockpile 2, and Ore Stockpile 3 on Figure A.2 of Appendix A. These ore stockpile pads have an approximate footprint of 5.7, 5.5, and 6.5 ha, respectively. As presented in Table 3.1, the maximum amount of ore stockpiled on the ore pads is 1,136,261 tonnes (t) in Q2 2019, from there the quantity of ore stockpiled stabilizes and then decreases until the end of operations in Q1 2022. No ore will remain on stockpile pads at the end of operations.

6.1 Ore Properties

A chemical characterization program investigated the geo-environmental properties of waste rock and ore report (FEIS Amendment Volume 5, Appendix 5-E). Static geochemistry tests, mineralogy and kinetic leaching tests were carried out to investigate the reactivity of these materials with respect to their potential to generate ARD and to release metals (ML) to the receiving environment.

The ore is PAG, and is enriched in arsenic, antimony, bismuth, chromium, selenium, silver and to a lesser extent, nickel. Some of the ore samples leached arsenic at concentrations that exceed the Portage effluent criterion in static (shake flask extraction) tests but exceedances were short-lived in the first cycles of kinetic leaching tests. The delay to onset of ARD from ore is expected to be substantially longer than the seven years of mine construction, operations, and closure.

6.2 Ore Stockpile Management

Seepage and runoff water from Ore Stockpiles 1, 2, and 3 will naturally flow to the Whale Tail Attenuation Pond; channels will be constructed if deemed required to direct the seepage and runoff to the pond. If the water quality does not meet discharge criteria, the contact water will be treated at the Whale Tail WTP prior to discharge to the outside environment.

The Ore Stockpile Pad 1, which constitute the first stage of the ore stockpile, was designed based on the following considerations. A minimum 1.0 m of overburden and/or waste rock will be placed over original ground to reduce any thaw-induced differential settlements. Waste rock will then be placed to follow the natural topography, thereby reducing the likelihood of water ponding on the surface of the pad requiring additional maintenance. A final grade of about 0.5% sloping towards the Whale Tail Attenuation Pond will be achieved. Any surface run off from the ore stockpile or the pad will therefore be directed to the Attenuation Pond containment area (Agnico Eagle, 2018).

6.3 Ore Stockpile Facility Dimensions

The three ore stockpiles will occupy an area of approximately 17.8 ha. A typical cross section of these facilities is presented in Appendix A (Drawing no. 6108-687-210-001). Currently, Ore Stockpiles 1, 2, and 3 are designed to stack three layers of 5 m maximum thickness for a total height of 15 m. The sideslope angle of these ore stockpiles will be 3V:1V, an angle generally considered stable for such facility. Slope stability analyses will be performed during the next engineering phases and a final design will be presented prior to construction.

SECTION 7 • MEADOWBANK TAILINGS STORAGE FACILITY - TAILINGS MANAGEMENT FOR WHALE TAIL PIT

According to the Whale Tail Pit LOM calculation, the addition of the Whale Tail Pit to the Meadowbank LOM (LOM 2015 – completion Q3 2018) will generate an addition of approximately 8.3 Mt (dry) of tailings to the Meadowbank TSF for a total of 35.4 Mt.

Currently, Meadowbank tailings are stored within the TSF North and South Cells. The TSF includes dikes/dams, and is located within the basin of the former north-west arm of Second Portage Lake which has been dewatered to allow mining in the Portage Pit (refer to Figure 1.2). The TSF North and South cells are separated by the Stormwater Dike. Tailings were deposited into the North Cell from 2010 until November 2014, and again from June to September 2015. The South Cell (former Portage Attenuation Pond) is currently operating and receiving tailings.

Tailings from Whale Tail Pit will be stored within the approved Meadowbank TSF footprint. According to the approved Meadowbank TSF design and Meadowbank LOM 2015, there remains a capacity of 5.3 Mt in the South Cell after the completion of mining Goose Pit, Portage Pit, Vault Pit, BB Phaser, and Phaser Pit. To provide the additional 3 Mt of capacity required to store Whale Tail Pit tailings, Agnico Eagle is proposing to construct an internal structure raise over the outside perimeter of the existing and frozen North Cell. This concept will increase the tailings beach elevation to a maximum of 153.5 masl in the North Cell.

The management operation and monitoring of the TSF is regulated under Agnico Eagles existing Type A Water Licence 2AM-MEA1526. Updates to the Meadowbank Mine Waste Rock and Tailings Management Plan has been provided in support of the Whale Tail Pit application and amendment needed to the existing Type A Water Licence to reflect changes in the Meadowbank operations.

SECTION 8 • CONTROL STRATEGIES FOR ACID ROCK DRAINAGE AND METAL LEACHATE IN COLD REGIONS

The generation of metal leachate in acidic drainage is a concern for mining projects. In evaluating the potential control strategies for the disposal of the mine waste for the Whale Tail Pit, consideration was given to strategies that are effective in cold regions. A discussion of the alternative control strategies considered is summarized below.

Common control strategies for the prevention or reduction of acid mine drainage in cold regions are:

1. Control of acid generating reactions;
2. Control of migration of contaminants; and
3. Collection and treatment.

In assessing the overall control strategies for the Project, emphasis has been placed on methods that satisfy (1) and (2) in the above list, which then has an impact on (3) by potentially reducing the requirements for these activities. Table 8.1 presents various acid mine drainage control strategies.

Table 8.1 Acid Mine Drainage Control Strategies of the Arctic

Strategy	Description
Freeze Controlled	Requires considerable volumes of non-acid waste rock for insulation protection. Better understanding of air and water transport through waste rock required for reliable design.
Climate Controlled	Requires control of convective air flow through waste rock, infiltration control with modest measures and temperature controls. Better understanding of waste rock air, water, and heat transport for reliable design.
Engineered Cover	Special consideration for freeze-thaw effects. Availability and cost of cover materials are major impediments.
Subaqueous Disposal	Very difficult to dispose of waste rock beneath winter ice.
Collection and Treatment	Costly to maintain at remote locations Long-term maintenance cost.

Source: Dawson and Morin (1996).

The Whale Tail Pit site is located within the zone of continuous permafrost, and has a mean annual air temperature of about -11.3°C. Based on thermal data collected during baseline studies, the mine area is underlain by permafrost to the depth of 425 m below the ground surface. In developing this Plan, freeze control and climate control strategies have been adopted.

Freeze control strategies rely on the immobilization of pore fluids to control acid mine drainage reactions, and the potential migration of contaminated pore water outside of the storage facility. The climate conditions in the project area are amenable to freeze control strategies, and hence should be taken advantage of. In addition to immobilization of pore fluids, permafrost can reduce the hydraulic conductivity of materials by several orders of magnitude. Consequently, freeze control strategies are effective methods for reducing the migration of contaminants through materials. According to

Dawson and Morin (1996), freeze control strategies can only be effective if sufficient quantities of NPAG waste rock are available for use as a cover and insulation protection.

Climate control strategies rely on cold temperatures to reduce the rate at which oxidation occurs. The low net precipitation in permafrost regions limits infiltration of water into waste rock and tailings disposal areas. Consequently, the climate of the Whale Tail Pit will act as a natural control to reduce the production of acid mine drainage and metal leachate. Climate control strategies are best applied to materials placed at a low moisture content to reduce the need for additional controls on seepage and infiltration. This strategy is considered to be effective for waste rock in arid climate such as the one of Whale Tail Pit.

Meadowbank Mine uses the climate control strategy for the reclamation of the WRSF and TSF. Research activities are ongoing about the behaviour and the performance of the proposed cover systems for Meadowbank Mine with the participation of the Université du Québec en Abitibi-Témiscamingue and Polytechnique: Research Institute Mines and Environment since 2014. Experience and knowledge acquired at Meadowbank Mine regarding the design, the closure cover conception and the monitoring of the facility and the cover system will be applied to the Whale Tail Pit waste rock storage facility.

SECTION 9 • MONITORING AND CLOSURE

9.1 Whale Tail Waste Rock Storage Facility

Progressive reclamation includes closure activities that take place prior to permanent closure in areas or at facilities that are no longer actively required for current or future mining operations. Reclamation activities can be done during operations with the available equipment and resources to reduce future reclamation costs, minimize the duration of environmental exposure, and enhance environmental protection. Progressive reclamation may shorten the time for achieving reclamation objectives and may provide valuable experience on the effectiveness of certain measures that might be implemented during permanent closure. The Whale Tail WRSF will be operated to facilitate progressive reclamation; detailed mine closure and reclamation activities are provided in the Whale Tail Interim Closure and Reclamation Plan.

A closure cover system will be added on the slopes and top surface of the Whale Tail WRSF, to encapsulate the PAG/ML waste rock. As for the Meadowbank WRSF, the NPAG/NML cover to be placed over the PAG/ML waste rock will be constructed during operations with the available equipment and resources in areas safe to access for work. The cover design proposed is the similar as the Meadowbank Portage WRSF. Based on results calibrated to the Meadowbank WRSF thermal data to date and climate change predictions, the maximum predicted thickness of the WRSF active layer is 4.2 m and a contingency of 0.5 m will be added. Thus, the cover will consist of a 4.7 m thick NPAG/NML waste rock placement as a final surface cover. The intent of the cover is to contain the yearly active layer inside the thickness of the cover and maintain a temperature below 0°C for the underlying PAG/ML waste rock. The objective of the cover is the control of acid generating reactions and migration of contaminants.

The segregation of the PAG/NPAG and ML/NML waste rock will occur during operations (see the Operational ARD-ML Sampling and Testing Plan and Section 5.2), as will the progressive placement of the final cover on the WRSF slopes. The covering of the top of the Whale Tail WRSF will be completed during the closure period using the stockpiled NPAG and NML waste rock. There is sufficient NPAG/NML material for the 4.7 m cover, if needed (Golder, 2018b). It is anticipated that the native lichen community will naturally re-vegetate the surface of the Whale Tail WRSF over time.

During operation, thermal monitoring will be conducted in the cover and the facility. These results, along with thermal modelling, will assess the performance of the WRSF closure cover and identify if adjustments in the cover placement or thickness will be required.

Thermal and water quality monitoring will be carried out during all stages of the mine life to demonstrate geotechnical stability and the safe environmental performance of the facilities. If any non-compliant conditions are identified, then maintenance and planning for corrective measures will be completed in a timely manner to ensure successful completion of the Whale Tail Interim Closure and Reclamation Plan.

Mine closure and the reclamation of the Whale Tail WRSF will use currently accepted management practices and appropriate mine closure techniques that will comply with accepted protocols and standards.

Geochemical testing indicates that some waste rock material is NPAG/NML, but some waste rock is characterized as PAG and/or ML (refer to Section 5.1) and therefore, means to limit oxidation and water infiltration need to be put in place. By containing the yearly active layer inside the thickness of NPAG/NML waste rock cover and maintain a temperature below 0°C for the underlying PAG/ML waste rock, the cover will provide control of acid generating reactions and migration of contaminants. Increased active thaw depth/rock cover from 4.0 to 4.7 m is expected to have no effect on WRSF contact water quality during operations, and long-term post closure effects to water quality of a thicker active layer are expected to be within model accuracy where a clean (low leaching) waste rock cover present.

The contact water management system for the Whale Tail WRSF (WRSF Dike and WRSF Pond) will remain in place until mine closure activities are completed and monitoring results demonstrate that water quality conditions from the Whale Tail WRSF are acceptable for discharge with no further treatment required. Water quality will be monitored as per the Whale Tail Pit Water License requirements. Once water quality meets the discharge criteria established through the water licensing process, the contact water management system will be decommissioned to allow the surface runoff and seepage water from the Whale Tail WRSF to naturally flow to the outside environment. Water quality predictions for Whale Tail Pit are provided in Volume 6, Appendix 6-H of the FEIS (Agnico Eagle, 2016).

9.2 Ore Stockpiles

Ore Stockpiles 1, 2, and 3 will used over the operations to stockpile ore and will be freed during Q1 2022. During the following summer, if metal contamination of ore pads is measured, the pad section targeted by the contamination will be excavated and placed in the Whale Tail WRSF before its final covering with NPAG waste rock. If deemed required, the Ore Stockpiles 1, 2, and 3 will be covered with NPAG/NML waste rock or soils. In the event of a short-term temporary closure, the water and dust management strategies for the ore stockpiles will be kept the same as used during active mine operations. In the event of a long-term temporary closure, surface water control structures will be maintained as required. Further details on mine site closure and reclamation, including the ore stockpiles, can be found in the Whale Tail Interim Closure and Reclamation Plan.

9.3 Water Quality Forecast for Whale Tail Pit Operation and Closure

An updated water quality forecast report including Whale Tail Pit was completed in 2017 (Golder, 2017). The purpose of the updated modelling was to identify through a mass balance approach the contaminants of concern during the pit flooding process and determine if water treatment will be required on site for closure activities when comparing the final contaminant levels to the CCME guidelines and/or site specific criteria for parameters that are not included in the CCME guidelines. In 2018, a hydrodynamic modelling of Whale Tail Pit Lake was conducted as additional analyses to determine the approximate fill time for the Whale Tail Pit at closure and to evaluate the potential for chemical stratification and the Pit Lake water quality profile post-closure. This hydrodynamic modelling study is addressing terms and conditions of NIRB project certificate, Condition 16 a), c). Results show that diffusion of arsenic from all pit walls has no significant effect on water quality in short and long-term. Arsenic transfer to the open pit by diffusion from the submerged pit walls is not significantly affected by the hydrogeological regime around the flooded open pit (Golder, 2018a).

By 2018, the pit lake is expected to be fully flooded by transfer from South Basin and natural inflows. Lake water is predicted to completely mix bi-annually in spring and fall and exhibit weak chemical stratification in summer and winter. Pit lake water quality meets SSWQO for arsenic, oligotrophic level of 0.01 mg/L phosphorous and receiving water quality guideline for and nitrate in 2028 and post-closure, allowing reconnection of North and South Basins and restore lake circulation (Golder, 2018a).

The hydrodynamic modelling indicated that the effluent discharge into Mammoth Lake will be well mixed (fully mixed conditions), which is representative of the closure conditions. The water quality forecast will be updated on an annual basis as new monitoring data is added at the site, as per the Whale Tail Water License requirements. Forecasted model values from prior years will be compared with the actual sample results from the following years for model calibration purposes.

9.4 Water Quality Forecast for Meadowbank Operation and Closure

Using Whale Tail Pit tailings geochemistry data, identified three contaminants of concern that could impact end Goose and Portage pits water quality at Meadowbank and therefore require treatment: copper, selenium and total nitrogen. These contaminants originate from the TSF reclaim water transferred to the pits in 2022 as outlined in Section 8.7 of the forecast (SNC, 2016). As the afore mentioned parameters may be of concern prior to dike breaching, treatment options for their removal during or after the pit flooding process will need to be examined and will be assessed in greater detail during the preparation of the Meadowbank Final Closure and Reclamation Plan to be submitted one year prior to the end of operations. The management operation and monitoring of the TSF and of the Portage and Goose pits water quality is regulated under Agnico Eagle existing Type A Water Licence 2AM-MEA1526.

9.5 Monitoring of Freezeback

9.5.1 Whale Tail Waste Rock Storage Facility

To observe the freezeback of Whale Tail WRSF, a series of subsurface thermistors will be installed at strategic locations. The purpose of the thermistors is to monitor the temperature within the facility as freezing progresses. The thermistors will be monitored regularly throughout the operational period as well as during closure and post-closure according to the Whale Tail Water Licence and as described in the Thermal Monitoring Plan. The results will be used to evaluate the predicted thermal response of the facility, and will allow for revision of the thickness of the final cover if required.

SECTION 10 • REFERENCES

Agnico Eagle (Agnico Eagle Mines Limited). 2018. Amaruq Stage 1 WRSF, Ore Stockpile 1 and Starter Pit Design Report and Drawings. Meadowbank Divison, June 2018.

Agnico Eagle, 2016. Final Environment Impact Statement (FEIS) Volumes 1 to 8, Whale Tail Pit Project, Meadowbank Division.

Dawson and Morin. 1996. Mine Effluent Neutral Drainage (MEND), 1.61.2: Acid Mine Drainage in Permafrost Regions: Issues, Control Strategies and Research Requirements, 1996.

Golder (Golder Associates Ltd.). 2018a. Hydrodynamic modelling of Whale Tail Pit Lake, Agnico Eagle Mines, Meadowbank Division.

Golder (Golder Associates Ltd.). 2018b. Evaluation of the Geochemical Properties of Waste Rock, Ore, Tailing, Overburden and Sediment from the Whale Tail Pit and Road Aggregate Materials, Agnico Eagle Mines, Meadowbank Division. Document No. 1789310_182. May 2018.

Golder Associates Ltd (Golder) 2018c, Whale Tail Pit Project Waste Rock Storage Facility Cover Thermal Assessment, Technical Memorandum Prepared for Agnico Eagle Mines Limited. Golder reference No. 1789310_177_TMRev0, 16 p. and Appendix. June 2018.

Golder Associates Ltd. 2017. Addendum to Agnico Eagle Mines Whale Tail FEIS Appendix 6-H. Sensitivity Analyses on Water Quality Modelling In Support of Responses to Technical Commitments 30, 36, 37 and 42 and Intervenor Comment ECCC#15 and INAC-TRC #3 and #5, on the Water Licence Application to the Nunavut Water Board. Prepared for Agnico Eagle Mines Ltd. Golder Doc. 015 1658927/6100/6120 Revision 3; August 2017.

Golder (Golder Associates Ltd.). 2016. Addendum for Closure and Reclamation Plan, Agnico Eagle Whale Tail FEIS, Appendix 8-F. Interim Whale Tail Closure Plan and Reclamation plan. Golder Associated Limited. June 2016.

Government of Canada. 2015. Historical Climate Data. Available online from: http://climate.weather.gc.ca/index_e.html

Heginbottom, J.A., M.A. Dubreuil and P.A. Harker. 1995. Canada – Permafrost. In, National Atlas of Canada, 5th Edition, National Atlas Information Service, Natural Resources Canada, MCR 4177.

IPCC (Intergovernmental Panel on Climate Change). 2014. *Summary for Policymakers*. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32

Knight Piesold. 2015. Agnico Eagle Mines Ltd.: Meadowbank Division – Whale Tail Pit – Permafrost and Hydrogeological Characterization, File No.:NB101-00622/04-A.01

MDRB (Meadowbank Review Board). 2015. Report No 17 Meadowbank Mine Dike Review Board Meeting July 27-30, 2015. Meadowbank Mine Dike Review Board. August 6th, 2015.

Overland, J.E., M. Wang, J.E. Walsh, and J.C. Stroeve. 2013. Future Arctic climate changes: Adaptation and mitigation time scales, Earth's Future, 2, doi:10.1002/2013EF000162.

SNC (SNC Lavalin). 2015. Whale Tail Pit Project Permitting Level Engineering, Geotechnical and Water Management Infrastructure, Rev. 00 Ref. 627215-1000-40ER-0004, Agnico Eagle Ref. 6108-REP-004_RA.

SNC. 2016. Tailings Storage Facility Expansion Project Phase 1 - Water Quality Assessment Technical Report. March 11th, 2016

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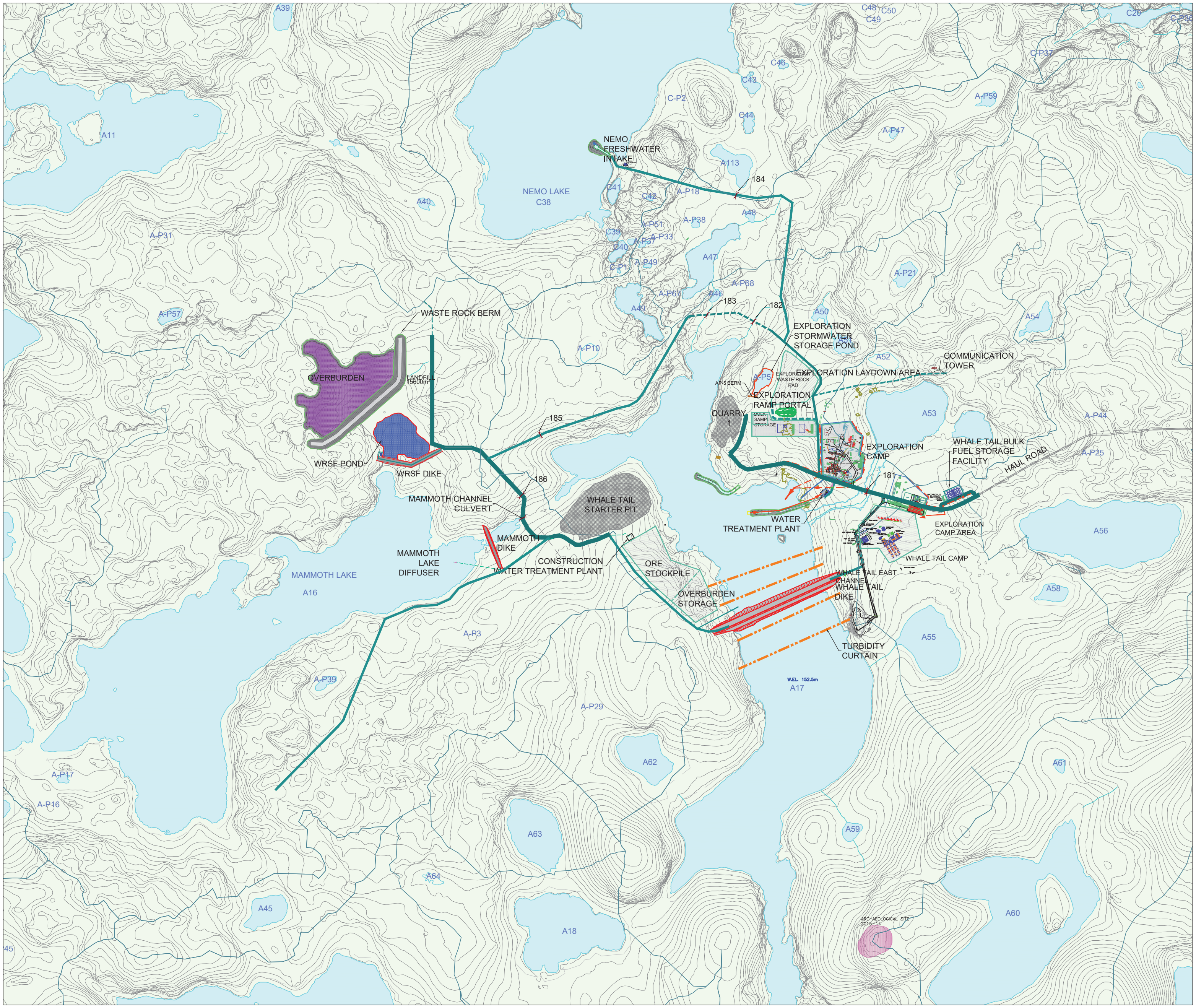
NO. DESSIN
DRAWING NO.

FORMAT ANSI C



PLAN CLÉ
KEY PLAN

NOTES GÉNÉRALES / GENERAL NOTES

LEGEND

- ROAD
- TEMPORARY ROAD
- NATURAL WATERSHED
- COLLECTION CHANNEL
- CULVERT
- INTAKE WATER PIPE
- CONTACT WATER PIPE
- FRESHWATER PIPE
- TURBIDITY BARRIER
- DIKE
- ARCHAEOLOGICAL SITE
- POND / SUMP

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

TITRE / TITLE	# DWG
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–	–

AGNICO EAGLE

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT

REVISIONS

TITRE / TITLE
AGNICO–EAGLE – MEADOWBANK DIVISION
WHALE TAIL PROJET
WM

YEARLY SITE LAYOUT PLAN
(YEAR –1:2018)

DESSINÉ PAR / DRAWN BY	J.CRETE	DATE	2018-05-04
VERIFIÉ PAR / CHECKED BY			
APPROUVÉ PAR / APPROVED BY			
ÉCHELLE / SCALE		DATE	
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NO. PROJET / PROJECT NO.		REVISION	FEUILLE / SHT 1 / 1

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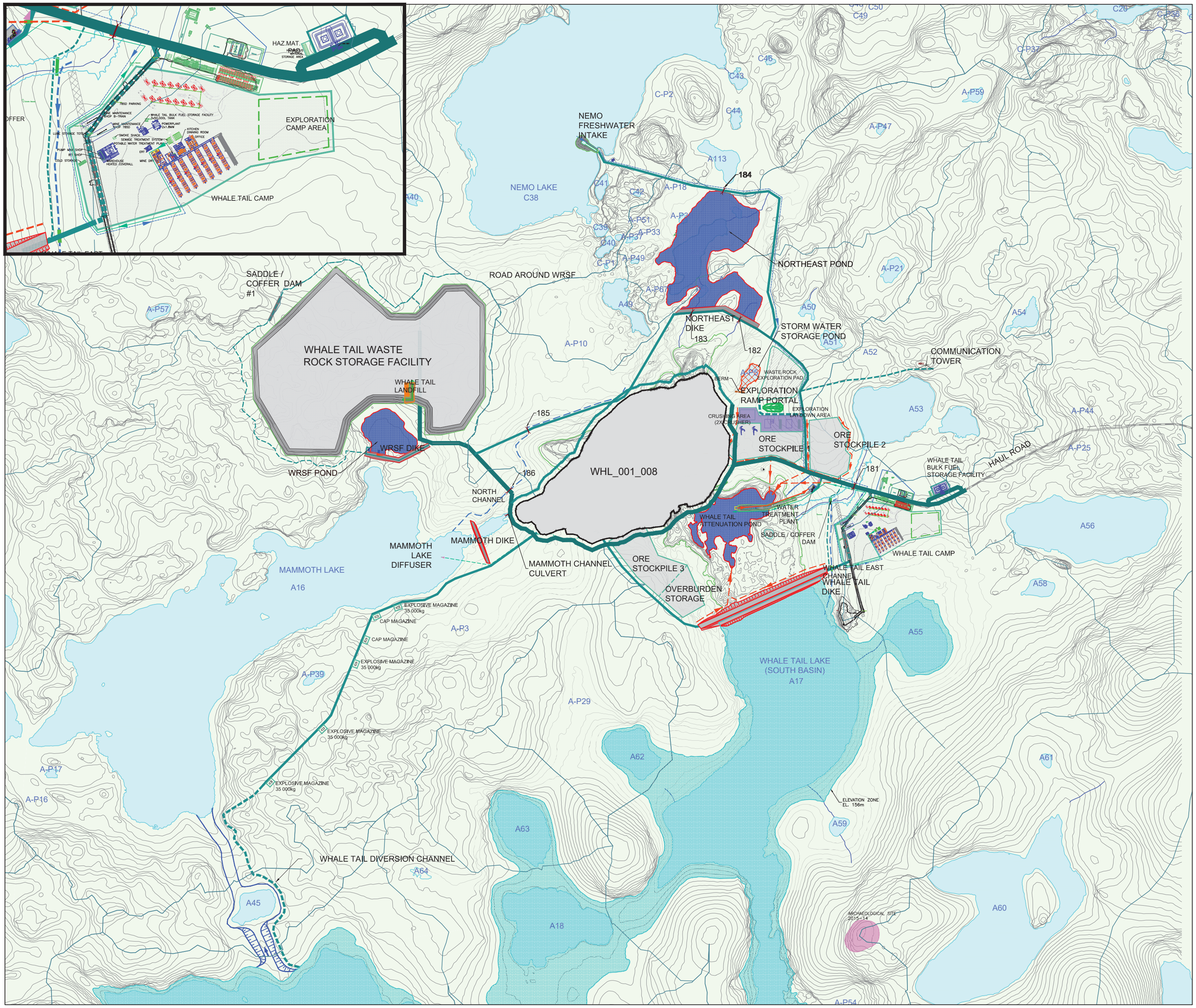

PLAN CLÉ
KEY PLAN

NOTES GÉNÉRALES / GENERAL NOTES

LEGEND

- WHALE TAIL LAKE(SOUTH BASIN) FLOODED LIMIT (WATER LEVEL 156.0m)
- ROAD
- TEMPORARY ROAD
- NATURAL WATERSHED
- DIVERSION CHANNEL
- COLLECTION CHANNEL
- CULVERT
- INTAKE WATER PIPE
- CONTACT WATER PIPE
- FRESHWATER PIPE
- DIKE
- POND / SUMP
- ARCHAEOLOGICAL SITE

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

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AGNICO EAGLE

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT

REVISIONS

TITRE / TITLE

AGNICO–EAGLE – MEADOWBANK DIVISION
WHALE TAIL PROJET
WM

YEARLY SITE LAYOUT PLAN
(YEAR 1:2019)

DESSINÉ PAR DRAWN BY	J.CRETE	DATE	2018-05-04
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APPROUVÉ PAR APPROVED BY			
ÉCHELLE SCALE		DATE	
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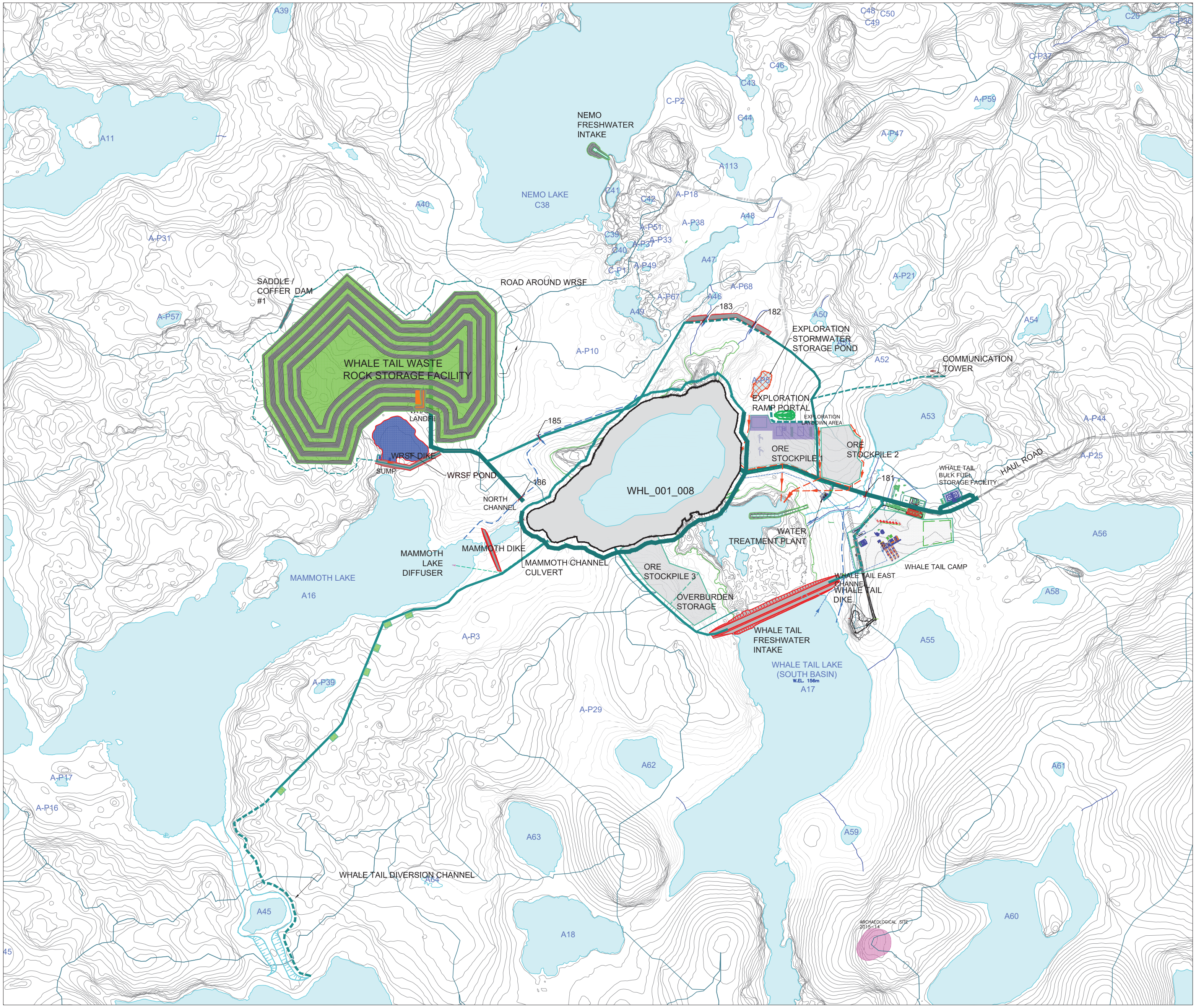

PLAN CLÉ
KEY PLAN

NOTES GÉNÉRALES / GENERAL NOTES

LEGEND

CLOSED FACILITY
ROAD
TEMPORARY ROAD
SCARIFIED ROAD & ACCESS
NATURAL WATERSHED
DIVERSION CHANNEL
COLLECTION CHANNEL
CULVERT
INTAKE WATER PIPE
CONTACT WATER PIPE
FRESHWATER PIPE
DIKE
POND / SUMP
ARCHAEOLOGICAL SITE

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

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AGNICO EAGLE

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT

REVISIONS

TITRE / TITLE
AGNICO–EAGLE – MEADOWBANK DIVISION
WHALE TAIL PROJET
WM

YEARLY SITE LAYOUT PLAN
(YEAR 4:2022)

DESSINÉ PAR / DRAWN BY: J.CRETE
DATE: 2018–05–04
VERIFIÉ PAR / CHECKED BY:
APPROUVÉ PAR / APPROVED BY:
ÉCHELLE / SCALE:
DATE:
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REVISION:
FEUILLE / SHT: 1 / 1

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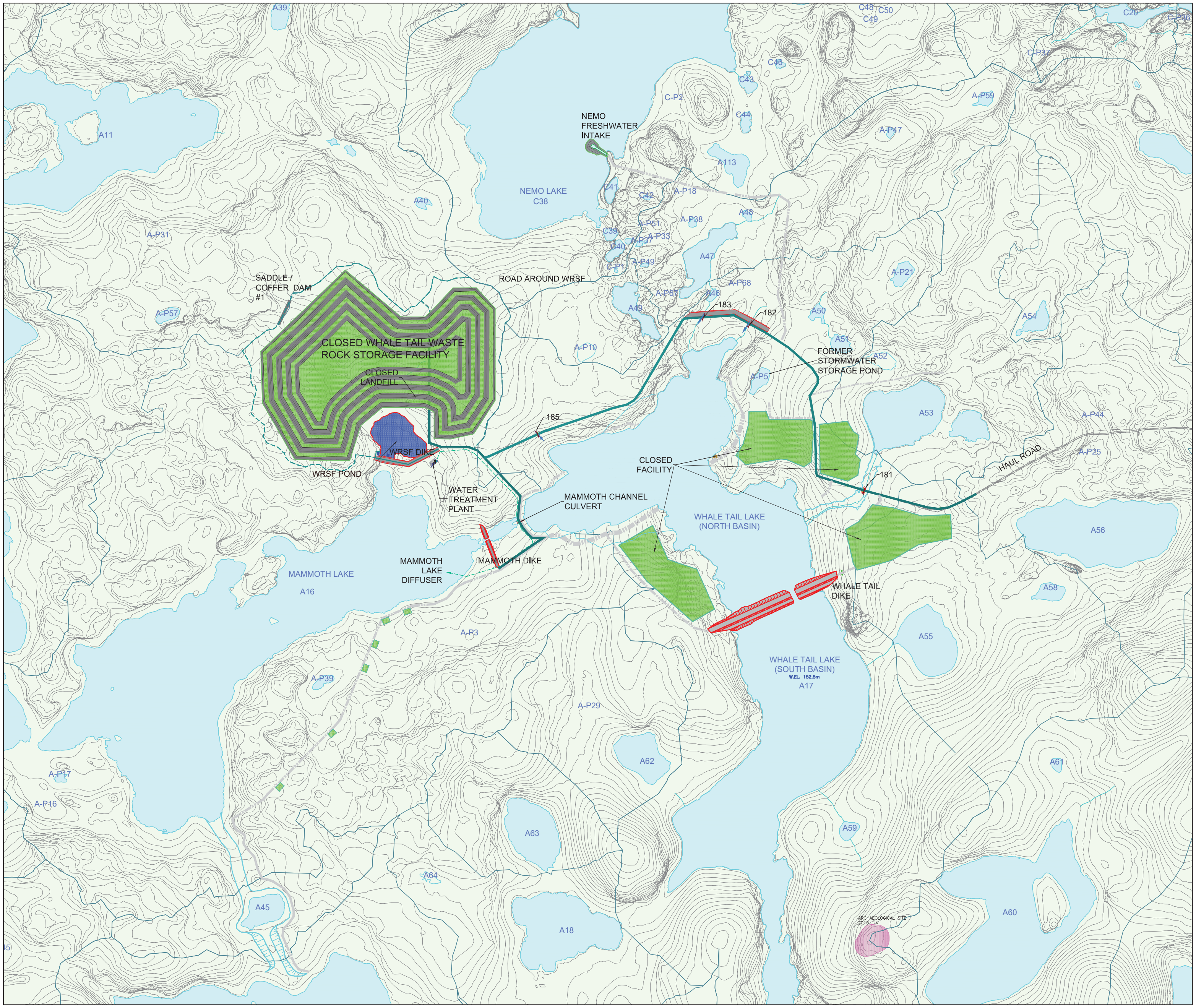

PLAN CLÉ
KEY PLAN

NOTES GÉNÉRALES / GENERAL NOTES

LEGEND

- CLOSED FACILITY
- ROAD
- TEMPORARY ROAD
- SCARIFIED ROAD & ACCESS
- NATURAL WATERSHED
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- FRESHWATER PIPE
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- ARCHAEOLOGICAL SITE

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

TITRE / TITLE	# DWG
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AGNICO EAGLE

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT

REVISIONS

TITRE / TITLE
AGNICO–EAGLE – MEADOWBANK DIVISION
WHALE TAIL PROJET
WM

YEARLY SITE LAYOUT PLAN
(YEAR 11:2029)

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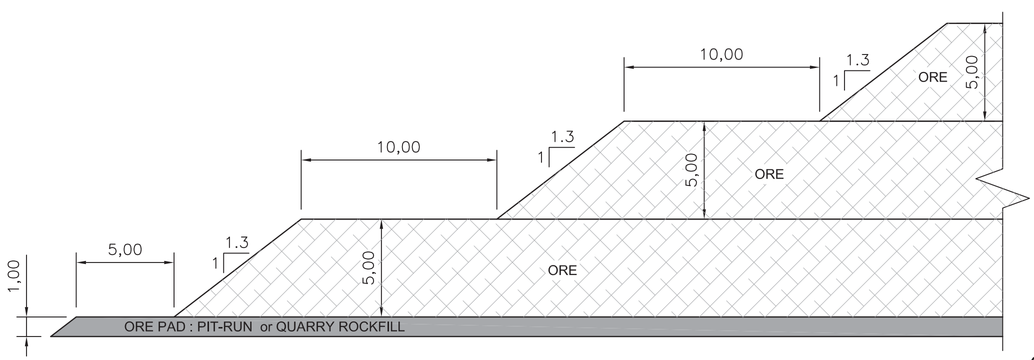

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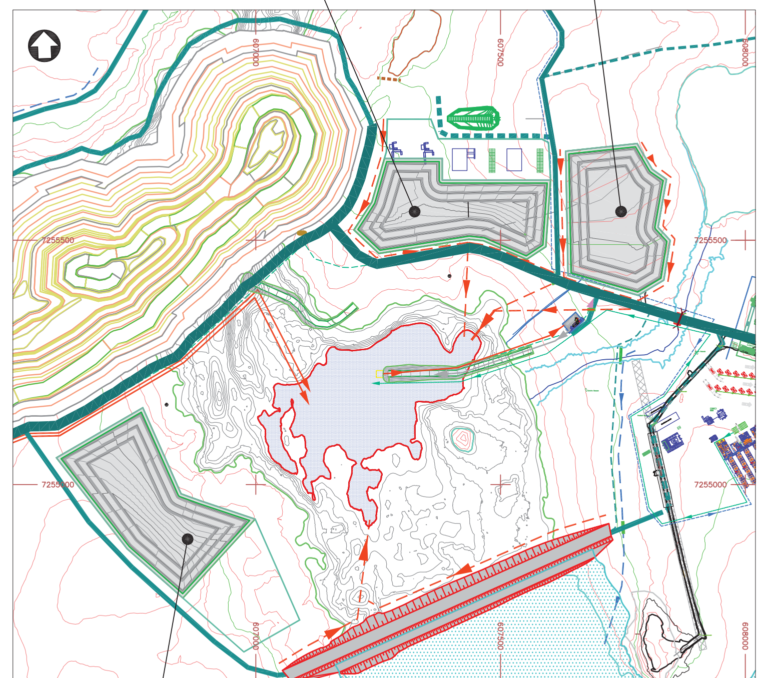

PLAN VIEW

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AGNICO EAGLE
DATE : 2016-05-03

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AGNICO EAGLE

Golder Associates

DESSINÉ PAR / DRAWN BY	J.CRETE	DATE	2016-05-02
VÉRIFIÉ PAR / CHECKED BY	F.PETRUCCI		2016-05-03
APPROUVÉ PAR / APPROVED BY	S. OUELLET		2016-05-03
No. PROJET / PROJECT NO.	6108		
DATE	2016-05-02		

TITRE / TITLE
AGNICO-EAGLE – MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT
ORE STOCK PILE #1, #2, #3
ORE PAD MAXIMUM CAPACITY
PLAN VIEW & TYPICAL SECTION

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Water Management Plan, Version 3

AGNICO EAGLE

Meadowbank Division

WHALE TAIL PIT

Water Management Plan

OCTOBER 2018
VERSION 3

EXECUTIVE SUMMARY

Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle) is proposing to develop Whale Tail Pit and Haul Road Project (Project), a satellite deposit located on the Amaruq property, to extend mine operations and milling at Meadowbank Mine.

The open pit mine, mined by truck-and-shovel operation, will produce 8.3 million tonnes (Mt) of ore, 61.3 Mt of waste rock, and 6.0 Mt of overburden waste. There are four phases to the development: 1 year of construction, 3 years of mine operations, 8 years of closure, and the postclosure period. According to the Whale Tail Pit Life of Mine (LOM) calculation, the addition of the Whale Tail Pit to the actual Meadowbank LOM (LOM 2015) will generate an addition of approximately 8.3 Mt (dry) of tailings to the Meadowbank Tailings Storage Facility (TSF) for a total of 35.4 Mt.

The water management objectives are to minimize potential impacts to the quantity and quality of surface water at the mine site. Water management structures (water retention dikes/berms and diversion channels) will be constructed, dependent on the potential presence and volume of water, to contain and manage the contact water from the areas affected by the mine or mining activities. The major water management infrastructure includes: two contact water ponds, three water diversion channels, four water retention dikes, and two Water Treatment Plants (WTP).

This Water Management Plan for the Project describes the main objectives pertaining to water management, which are to limit and/or stop the flow of surface water runoff in the pit and to limit the impact on the local environment. In developing the water management plan, the following principles were followed:

- keep the different water types separated as much as possible;
- control and minimize contact water through diversion and containment;
- minimize freshwater consumption by recycling and reusing the contact and process water wherever feasible; and
- meet discharge criteria before any site contact water is released to the downstream environment.

During mine construction and operations, contact water originating from affected areas on surface will be intercepted, diverted and collected within the various collection ponds. The collected water on the mine site will be eventually pumped and stored in the Whale Tail Attenuation Pond, where the contact water will be treated by the WTP prior to discharge to the receiving environment or reused in the operations.

During operations, site contact water quality is predicted to exceed established effluent criteria (i.e. under the Meadowbank Water Licence for Portage Pit) for arsenic and total dissolved solids in Whale Tail Waste Rock Storage Facility (WRSF) Pond and in Whale Tail Pit sump. Therefore, this water will be controlled by constructing the Whale Tail WRSF Dike and the Whale Tail Attenuation Pond. The Whale Tail WRSF Pond water will report with all other contact water and will be mixed in the Whale Tail Attenuation Pond and treated during operations. Through best management practices and mitigation, the predicted water quality of Whale Tail Lake (North Basin) meets aquatic life guidelines post-closure.

During operations when the mine is at its maximum footprint, the conservative predictions of future water quality indicate that most parameter concentrations in the downstream environment are below CEQG-AL except for arsenic. A site wide water balance will be updated on a regular basis and end pit water quality modelling will be conducted as needed to update predictions.

Dikes will not be breached until the water quality in the flooded area meets Canadian Council of Ministers of the Environment Water Quality Guidelines, baseline concentrations or appropriate site specific water quality objectives. During mine closure, no mine discharges will occur to the downstream receiving environment since all contact waters are diverted to the open pit and Whale Tail Lake (North Basin) for re-flooding. The water quality in open pit and Whale Tail Lake (North Basin) averaged over the closure period is predicted to be similar to that of the last year of operations, with similar maximum and average concentrations.

DOCUMENT CONTROL

Version	Date	Section	Page	Revision	Author
1	January 2017			Water Management Plan for the Whale Tail Pit	Agnico Eagle Meadowbank Division and Golder Associates Ltd.
2	September 2018	All	All	Water Management Plan for the Whale Tail Pit	Agnico Eagle Meadowbank Division and SNC-Lavalin inc.
3	October 2018	3.1.4.11 3.3.1	23 32	Updated to align with recommendations issued by CIRNAC, ECCC and KIA in October 2018	Agnico Eagle Meadowbank Division

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ACRONYMS

Agnico Eagle	Agnico Eagle Mines Limited – Meadowbank Division
CCME	Canadian Council of Ministers of the Environment
DFO	Department of Fisheries and Oceans Canada
FEIS	Final Environmental Impact Statement
NWB	Nunavut Water Board
OMS	Operation, Maintenance, and Surveillance
PGA	Peak Ground Acceleration
Plan	Water Management Plan
Project	Whale Tail Pit
STP	Sewage Treatment Plant
TSS	total suspended solids
WRSF	Waste Rock Storage Facility
WSER	Wastewater System Effluent Regulations
WTP	Water Treatment Plant

UNITS

±	plus or minus
<	less than
%	percent
°C	degrees Celsius
°C/m	degrees Celsius per metre
masl	metre(s) above sea level
mg/L	milligrams per litre
km	kilometre(s)
km^2	kilo square metre(s)
L/day/person	litres per person per day
m	metre
mm	millimetre
m^3	cubic metre(s)
m^3/day	cubic metres per day
m^3/hour	cubic metres per hour
m^3/year	cubic metres per year
Mm^3/year	million cubic metre(s) per year
Mm^3	million cubic metre(s)
t	tonne
Mt	million tonne(s)

SECTION 1 • INTRODUCTION

Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle) is proposing to develop Whale Tail Pit and Haul Road Project (Project), a satellite deposit located on the Amaruq property, to continue mine operations and milling at Meadowbank Mine.

The Amaruq property is a 408 square kilometre (km^2) site located on Inuit Owned Land approximately 150 kilometres (km) north of the hamlet of Baker Lake and approximately 50 km northwest of Meadowbank Mine in the Kivalliq Region of Nunavut. The deposit will be mined as an open pit (i.e., Whale Tail Pit), and ore will be hauled to the approved infrastructure at Meadowbank Mine for milling.

The open pit mine, mined by truck-and-shovel operation, will produce 8.3 million tonnes (Mt) of ore, 61.3 Mt of waste rock, and 6.0 Mt of overburden waste. There are four phases to the development: 1 year of construction, 3 years of mine operations, 8 years of closure, and the postclosure period. According to the Whale Tail Pit Life of Mine (LOM) calculation, the addition of the Whale Tail Pit to the actual Meadowbank LOM (LOM 2015) will generate an addition of approximately 8.3 Mt (dry) of tailings to the Meadowbank Tailings Storage Facility (TSF) for a total of 35.4 Mt.

The construction and preparation of material started in summer 2018 after all permits and authorizations were received andconstruction of the dikes has started in the third quarter of Year -1 (2018). Focus on site preparation and construction of infrastructure, with the development of the open-pit to produce construction material will continue in 2018. During this first phase, waste rock and overburden will be piled in the Whale Tail Waste Rock Storage Facility (Whale Tail WRSF) and ore stockpiled on the ore pads. The operational phase will span approximately 3 years, from Year 1 (2019) to Year 4 (2022). Mining activities are expected to end in Year 3 (2021) and ore processing is expected to end during the first quarter of Year 4 (2022). Closure will occur from Year 4 (2022) to Year 11 (2029) after the completion of mining and will include removal of the non-essential site infrastructure and flooding of the mined-out open pit as well as reestablishment of the natural Lake A17 (Whale Tail Lake) level. Only essential infrastructure related to water treatment will remain on site during the closure and post-closure phases. Accordingly, in addition to the Water Treatment Plant (WTP), a part of the camp, including all infrastructure allowing camp autonomy and security, as well as site roads, will be maintained following the operational phase (see more information in Whale Tail Pit Interim Closure and Reclamation Plan). Post-closure is expected from Year 11 (2029) forwards. Site and surrounding environment monitoring will start from the beginning of the construction and be completed during the post-closure phase when it is shown that the site and water quality meets the regulatory closure objectives. Table 1.1 summarizes the overview of the timeline and general activities.

Table 1.1 Overview of Timeline and General Activities

Phase	Year	General Activities
Construction	Year -1	• Construct site infrastructure • Develop open pit mine • Stockpile ore
Operations	Year 1 to 3	• Open pit operations • Transport ore to Meadowbank Mine • Stockpile ore • Discharge Tailings in Meadowbank TSF
	Year 4	• Complete transportation of ore to Meadowbank Mine • Complete discharge tailings in Meadowbank TSF
Closure	Year 4 to 11	• Remove non-essential site infrastructure • Flood mined-out open pit • Re-establish natural Whale Tail Lake level
Post-Closure	Year 11 forwards	• Site and surrounding environment monitoring

TSF = Tailings Storage Facility

This document presents the Water Management Plan (Plan) for the Project in accordance with Part B, conditions 14 and 15, and Part E, condition 7, of the Nunavut Water Board (NWB) Water License 2AM – WTP1826. It is also addressing Term and Condition n. 6 of the Nunavut Impact Review Board (NIRB) project certificate. Agnico Eagle has applied the same water management and water balance approach in this document as used for the annual Meadowbank Mine Water management report (Agnico Eagle, 2015a and 2018). The purpose of this Plan is to provide consolidated information on water management, required water management infrastructure and water balance for the operations of Whale Tail Pit as a satellite pit for the Meadowbank Mine.

This Plan will be updated as required to reflect any changes in operations or economic feasibility occurs, and to incorporate new information and the latest technology, where appropriate.

SECTION 2 • BACKGROUND INFORMATION

2.1 Site Conditions

The general mine site location for the Project is presented in Figure 2-1.

2.1.1 Climate

Climate characteristics presented herein were extracted from the permitting level engineering report (SNC 2015).

The Project is located in an arid arctic environment that experiences extreme winter conditions, with an annual mean temperature of -11.3 degrees Celsius (°C). The monthly mean temperature ranges from -31.3°C in January to 11.6°C in June, with above-freezing mean temperatures from June to September. The annual mean total precipitation at the Project is 249 millimetres (mm), with 59 percent (%) of precipitation falling as rain, and 41% falling as snow. Mean annual losses were estimated to be 248 mm for lake evaporation, 80 mm for evapotranspiration, and 72 mm for sublimation. Mean annual temperature, precipitation, and losses characteristics are presented in Table 2.1.

Short-duration rainfall, representative of the Project are presented in

Table 2.2, based on intensity-duration-frequency curves available from the Baker Lake A meteorological station (Station ID 2300500) operated by the Government of Canada (2015).

Figure 2.1 Location of the Project

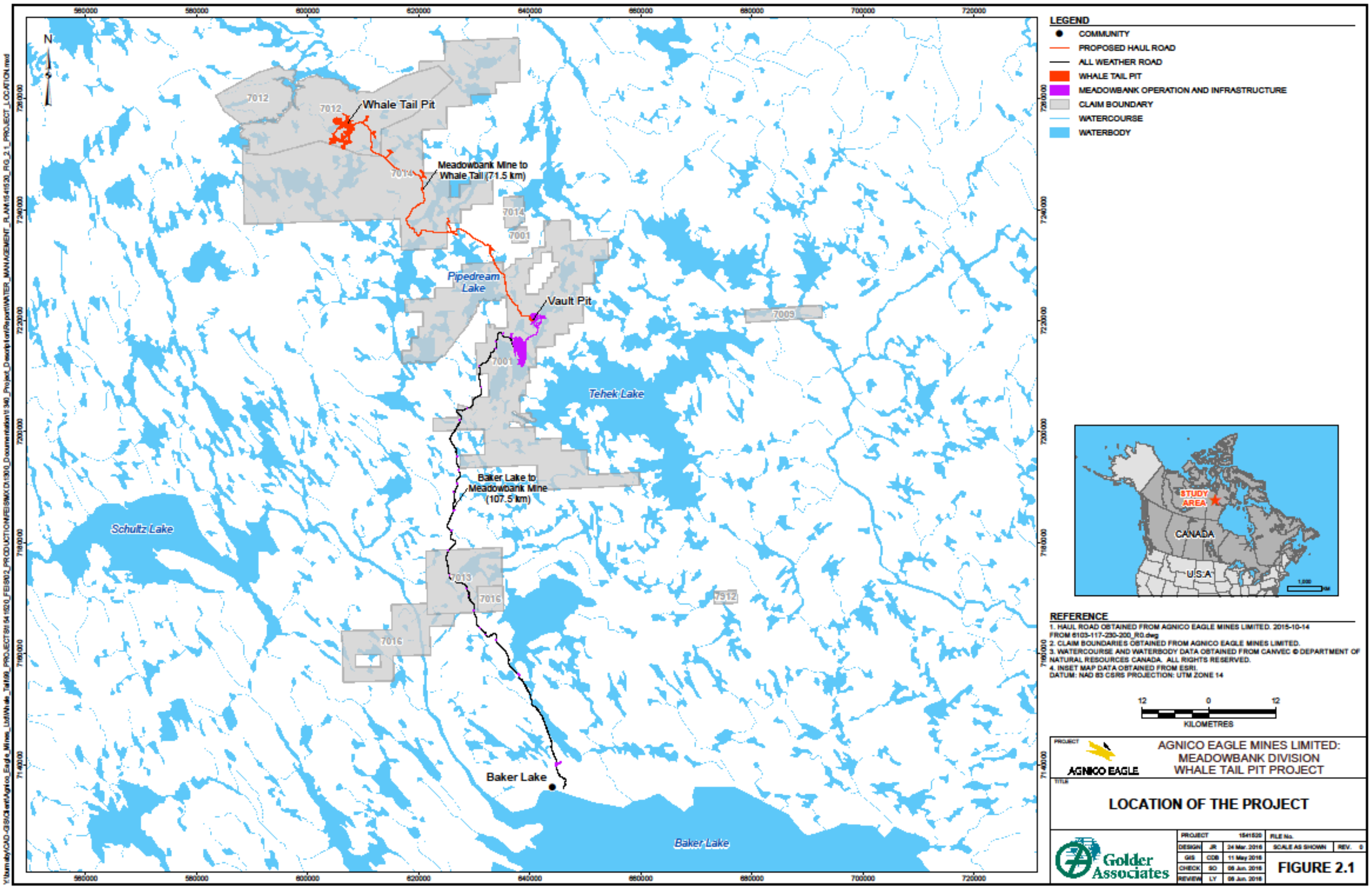


Table 2.1 Estimated Mine Site Monthly Mean Climate Characteristics

Month[a]	Mean Air Temp. (°C) [a]	Monthly Precipitation (mm) [a]			Losses [a]		
		Rainfall (mm)	Snowfall Water Equivalent (mm)	Total Precip. (mm)	Lake Evap. (mm)	Evapo-transpiration (mm)	Snow Sublimation (mm)
January	-31.3	0	7	7	0	0	9
February	-31.1	0	6	6	0	0	9
March	-26.3	0	9	9	0	0	9
April	-17.0	0	13	13	0	0	9
May	-6.4	5	8	13	0	0	9
June	4.9	18	3	21	9	3	0
July	11.6	39	0	39	99	32	0
August	9.8	42	1	43	100	32	0
September	3.1	35	7	42	40	13	0
October	-6.5	6	22	28	0	0	9
November	-19.3	0	17	17	0	0	9
December	-26.8	0	10	10	0	0	9
Annual	-11.3	146	103	249	248	80	72

[a] SNC (2015).

°C = degrees Celsius; mm = millimetre.

Table 2.2 Estimated Mine Site Extreme 24-Hour Rainfall Events

Return Period (Years) [a]	24-hour Precipitation (mm) [a]
2	27
5	40
10	48
25	57
50	67
100	75
1000	101

[a] SNC (2015).

mm = millimetre.

2.1.2 Permafrost

The mine site is located in an area of continuous permafrost, as shown on Figure 2.2. Based on measurements of ground temperatures (Knight Piésold 2015), the depth of permafrost at the mine site is estimated to be in the order of 425 metres (m) outside of the influence of waterbodies. The depth of the permafrost and active layer will vary based on proximity to the lakes, overburden thickness, vegetation, climate conditions, and slope direction. The typical depth of the active layer is 2 m in this region of Canada.The typical permafrost ground temperatures at the depths of zero annual amplitude (typically at the depth of below 15 m) is approximately -8.0 °C in the areas away from lakes and streams. The geothermal gradient measured is 0.02 degrees Celsius per meter (°C/m) (Knight Piésold 2015). Late-winter ice thickness on freshwater lakes is approximately 2.0 m. Ice covers usually appear by the end of October and are completely formed in early November. The spring ice melt typically begins in mid-June and is complete by early July.

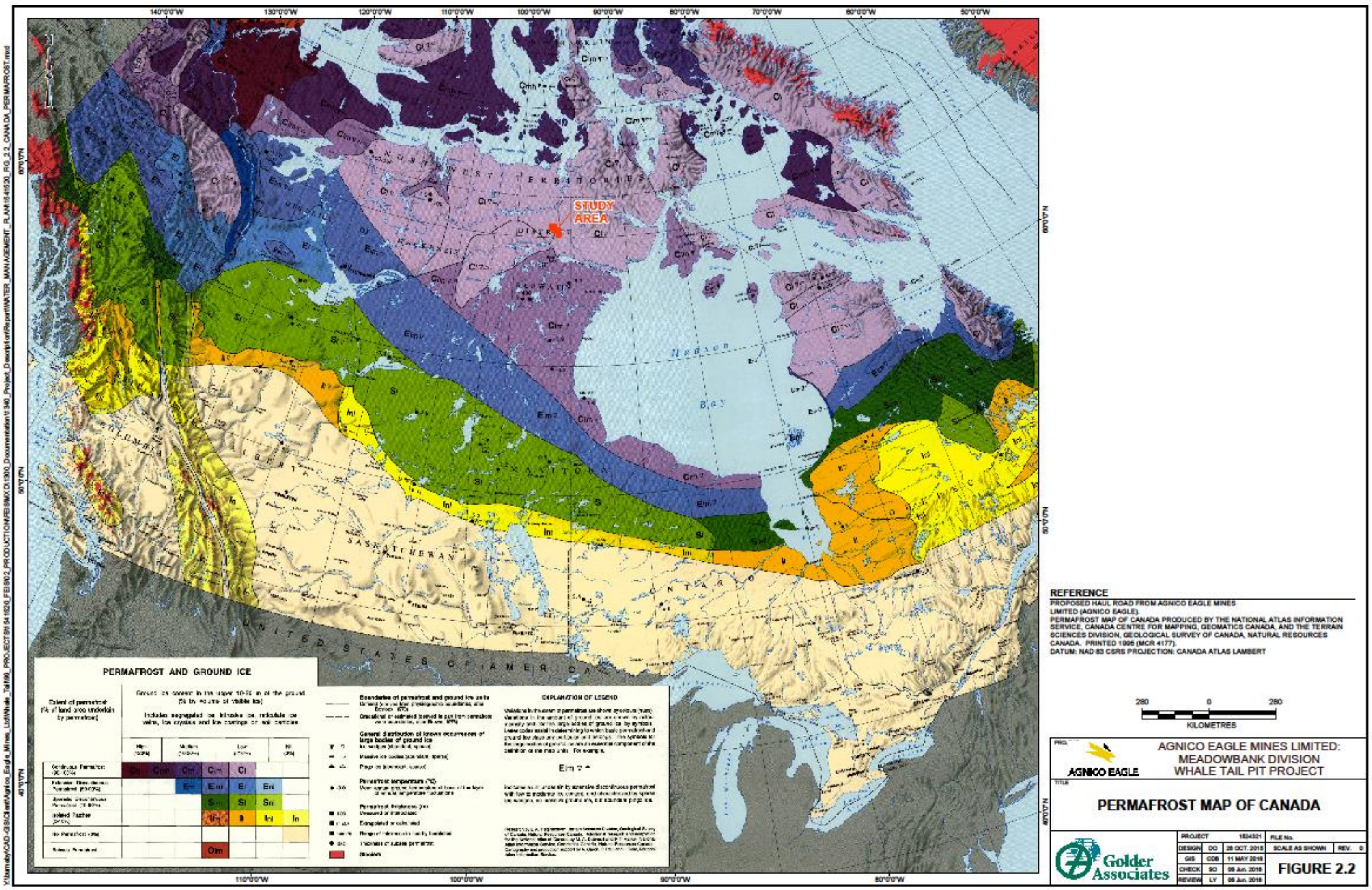
Groundwater characteristics at the mine site are detailed in the Final Environmental Impact Statement (FEIS), Volume 6, Section 6.2 (Agnico Eagle, 2016) and are briefly summarized herein.

Two groundwater flow regimes in areas of continuous permafrost are generally present:

- a deep groundwater flow regime beneath the base of the permafrost; and
- a shallow flow regime located in an active (seasonally thawed) layer near the ground surface.

From late spring to early autumn, when temperatures are above 0˚C, the active layer thaws out. Within the active layer, the water table is expected to be a subdued replica of topography, and is expected to parallel the topographic surface. Project area groundwater in the active layer flows to local depressions and ponds that drain to larger lakes at velocities estimated to range from about 0.004 m/day to 0.08 m/day.

Figure 2.2 Permafrost Map of Canada



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2.1.3 Hydrology

Hydrology characteristics were extracted from surface water quantity impact assessment section (FEIS, Volume 6, Section 6.3; Volume 6, Appendix 6-C, Agnico Eagle, 2016).

The proposed mine site is located in the A watershed (i.e., where Lake A17 [Whale Tail Lake] and Lake A16 [Mammoth Lake] are located), and water management activities are planned in the A watershed, and the C watershed (i.e., where Lake C38 [Nemo Lake] is located); these two watersheds drain into Lake DS1, which drains north to the Meadowbank River. These watersheds comprise an extensive network of lakes, ponds, and interconnecting streams, and have lake water surface fractions (i.e., the ratio of lake area to watershed area) of 16% (A watershed) and 23% (C watershed).

Shorelines in the mine site area exhibit a consistent terrain type related to shorelines that have developed in morainal material. These morainal shorelines were observed at all lakes visited during the 2015 field survey. Limited areas of bedrock and shallowly sloped sandy shorelines were also observed. As a general characteristic for the surveyed shorelines, the predominant materials are boulder gardens mixed with cobble with very limited soils or organic materials on top. The outlet channels are relatively short with a low sinuosity (i.e., close to 1.0) and exhibit the same characteristics for streambed materials, which results in interstitial flow through large boulders or below the surface likely close to the bedrock, making flow difficult to observe and measure.

Discharges of watercourses in the mine site area typically peak in late-May to mid-June from snowmelt, rapidly decline in July, and low discharges prevail until frozen conditions in October to November, with a secondary peak in September from rainfall events. Watercourses in the Project area are frozen over the winter.

Derived long-term mean annual water yield for selected lakes in the mine site area vary between 86 mm at Lake C38 (Nemo Lake) to 230 mm at Lake A69. These water yields are similar to regional water yields reported at the Meadowbank Mine.

2.1.4 Surface Water Quality

Water quality characteristics were extracted from the water quality baseline report (FEIS, Volume 6, Appendix 6-G, Agnico Eagle, 2016) and the water quality impact assessment section (FEIS, Volume 6, Section 6.4, Agnico Eagle, 2016). Baseline water quality sampling was conducted at lakes and tributaries in various watersheds in the study area during open-water conditions in 2014 and 2015.

Surface water collected from lakes during the open water season was characteristic of low productivity headwater lakes in the Arctic; soft water, with low alkalinity, low turbidity (and corresponding high Secchi depth) and low total suspended solids (TSS). There was minor thermal stratification evident at some deeper lake stations. The water columns of lakes are well oxygenated and pH was neutral to slightly acidic. The majority of water chemistry parameter concentrations were below the analytical detection limit and below the Canadian Council of Ministers of the Environment water quality guidelines for the protection of aquatic life (CCME, 1999) and the Canadian drinking water guidelines (Health Canada, 2014).

Samples collected from the tributaries showed them to be well oxygenated, with low conductivity, and neutral to slightly alkaline pH. As with the lakes, the majority of the water chemistry parameter concentrations were below the aquatic life and drinking water quality guidelines.

2.1.5 Climate Change

Climate change information presented herein was extracted from the air quality impact assessment section (FEIS, Volume 4, Section 4.2, Agnico Eagle, 2016).

The climate in the Arctic is changing faster than at mid-latitudes (IPCC, 2014). The most recent set of climate model projections (CMIP5) predict an Arctic-wide year 2100 multi-model mean temperature increase of +13^{o}C in late fall and +5^{o}C in late spring under the IPCC's "business as usual scenario" (RCP8.5). IPCC climate change mitigation scenario RCP4.5 results in a year 2100 multi-model Arctic wide prediction of +7^{o}C in late fall and +3^{o}C in late spring (Overland et al., 2013). The effects of changes of this magnitude to terrestrial, aquatic and marine ecosystems, social and economic systems of the Arctic are an active area of research. However, the short duration of the proposed Project means that climate change related effects to the Project are likely negligible.

2.1.6 Seismic Zone

The mine site is located in an area of relatively low seismic risk. The peak ground acceleration (PGA) for the area was estimated using seismic hazard calculator from the 2010 National Building Code of Canada website (http://www.earthquakescanada.nrcan.gc.ca/hazard-alea/interpolat/index_2010-eng.php). The estimated PGA is 0.019 g for a 5% in 50-year probability of exceedance (0.001 per annum or 1 in 1,000 year return) and 0.036 g for a 2% in 50-year probability of exceedance (0.000404 per annum or 1 in 2,475 year return) for the area.

2.2 Mine Operations Description

2.2.1 Mine Development Plan

Whale Tail Pit will be mined using traditional open pit method, and the mining is planned from Q2 of Year -1 (2018) to the end of Year 3 (2021).

Two mine waste streams will be produced at Whale Tail Pit, waste rock and overburden. Approximately 61.3 Mt of waste rock and 6.0 Mt of overburden will be generated by the Project. As ore is transported to the Meadowbank Mine for processing, a third mine waste stream, tailings, will be produced at Meadowbank Mine (Refer to the Meadowbank Mine Waste Rock and Tailings Management Plan). The operation management and monitoring of the TSF is regulated under Agnico Eagle Type A water Licence 2AM-MEA1526.

The mine development will include the following major infrastructure:

- industrial area (camp and garage);
- crusher;
- ore stockpiles;
- rock and Overburden Storage facilities;
- landfill;
- haul and access roads; and
- open pit mine.

In addition, the mine development will include construction of water management facilities, listed in Section 3.1.2.

2.2.2 Summary of Mine Waste Management

This section describes a summary of the mine waste management plan. More detailed information on mine waste management is presented in the Whale Tail Pit Waste Rock Management Plan. Water management associated with mine waste management is described in Section 3.1.4 of this document. One area was identified as the Whale Tail WRSF to store waste rock and overburden material, as shown in Figure A.1 to Figure A.4 in Appendix A. Table 2.3 presents a summary of the total tonnage of mine waste materials and their proposed usage or destination.

Table 2.3 Summary of Mine Waste Tonnage and Destination

Mine Waste Stream	Estimated Quantities	Waste Destination
Overburden	6.0Mt	• Temporary storage West of Whale Tail Lake (~ 0.1 Mt for operations) • Co-disposed with waste rock in Whale Tail WRSF
Waste Rock	61.3Mt	• Construction material • Whale Tail WRSF • Closure and site reclamation
Tailings	8.3 Mt	• As slurry tailings placed in the approved Meadowbank Mine tailings storage facility

WRSF = Waste Rock Storage Facility; Mt = million tonne

SECTION 3 • WATER MANAGEMENT PLAN AND WATER BALANCE

3.1 General Water Management Strategy

3.1.1 Water Management Objectives and Strategies

The goal of water management is to minimize the impact of the mine activities on the aquatic ecosystem surrounding the mining area. The key objectives for water management are:

- keep the different water types (i.e., contact, non-contact, and freshwater) separated to the extent practical;
- control and minimize contact water through diversion and containment;
- minimize freshwater usage by recycling and reusing the contact water to the extent practical; and
- meet discharge criteria before any site contact water is released to the downstream environment.

To achieve the above water management objectives, the following key strategies were implemented to develop the Plan:

- Two levels of catchment disturbance have been defined for the area, namely undisturbed and disturbed. Areas that have been disturbed as part of the mine development are considered disturbed catchments, while the areas left unaffected are considered undisturbed catchments.
- For the purpose of mine water management, runoff from undisturbed areas is considered non-contact water, while runoff from disturbed catchment areas is considered contact water. Surface water that is diverted around the mine facilities, or groundwater that does not emerge into a mine facility, is considered non-contact water. Any non-contact water that mixes with contact water becomes contact water.
- Conveyance and storage of contact water will be controlled by channels and containment structures (i.e., sumps and ponds). Sumps will be installed in the open pit and in low points surrounding the open pit. Contact water will be diverted and collected in various sumps and water collection ponds and conveyed to the Whale Tail Attenuation Pond.
- The collected water will be treated if the water quality does not meet the discharge criteria established in the Water Licence 2AM-WTP1826.
- The treated water will be reused as much as possible to minimize the freshwater requirements. The excess treated water will be discharged into Lake A16 (Mammoth Lake) through a submerged diffuser.
- Non-contact water will be intercepted and directed away from disturbed areas by means of natural catchment boundaries and/or man-made diversion structures and will be allowed to flow to the neighbouring waterbodies.

3.1.2 Water Management System

The water management system includes the following components (identified on Figure A.1 to Figure A.5 in Appendix A):

- Turbidity Curtains;
- low-permeability access road to reach the Stage 1 WRSF and a collection sump;
- two contact water collection ponds (Whale Tail Attenuation and Whale Tail WRSF);
- two freshwater collection ponds (Whale Tail Lake (South Basin) and Northeast Sector);
- three proposed water diversion channels (Whale Tail, East, and North, if deemed necessary);
- four water retention dikes (Whale Tail, Mammoth, Whale Tail WRSF, and Northeast);
- two coffer/saddle dams;
- seven proposed culverts (Culverts 181, 182, 183, 184, 185, 186, and Mammoth Channel Culvert, if deemed necessary);
- a freshwater intake causeway and pump system;
- a WTP and associated intake causeway;
- a WTP for construction;
- a Sewage Treatment Plant (STP);
- pipeline and associated pump system;
- a Potable WTP; and
- a discharge diffuser located in Lake A16 (Mammoth Lake).

3.1.3 Waterbody Inventory

The A and C watersheds will potentially be impacted by mining activities, primarily by dewatering of Whale Tail Lake (North Basin) to Lake A16 (Mammoth Lake), the Northeast Diversion to the C watershed, and the Whale Tail Lake (South Basin) Diversion to Lake A16 (Mammoth Lake). Waterbodies directly impacted by mining activities are presented in Table 3.1 and shown in Figure A.2 in Appendix A.

Table 3.1 Inventory of Waterbodies Directly Impacted by Mining Activities

Watershed	Primary Disturbance	Waterbody	Note
A	Dewatering	Lake A16 (Mammoth Lake)	Receiving lake during dewatering activities
	Northeast Diversion	Lake A47	Flooded
		Lake A48	Flooded
		Lake A55	Flooded
		Lake A62	Flooded
		Lake A63	Flooded
		Lake A65	Flooded
		Lake A113	Flooded
		Pond A-P38	Flooded
		Pond A-P68	Flooded
	Whale Tail Lake (South Basin) Diversion	Lake A18	Flooded
		Lake A19	Flooded
		Lake A20	Flooded
		Lake A21	Flooded
		Lake A22	Flooded
		Lake A45	Part of diversion channel
		Lake A55	Flooded
		Lake A62	Flooded
		Lake A63	Flooded
		Lake A65	Flooded
		Pond A-P1	Flooded
		Pond A-P53	Flooded
	Various Water Management Activities	Lake A17 (Whale Tail Lake)	Water management activities include diversion of upper watershed and dewatering of Whale Tail Lake (North Basin)
C	Water Intake	Lake C38 (Nemo Lake)	

3.1.4 Water Management Plan during Construction and Operations

3.1.4.1 Infrastructure Required for Mine Site Water Management

During the mine construction, operational and closure phases, a network of collection and interceptor channels and sumps will be constructed and maintained to facilitate mine site water management. A list of the water management control structures and facilities is presented in Table 3.2 together with the proposed construction schedule. These structures were designed according to design criteria presented in the FEIS, Volume 2, Appendix 2-J (Agnico Eagle, 2016). Final design details of these structures will be provided to the regulators for approval at least 60 days prior to construction.

Appendix A, Figure A.1 to Figure A.5 shows the location of the respective structures at the different development stages of the mine life. Information on operation, maintenance, and surveillance (OMS) of Project dikes is provided in the following sub-sections.

Table 3.2 Water Management Facilities and Construction Schedule

Mine Year	Figure	Water Management Facilities Constructed or Installed
Year -1 (2018) Construction	A.1 and A.5	• Turbidity Curtains • Start Whale Tail Dike • Start Mammoth Dike • Start the contact water intake causeway in the Whale Tail Attenuation Pond • Construction of the low-permeability access road built of overburden and collection sump for Stage 1 WRSF • Freshwater intake causeway in Nemo Lake • Water Treatment Plant and Construction Water Treatment Plant • Pipelines and associated pump systems for water management and dewatering • Sewage Treatment Plant • Potable Water Treatment Plant • Discharge diffuser in Mammoth Lake • Culverts 184, 186, and Mammoth Channel
Year 1 (2019) Operations	A.2	• Complete Whale Tail Dike • Complete Mammoth Dike • Complete the contact water intake causeway in the Whale Tail Attenuation Pond • Whale Tail WRSF Dike • Northeast dike • Whale Tail Lake (South Basin) Diversion Channel • Whale Tail East Channel and Saddle/Coffer Dam • If deemed necessary, North Diversion Channel • Saddle/Coffer Dam #1 in Whale Tail WRSF

WRSF = Waste Rock Storage Facility.

3.1.4.2 Dike Construction

The Whale Tail Dike is intended to raise Whale Tail Lake (South Basin), Lake A18, Lake A19, Lake A20, Lake A21, Lake A22, Lake A55, Lake A62, Lake A63, Lake A65, Pond A-P1, and Pond A-P53, to an elevation of 156.0 metres above sea level (masl), and divert runoff downstream to the Lake A16 (Mammoth Lake) watershed through the Whale Tail Lake (South Basin) diversion channel. Whale Tail Dike will be constructed as a zoned rockfill dike on the lakebed foundation with a core composed of a fine filter dynamically compacted. A coarse filter will be placed between the rockfill and the fine filter.

A cement-bentonite cutoff wall consisting mainly of secant piles will be constructed through this dense core and will act as a seepage barrier. The construction technique will differ for the sections extending into the existing lake from those at the abutments. For the lake sections of the dike, construction will be initiated by advancing two single-line platforms built at elevation 154.0 masl. After cleaning out the central key trench by reaching the bedrock, backfill consisting of fine and coarse filters will be gently deposited up to elevation 154.0 masl. The WTD will then be constructed up to elevation 157.0 masl. From this level, the fine filter will be dynamically compacted by heavy tamping. The secant piles will then be installed from elevation 157.0 masl to 1.0 m below the bedrock surface. The type of material used for the cutoff wall will be a cement-bentonite mix. The maximum height of the secant pile cutoff wall is expected to be of 10.5 m.

At the west abutment, the footprint of WTD will cross an esker which extends well below lake level. The esker will be blasted to about elevation 153.0 masl at the west abutment. The bottom of the excavation would be 0.5 m above lake level and then the rockfill zones and fine filter would be placed. Above elevation 153.0 masl, a key trench to the bedrock will then be progressively excavated in the thawed esker to expose its surface. In addition, and to minimize the number of secant piles, it is proposed to place a cement-bentonite slurry cutoff wall where bedrock surface is above elevation 155.5 masl. The secant piles will overlap the cured CB slurry cutoff over 1.5 m in horizontal length.

The strategy for the east abutment will be different than for the west abutment. It would be beneficial to remove (in the core trench area) the layer that contains ice rich till prior to the placement of any material. Due to schedule and access constraints, the east abutment will be blasted in order to remove about 4 m of frozen soil (in the core trench area) that contains ice rich material.

The performance of Whale Tail Dike will be evaluated based on the quantity of seepage collected (compared to the design estimate). This structure will be highly instrumented with sections of piezometers and thermistor strings to understand the hydraulic and thermal behaviour during reservoir filling. The thermal regime will be monitored all along the dike to note the thermal impact of raising the lake water level. Monuments and inclinometers will be installed along the dike as well. Typical sections of Whale Tail Dike and of Whale Tail Dike abutment are shown in Figure 3.1. All design drawings and figures can be found in the Whale Tail Dike Detailed Design Report (SNC, 2018).

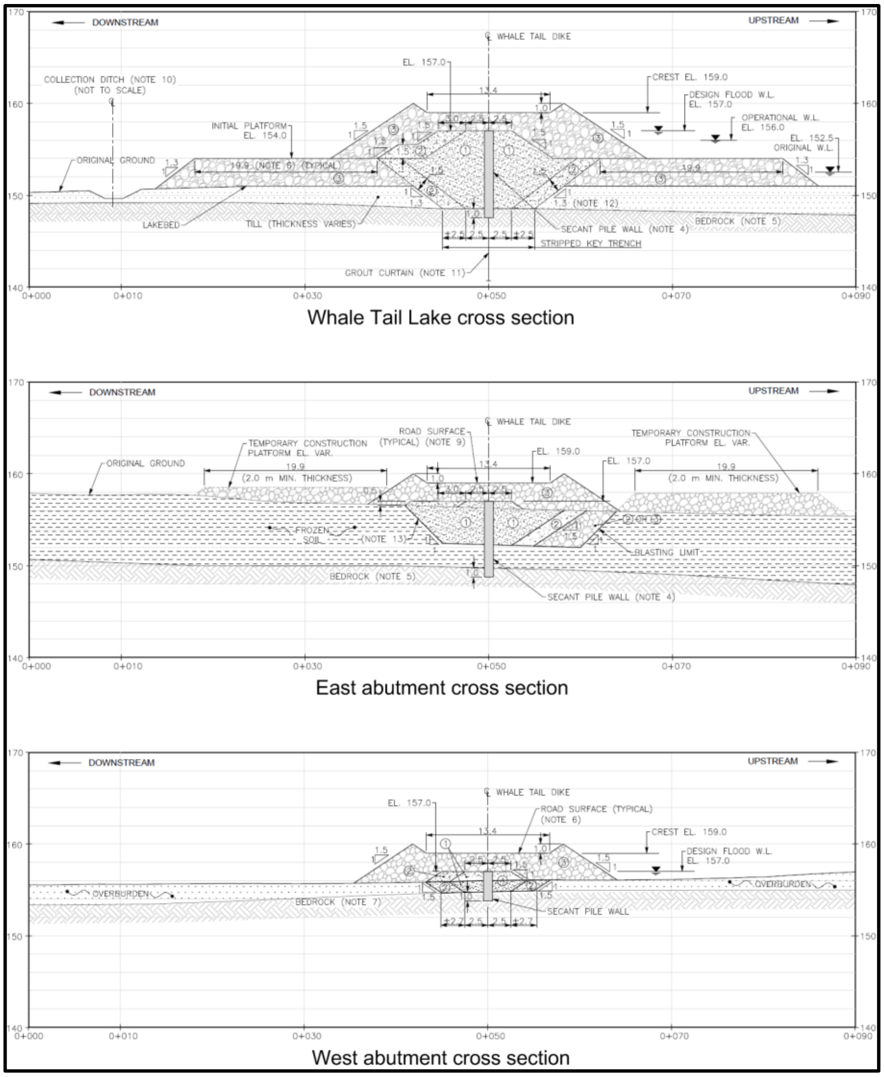

Figure 3.1 Typical Sections of Whale Tail Dike and Whale Tail Dike Abutment

The Mammoth Dike is intended to protect the mine site area from potential backwatering from Lake A16 (Mammoth Lake) during the operational and closure phases. The concept of this structure is similar to the other dikes in shallow water operated by Agnico Eagle (as Vault Dike). Mammoth dike has a length of about 300 m and a height of 2 m. It will be a rockfill dike lined with bituminous geomembrane on its upstream face encapsulated at the toe in a layer of fine filter amended with bentonite (FFAB) liner in turn constructed in a key trench. The key trench will extend down to the bedrock and all boulders along the alignment will be removed. A thermal cap of rockfill will be placed on top during the winter season to prevent the FFAB from thawing. The winter construction technique aims to reinforce the permafrost strength of the foundation. A typical section of the Mammoth Dike is shown in Figure 3.2.

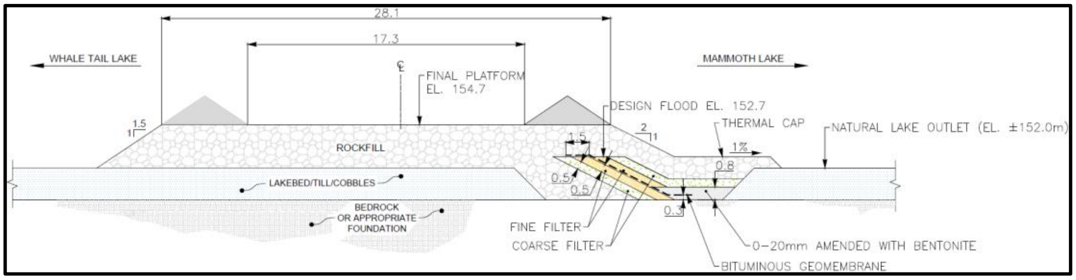

Figure 3.2 Typical Section of Mammoth Dike

Note: Adapted from SNC-Lavalin (2017).

The Whale Tail WRSF Dike confines contact water in the Whale Tail WRSF Pond before it is pumped to the Whale Tail Attenuation Pond. The WRSF dike is about 300 m and 5 m height and has been classified as a high based on CDA Guidelines. As the Mammoth Dike, the Whale Tail WRSF Dike will be a rockfill dike with a bituminous liner on its upstream face encapsulated at the toe in a layer of FFAB liner in turn constructed in a key trench anchored to the bedrock during the summer season. The liner will take advantage of frozen soil conditions to integrate the permafrost into its foundation (and key trench). The key trench will be stripped during the summer season. All ice-rich material sensitive to thawing will be removed below the liner. Once the bedrock is exposed, the bituminous liner will be sealed with FFAB. While the geomembrane in the key trench is buried, a thermal cap will be put in place to protect the foundation against sources of heat. If during the operation the degradation of the permafrost occurs, a grout curtain will be installed to enhance the performance of the dike. A typical section of the Whale Tail WRSF Dike is shown in Figure 3.3.

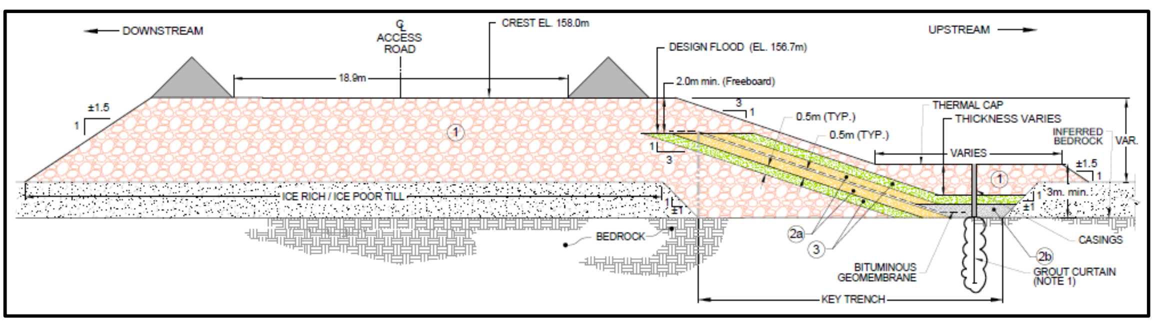

Figure 3.3 Typical Section of Whale Tail Waste Rock Storage Facility Dike

Note: Adapted from SNC (2015).

The Northeast (NE) Dike is a temporary structure with an estimated service life of about two (2) years and is designed to prevent runoff from the Northeast watershed reporting to the Whale Tail Pit As both Mammoth and WRSF Dikes, the upstream slope of the NE Dike will be lined with bituminous geomembrane encapsulated at the toe in a layer of FFAB liner in turn constructed in a key trench to the bedrock or to an appropriate foundation (ice-poor till). The construction will promote the extraction of heat to reinforce the permafrost of the key trench thus making it impervious. Dewatering should be completed prior to beginning of winter to promote development of permafrost in the foundation. A thermal cap will be put in place to limit the penetration of heat into the foundation. A typical section of the Whale Tail WRSF Dike is shown in Figure 3.4.

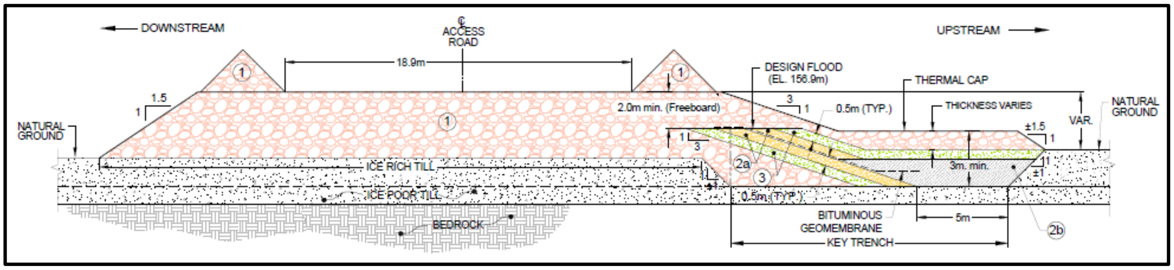

Figure 3.4 Typical Section of Northeast Dike

Note: Adapted from SNC (2015).

During dike construction, both the dike material itself as well as the disturbed material on the lake floor (particularly in the deep areas of the lakes) will contribute to increases in concentrations of suspended sediments in the water column. In the absence of sediment control measures, suspended sediment plumes would be expected to migrate with wind-driven currents. The key means for minimizing suspended sediment discharges from the dike construction zones during dike construction include the deployment of Turbidity Curtains and water treatment (if deemed necessary).

For the construction of Whale Tail Dike, a total of four (4) layers of turbidity curtains will be installed across Whale Tail Lake (two (2) on each side of the dike). These curtains will be deployed concurrently with the start of the dike construction to contain turbid water caused by the construction while the fishout is taking place. In addition, requirement for pumps installed in the water in front of the construction platform to neutralise the current created by the displacement of water from the deposition of rock in the lake will be evaluated at the beginning of the construction. If such mitigation measure is required, water will be pumped to the dewatering WTP and discharged into Lake A16 (Mammoth Lake) through the existing discharge diffuser system. The proposed location for the Turbidity Curtains is shown in Figure A.1.; however final location of the curtains will depend of the final dike design and site conditions.

For Northeast Dike, no specific TSS management plan is expected as the construction of this facility is planned when the open pit will be in operation and contact water will be managed as part of the current operations.

3.1.4.3 Dewatering

To allow the mining of the Whale Tail Pit, Lake A17 (Whale Tail Lake) will be partly dewatered once the Whale Tail Dike is constructed. The estimated total volume of Whale Tail Lake (Lake A17) is 8.5 million m^3 (Mm^3); the upper portion of Lake A17 (3.4 Mm^3) will be pumped to either Whale Tail Lake (South Basin) or to Lake A16 (Mammoth Lake) through the discharge diffuser. It is assumed that approximately 66% of the volume of water will be pumped directly to Whale Tail Lake (South Basin) if it meets discharge criteria, and the remaining 34% of water will be pumped to the WTP first and then discharged to Lake A16 (Mammoth Lake) after treatment. The dewatering activity is planned from March to May 2019 to Whale Tail Lake (South Basin) and from June to September 2019 to Lake A16 (Mammoth Lake).

3.1.4.4 Key Water Management Activities during Construction and Operations

An inventory of waterbodies impacted by mining activities is provided in Table 3.1 (Section 3.1.3) and the water management facilities required for the Plan is provided in Table 3.2 (Section 3.1.4.1). These tables should be read in conjunction with Table 3.3, which presents the yearly major water management activities during the construction and operational phases. Water management activities during the closure phase are described in Section 3.2.

Table 3.3 Water Management Activities during Construction and Operations

Mine Year	Water Management Activities and Sequence
Year -1 (2018)	• Temporary pump contact water from the Stage 1 WRSF sump to quarry 1 • Temporary pump contact water from the starter pit to quarry 1 • Temporary pump contact water from open pit to the Whale Tail WRSF Pond • Treat turbid water from construction using the construction WTP and discharge in Lake A16 (Mammoth Lake) • Treat contact water from quarries using the construction WTP and discharge in Lake A16 (Mammoth Lake)
Year 1 (2019)	• Dewater Whale Tail Lake (North Basin) • Pump contact water from the open pit to the Whale Tail Attenuation Pond • Pump contact water from the Whale Tail WRSF Pond to the Whale Tail Attenuation Pond • Treat through the WTP the Whale Tail Attenuation Pond contact water and discharge in Lake A16 (Mammoth Lake) • Whale Tail East channel diverts non-contact water from Lake A53 to Whale Tail Lake (South Basin) • If deemed necessary, North channel diverts non-contact water from the north shore of the open pit to Lake A16 (Mammoth Lake)
Year 2 (2020)	• Continue to pump contact water from the open pit to the Whale Tail Attenuation Pond • Continue to pump contact water from the Whale Tail WRSF Pond to the Whale Tail Attenuation Pond • Treat through the WTP the Whale Tail Attenuation Pond contact water and discharge in Lake A16 (Mammoth Lake) • Northeast Pond flows towards the C watershed • Whale Tail Lake (South Basin) flows to Lake A16 (Mammoth Lake) through the Whale Tail Lake (South Basin) Diversion Channel

WRSF = Waste Rock Storage Facility; WTP = Water Treatment Plant.

A brief summary of the Plan during the construction and operational phases is presented as follows:

- Turbidity Curtains will be used during the construction of the Whale Tail Dike and, if deemed necessary for the construction of Mammoth Dike and Whale Tail WRSF Dike.
- During the construction, to the extent practical, turbid water originating from Lake A17 (Whale Tail Lake) and from the quarry 1 will be treated and discharged in Lake A16 (Mammoth Lake).
- The main contact water pond of the Project (i.e., Whale Tail Attenuation Pond) is located in a deep part of Whale Tail Lake (North Basin).
- Contact water from the major mine infrastructure will be diverted and/or collected in the Whale Tail Attenuation Pond.
- Contact water from the Whale Tail WRSF Pond will be pumped to the Whale Tail Attenuation Pond.
- Runoff water in the open pit will be collected by the sumps and then pumped to the Whale Tail Attenuation Pond.
- Water collected in the Whale Tail Attenuation Pond will be reused to the extent practical in the open pit and dust control operations, and the excess water will be treated by the WTP prior to discharge to the receiving environment via the diffuser into Lake A16 (Mammoth Lake). Water quality objectives for arsenic and phosphorous will be meet via the proposed diffusor design: 10 ports at 12.6 m spacing and 75mm, diameter diffusor ports, effluent mixing (mixing zone). Within Mammoth Lake, the required dilution of WRSF seepage is predicted to be met at 60 m from the discharge location in all scenarios. A rock fill weir at outlet will channelize seepage outflow into Mammoth Lake and facilitate dilution.
- Non-contact water is diverted away from the mine site infrastructure by reversing natural flows and/or using diversion channels.
- Freshwater usage on site will be supplied from Lake C38 (Nemo Lake) during operations, and from Whale Tail Lake (South Basin) during closure.

Table 3-4 summarizes the overall contact water management plan for the major mine infrastructure with the initial water collection location and final water destination. Detailed water management information for major mine infrastructure areas is described in the following sub-sections. Water management flowsheets for the construction and operations phase are provided in Appendix B.

Table 3.4 Overall Site Surface Contact Water Management Plan

Contact Water Source	Initial Contact Water Collection Location	Final Contact Water Collection Location
Industrial Sector	Whale Tail Attenuation Pond	Whale Tail Attenuation Pond
Whale Tail WRSF Sector	Whale Tail WRSF Pond (Quarry 1 for the temporary Stage 1 WRSF sump)	
Ore Stockpiles	Whale Tail Attenuation Pond	
Landfill	Whale Tail WRSF Pond	
Open Pit	Open pit sumps	

WRSF = Waste Rock Storage Facility.

3.1.4.5 Erosion and Sediment Control Plan

As described in the previous sections, Whale Tail Pit site infrastructure, channels, sumps and associated water management activities are designed with consideration of site wide erosion and sediment control. In addition to design controls, best management practices (BMPs) will furthermore ensure that activities, practices, devices or a combination thereof will prevent or reduce the release of sediments and will control erosion. The selection of permanent or temporary BMPs will be specific to the site and timing and may require regulatory approval prior to installation or construction.

Temporary BMPs Whale Tail Pit may include:

- Silt fences and fabric installation;
- Turbidity curtains;
- Sediment control basins to detain sediment-laden water; and
- Diversion of flows away from the construction area.

Permanent BMPs at the Whale Tail Pit may include:

- Infiltration basins and trenches;
- Sedimentation basins or ponds; and
- Construction of swales in ditches.

Monitoring of erosion and sedimentation associated with construction and operations are discussed in Section 3.2 of this plan and are detailed in the Whale Tail Pit Water Quality and Flow Monitoring Plan (FEIS Appendix 8 B.3, Agnico Eagle, 2016) and dike construction sediment control and monitoring is presented in Whale Tail Pit Dike Construction and Dewatering Management Plan (FEIS Appendix 8 – A.2, Agnico Eagle, 2016).

For specific details on sediment control guidelines and license requirements, on erosion monitoring and mitigation during freshet and the rise of water level in the South Basin of Whale Tail Lake, refer to the Whale Tail Project - Erosion Management Plan (Agnico Eagle, 2018b).

3.1.4.6 Water Management in Whale Tail Waste Rock Storage Facility

As mentioned in the document Amaruq Stage 1 WRSF, Ore Stockpile 1 and Starter Pit Design Report and Drawings (Agnico Eagle, 2018c), while awaiting the construction of the Whale Tail WRSF dike expected in winter 2019, a Stage 1 WRSF will be initiated. The Stage 1 WRSF, located within the footprint of the final location of the WRSF, will be positioned as to be able to control the watershed using the topography in combination with temporary water management structures in order to prevent potentially contaminated contact water from seeping into the environment. The duration of this Stage 1 WRSF will be during the second half of 2018 until the aforementioned WRSF dike is constructed or when weather conditions are sufficiently cold that no thawing or water runoff can occur.

To avoid any potential contact water from entering the environment, a low-permeability access road built of overburden will be established first to reach the Stage 1 WRSF location and will act as a barrier to any water not naturally diverted towards a containment sump that will be established once the access road is completed and prior to any placement of PAG / ML material. The location of the Stage 1 WRSF was chosen as to use the topography to control water runoff, in combination with the access road and collection sump designed to sustain a 1:100 year rain event. All water collected in the sump will be directed towards Quarry 1 in a closed circuit. Refer to Figure A.5 of Appendix A.

The Whale Tail WRSF will be used to permanently store all waste rock and overburden from mining activities. Seepage and runoff from the Whale Tail WRSF during the construction and operational phases will be managed via the Whale Tail WRSF Pond, isolated by the Whale Tail WRSF dike, where the contact water will be pumped to the Whale Tail Attenuation Pond for further treatment. During the construction phase or until the Whale Tail WRSF Dike is operational, runoff and especially water originating from thawed ice-rich soils will be managed with ditches and local sumps. All overburden soils will be stabilized with waste rock berms in order to limit spreading and soil water separation. More details about management of the Whale Tail WRSF are presented in the Mine Waste Rock and Tailings Management Plan.

3.1.4.7 Water Management for Ore Stockpile Areas

The ore stockpiles are located within the catchment of the Whale Tail Attenuation Pond as shown in Figure A.2, Figure A.3 and Figure A.5 (Appendix A). Based on the topographic information, contact water will naturally flow to the Whale Tail Attenuation Pond for further treatment. Channels will be constructed if deemed required to direct the seepage and runoff to the pond.

The Ore Stockpile Pad 1, which constitute the first stage of the ore stockpile, was designed based on the following considerations. A minimum 1.0 m of overburden and/or waste rock will be placed over original ground to reduce any thaw-induced differential settlements. Waste rock will then be placed to follow the natural topography, thereby reducing the likelihood of water ponding on the surface of the pad requiring additional maintenance. A final grade of about 0.5% sloping towards the Whale Tail

Attenuation Pond will be achieved. Any surface run off from the ore stockpile or the pad will therefore be directed to the Attenuation Pond containment area.

3.1.4.8 Water Management for the Pit Sector

The Whale Tail open pit is planned to extend to approximately 115 m below the ground surface. The open pit will be mined mostly within permafrost except for the north-central portion of the pit which will be within the closed talik at the northern end of Lake A17 (Whale Tail Lake). The pit does not extend through the bottom of the closed talik; however, the open pit acts as a sink for groundwater flow during operations, with water induced to flow up through the open talik beneath the central portion of Lake A17 (Whale Tail Lake) and into the open pit. Accordingly, groundwater inflows into open pit are expected, this water will be mixed with the open pit contact water and pumped the Whale Tail Attenuation Pond for further treatment.

3.1.4.9 Water Management for Haul Road

A network of access and haul roads will connect the ore body to the Whale Tail WRSF Sector and the Industrial Sector. The majority of the roadways servicing the mining area will drain directed towards the proposed contact water management infrastructure. Detailed information on roads is described in the Whale Tail Pit Haul Road Management Plan.

The approach to water management for these roads will involve the implementation of local best management practices during the construction, operational, and closure phases. The roads are constructed of non-potential for acid generating and non-leaching waste rock from mining operations. Other best management practices will strive to minimize the amount of runoff originating from the roadways and to prevent the migration of surfacing material from the roadways and crossings. Any areas identified as point sources of runoff originating from the roadways or crossings can be managed locally with silt fences, straw booms, turbidity curtains, interceptor channels, rock check dams, and/or small sedimentation ponds.

3.1.4.10 Water Management for Landfill

The landfill is located southeast of the Whale Tail WRSF, within the catchment of Whale Tail WRSF Pond, as shown in Figure A.2 to Figure A.4 (Appendix A). Based on the topographical information (PhotoSat 2015), runoff and any seepage from the landfill will naturally flow to the Whale Tail WRSF Pond and then pumped to the Whale Tail Attenuation Pond for further treatment before discharge.

Further information on the management of this facility is described in the Whale Tail Pit Landfill and Waste Management Plan.

3.1.4.11 Sludge Management from Water Treatment Plant

Sludge water from the Operation Water Treatment Plant (OWTP) will be dewatered with a centrifuge to produce a cake having a density with 20% of solid content. This cake will be stored in the Whale Tail WRSF. The maximum predicted annual volume of cake from the OWTP is approximately 5,760 cubic metres (m3). The OWTP, is designed to treat total suspended solids and arsenic during the Operations Phase.

3.1.5 Freshwater and Sewage Water Management

3.1.5.1 Freshwater Management

Freshwater for the Whale Tail Camp will be sourced from Lake A17 (Whale Tail Lake) and from Lake C38 (Nemo Lake), as per Part E, conditions 1, 2 and 3 of the Water License 2AM-WTP1826. Freshwater usage includes potable use, fire suppression, dust suppression, drilling water, if contact water is not available, and water for the truck shop. The freshwater source is Lake C38 (Nemo Lake) during construction and operations, and Lake A17 (Whale Tail Lake) during closure. For explosives mixing and associated use, the water will be pumped from the unnamed lake, as per Part E, condition 4 of the Water License 2AM-WTP1826. Freshwater will also be required to refill Whale Tail Lake (North Basin) at closure and will be sourced from the Whale Tail Lake (South Basin) and inflows to Whale Tail Lake (North Basin). Agnico Eagle will endeavour to minimize the amount of freshwater required for the Project, where possible.

Freshwater will be sourced through a freshwater intake and pump system. The intake will consist of vertical filtration wells fitted with vertical turbine pumps that supply water on demand. The intake will be connected to the pump house with piping buried under a rockfill causeway. The intake pipe will exit at the bottom of the causeway and will be fitted with a stainless steel screen, as per Part E, condition 6 of the Water License 2AM-WTP1826. The rockfill causeway will act as a secondary screen to prevent fish from becoming entrained. The stainless steel screens design for the water intake will be consistent the Fisheries and Oceans Canada (DFO) "Freshwater Intake End-Of-Pipe Fish Screen Guideline" (DFO 1995). As per the DFO policy intake screens will be cleaned every 2 years. The freshwater intake will be moved to Whale Tail Lake (North Basin) at closure.

Freshwater will be pumped to an insulated main storage tank located at the Whale Tail Camp. The freshwater pipeline will be a high density polyethylene pipe and insulated and heat traced. The Whale Tail Camp will have a WTP for potable (domestic) water. The design flow rate for the potable water for the Whale Tail Camp and accommodations (i.e., kitchen, laundry) is 84 cubic metres per day (m^3/day), based on a 350 people camp capacity, using both the existing Exploration Camp and additional 210 units and a nominal consumption of 240 litres per day per person (L/day/person). In the Potable WTP, the freshwater will first go through sand filters and then be pumped through ultraviolet units, and finally be treated with chlorine. The treated water will be stored within a potable water tank. Potable water will be monitored according to the Nunavut health regulations for total and residual chlorine and microbiological parameters. Treated potable water will be piped to other facilities requiring potable water.

Approximately 8,760 cubic metres per year (m^3/year) of freshwater will be required during the construction phase, 118,625 m^3/year during the operational phase, and 17,520 m^3/year during the closure phase. The use of freshwater will respect the limits as per Part E, conditions 1 and 2 of the Water License 2AM-WTP1826 During closure, the Whale Tail Pit and Whale Tail Lake (North Basin) will be allowed to flood naturally with non-contact, treated, and freshwater from direct precipitation, runoff from adjacent land, and Whale Tail Lake (South Basin). It is anticipated that approximately 24,000,000 m^3 over 8 years is required to fill the mined-out Whale Tail Pit (i.e., approximately 17,000,000 m^3) and Whale Tail Lake (North Basin) (i.e., approximately 7,000,000 m^3) to its original level, including approximately 2,300,000 m^3/year from Whale Tail Lake (South Basin), 120,000 m^3/year from tributaries to Whale Tail Lake (North Basin), and 580,000 m^3/year from direct precipitation to Whale Tail Lake (North Basin). As per part E, condition 5 of the Water License 2AM-WTP1826, the use of water from Whale Tail Lake shall not exceed a total of 10,655,000 m^3/year commencing when notification of closure is received by the NWB through to the expiry of the Licence.

3.1.5.2 Sewage Water Management

Sewage will be collected from the camp and change-room facilities and pumped to a STP. The objective of the STP is to treat sewage to an acceptable level for discharge to the Whale Tail Attenuation Pond via a sewage water discharge pipeline. The STP will be housed in a prefabricated (modular) structure located in the Whale Tail Camp. The sewage treatment system will be designed based on a flow rate of 200 L per day per room for a peak load of 210 rooms, for an average daily flow rate of 42 m^3 (1.75 cubic metres per hour [m^3/hour]). As already installed on site for the Exploration Camp, additional Bionest Kodiak biological reactor units are envisioned to be installed to treat camp waste water and accommodate for a total of 350 rooms.

The STP for the camp facilities will be designed to meet appropriate guidelines for wastewater discharge (for example, NWT Water Board 1992). Wastewater System Effluent Regulations (WSER) criteria are not currently applicable to systems located in Nunavut, and is unlikely to apply to the Project effluent quality.
Table 3.5 provides the anticipated performance of the system compared to the WSER criteria.
Further information on the management of this facility is described in the Whale Tail Sewage Treatment Plant Operation and Maintenance Manual.

Table 3.5 Effluent Quality and Wastewater Characteristics

Parameter	Units	Regulatory Limit	Design Value
Wastewater			
• Biochemical Oxygen Demand	mg/L	-	952
• Total Suspended Solids	mg/L	-	300
• Total Kjeldahl Nitrogen	mg/L	-	130
• Ammonia nitrogen	mg/L	-	130
• Fat, Oil and Grease	mg/L	-	30
• pH	-	-	6 to 9.5
• Water Temperature	°C	-	10 to 25
• Alkalinity	mg/L as $CaCO_3$	-	471.1
• Prohibited Chemicals/Compounds	Not present		
• Grinder Pumps	Not present Upstream of MBR		
Effluent			
• pH	-	6-9.5	6.5 to 8.5
• Carbonaceous Biochemical Oxygen Demand	mg/L	<25	<5
• Total Suspended Solids	mg/L	<25	<1
• Un-ionized ammonia	mg/L	<1.25	<0.08
• $N0_3$-N	mg/L	<5	4
• TP	mg/L	<0.5	0.5
• Fat, Oil and Grease	mg/L	<5	<1
• Fecal Coliform	CFU/100mL	<200	Non-Detect
• Total Residual Chlorine	mg/L	<0.02	0

1. Noted values are assumed blend between kitchen and dormitory wastewater after the grease trap.
2. A complete list of prohibited chemicals is included in the membrane maintenance manual.

3.2 Operation, Maintenance, and Surveillance of Project Dikes

3.2.1 Consequence of Failure

The consequence of failure classification is presented in SNC (2018b) based on the guidelines provided in the Canadian Dam Association Dam Safety Guidelines (CDA, 2014). The Whale Tail Dike and the Mammoth Dike are rated as "High" consequence of failure structures, Northeast Dike is rated as "Significant" consequence of failure structure, and Whale Tail WRSF Dike is classified as "Low" consequence of failure structure.

No flooding or inundation mapping has been completed.

It is assumed that failure of Whale Tail Dike and Mammoth Dike could flood the Whale Tail Pit, resulting in associated threat to the safety of mine personnel, equipment, and other workings within the dewatered area. Flooding would likely cause cessation of mining operations within the pit, either temporarily or permanently.

Finally, as the Whale Tail WRSF Pond will have a small volume and will continue to be pumped to the Whale Tail Attenuation Pond over the summer season, a low probability of failure is attributed to the Whale Tail WRSF Dike and then to the consequence of failure.

3.2.2 Operation, Maintenance, and Surveillance Manual

The Meadowbank Mine OMS manual (Whale Tail Addendum) will be updated by Agnico Eagle before the operations of the dikes, reviewed on an annual basis and revised as necessary to accommodate changes in the condition and operations of the facilities or in management structure as per Part B, condition 13 of the Water License 2AM-WTP1826 . The OMS Manual will be an extension of the existing Meadowbank OMS Manual (Agnico Eagle, 2017).

3.2.3 Role and Manual Holders

The Meadowbank Mine Engineering Superintendent will be responsible for delivering the first release of the OMS Manual as well as issue all revisions and addenda to the registered holders: General Mine Manager, Environment Superintendent, Mine Operations Superintendent, Engineering Superintendent, General Services Manager, Site Services Superintendent, Corporate Environment Director, Health and Safety Superintendent, and Dike Design Engineer. The role and responsibilities of holders will be revised when issuing the OMS Manual.

3.2.4 Dewatering

Based on SNC (2018c), the design criteria for minimum freeboard for the dikes are presented in Table 3.6. The freeboard may change due to fluctuations in Whale Tail Lake and Ponds, or due to settlement in the dikes. Maintenance may be required to restore loss of freeboard due to settlement. The freeboard may also change during further advanced engineering phases.

Table 3.6 Design Minimum Freeboard

Structure	Minimum Freeboard		
	Normal operation (m)	Design flood conditions (m)	Actual minimum freeboard (m)
Whale Tail Dike	2.0	1.8	2.0
Mammoth Dike	No water	1.3	1.5
Whale Tail WRSF Dike	No water	0.6	0.7
Northeast Dike	No water	0.7	0.8

m = metre; WRSF = Waste Rock Storage Facility.

Based on past experience at dewatering operations (i.e. Vault Lake for Meadowbank operations), a WTP was not required because the regulatory criteria limit was reached without treatment or a WTP was used only during the latter stages when TSS from bottom sediments were present. It is expected for the Project that approximately 2/3 of the dewatered water from the Whale Tail Lake (North Basin) will be pumped and directly discharged to Whale Tail Lake (South Basin) while the remaining 1/3 of the water will be processed through the WTP to reduce TSS and discharged to Lake A16 (Mammoth Lake) thru a diffuser. During new dike construction, Agnico Eagle will abide by limits established by the NWB in the Water License 2AM-WTP1826. .

Pore water pressures in the foundation of the dewatering dikes will be monitored during dewatering as a predictor of possible slope instability. Both pore water pressures and temperature measurements will be monitored during dewatering as one method of detecting potential zones of seepage. The quantity of water pumped out during dewatering will be monitored with flow meters in addition to monitoring the water level downstream of the Lake A17 (Whale Tail Lake) watershed.

3.2.5 Operations

Water from the seepage collection systems of the dikes is to flow naturally to the Whale Tail Attenuation Pond or to the Open-Pit and the Collection Ponds and be pumped to the Whale Tail Attenuation Pond. The quantity of seepage through the dikes will be estimated on further advanced engineering phases. Seepage rates, volumes and the condition of the seepage water (i.e. turbidity, temperature, etc.) will be monitored as per Part I, conditions 15 and 16 of the Water License 2AM-WTP1826, and incorporated in the Water Balance.

Water quality of the seepage and runoff collected in the sumps and ditches at the toe of the dikes is to be monitored during operations according to the Water License 2AM-WTP1826requirements. Weekly inspections will be performed as an indicator of dike performance to note whether seepage water is clear, cloudy or if fine material is present.

3.2.6 Surveillance

A program of regular surveillance is required to ensure that the dikes, instrumentation and seepage collection systems are performing adequately and that problems are detected so that the necessary corrective actions can be implemented in a timely manner. A surveillance program will be implemented based on the International Commission on Large Dams (ICOLD 1998) for detection of potential failure mechanisms applicable to the dikes, primarily Whale Tail Dike, Northeast Dike and Whale Tail WRSF Dike. The surveillance program for the Project will be implemented in the OMS Manual by Agnico Eagle before the operations of the dikes.

3.2.7 Monitoring and Instrumentation

Monitoring of the dikes will be carried out for the purpose of environmental monitoring, assessment of physical stability of the structures, assessment of overall performance of the dikes, and aiding in future design. Monitoring complements the surveillance and is divided into the following aspects: drawdown rate and water quality during dewatering, geotechnical instrumentation including piezometers, thermistors, inclinometers, survey prisms, etc., and seepage rates and water quality during operations. The monitoring program for the Project will be implemented by the OMS Manual issued by Agnico Eagle before the operations of the dikes.

3.2.8 Reporting Procedures and Data Management

Emergency, inspection, and instrumentation measurements will be reported according to the role and responsibility of individuals and as per the OMS Manual requirements. An electronic library or database will be set up to catalogue and store inspection documents, maintenance reports and instrumentation measurements. Hard copies will also be catalogued and stored on site.

3.2.9 Decommissioning

The decommissioning of the dikes will take place progressively as the dikes are decommissioned and opened to reconnect lakes.

The Whale Tail Dike and the Mammoth Dike will remain intact during the controlled flooding of the Whale Tail Pit and Whale Tail Lake (North Basin). These are flooded gradually over the course of several years. Once the water levels have stabilized within Whale Tail Lake (South Basin) and Whale Tail Lake (North Basin) and water quality is considered acceptable for mixing with neighbouring lakes, these two dikes will be decommissioned to allow circulation of lake water.

The Northeast Pond will be draw-down into the open-pit before the dike be decommissioned.

The Whale Tail WRSF Dike will remain in place during closure and post-closure period or until the water quality monitoring results meet discharge criteria to allow water to naturally flow to the receiving environment. Following confirmation the water quality monitoring results meet discharge criteria the Whale Tail WRSF Dike will be decommissioned.

Long-term inspection will be carried out to ensure the adequate performance of maintained closure and post-closure facilities.

3.2.10 Emergency Preparedness Plan

The purpose of an Emergency Preparedness Plan is to present a basic procedure for responding to potential failure mechanisms for dikes. The procedure identifies various measurable or observable effects or causes of the failure mechanisms, identifies the appropriate people to notify, presents the procedure to put in place according to the level of emergency and lists the response reference. The Emergency Preparedness Plan for the Project will be implemented in the OMS Manual by Agnico Eagle before the operations of the dikes.

3.3 Water Management during Closure

Mine closure is integral to the mine design and will be modified during operations. Planning for permanent closure is an active and iterative process. The intent of the process is to develop a final closure plan including specific water management components using adaptive management. This begins during the mine design phase and continues through to closure implementation. Adaptive management enables the plan to evolve as new information becomes available through analysis, testing, monitoring, and progressive reclamation. The detailed mine closure and reclamation activities are provided in the Whale Tail Pit Interim Closure and Reclamation Plan (FEIS, Volume 8, Agnico Eagle Mine, 2016).

Water management during closure and reclamation will involve maintaining contact water management systems on site until monitoring results demonstrate that water quality is acceptable for discharge of all contact water to the environment without further treatment. Once water quality meets the discharge criteria, the water management systems will be decommissioned to allow the water to naturally flow to the receiving environment. In 2018, a WRSF seepage analysis and Hydrodynamic modelling of Mammoth Lake were conducted to address NIRB project certificate Term and Condition no. 6 a). The objectives were to assess Mammoth Lake near-field water quality at WRSF seepage outlet post-closure and to evaluate seasonal water circulation patterns in Mammoth Lake resulting from effluent discharge. This analysis also aimed to predict and evaluate the water quality within Mammoth lake during operations and post-closure (Golder, 2018a). Results show that no modification to the water management strategy are needed concerning closure activities and sequence.

The key water management activities during mine closure are summarized in Table 3.7. Figure B.2 to Figure B.4 in Appendix B show the water management flowsheets during mine closure phases.

Table 3.7 Key Water Management Activities during Mine Closure

Mine Year	Figure	Key Water Management Activities and Sequence
Year 4 (2022) to Year 7 (2025)	A.3	• Fill the mined-out open pit with active pumping of water from Whale Tail Lake (South Basin) and treated Whale Tail WRSF pond water • Draw-down of the raised Northeast Sector and breaching of the Northeast Dike. The Northeast Pond water flows in the open pit and Lake A47, Lake A48, Lake A113, Pond A-P38, and A-P68 return to their natural water level and drainage patterns • Water from the A watershed stops to flow in the C watershed • Water from Whale Tail Lake (South Basin) stops flow through Whale Tail Lake (South Basin) Diversion Channel and to Lake A16 (Mammoth Lake) • Draw-down of the raised Whale Tail Lake (South Basin) to natural water level by pumping to Whale Tail Lake (North Basin). Lake A55, Lake A65, Lake A62, Lake A63, Lake A18, Pond A-P23, Lake A20, Lake A21, Lake A22, and Lake A45 return to their natural water level and drainage patterns. • The freshwater intake is moved in Whale Tail Lake (South Basin) • The monitoring of the site water quality starts • If necessary, the WTP is moved in the Whale Tail WRSF sector
Year 8 (2026) to Year 11 (2029)	A.4	• Fill Whale Tail Lake (North Basin) with active pumping water from Whale Tail Lake (South Basin). The pumping rate will be equivalent to the natural inflow to Whale Tail Lake (South Basin) to keep a constant and natural water level in Whale Tail Lake (South Basin) • The Whale Tail Attenuation Pond as well as the Industrial Sector and the Whale Tail Camp are no longer considered as contact water and now contribute to the re-establishment of the natural water level of the Whale Tail Lake (North Basin) • Whale Tail Dike and Mammoth Dike are breached when i) the South side and the North side of the Whale Tail Dike are at the same water level (i.e., at natural water level) and ii) the water quality monitoring results meet discharge criteria to allow water to naturally flow to the receiving environment Remove non-essential site infrastructure
Post-Closure	N/A	• Treated contact water from the Whale Tail WRSF Sector is discharged in Lake A16 (Mammoth Lake) through the existing diffuser system. This water is treated until water quality meet direct discharge criteria, following which the water management system is decommissioned • Breach the Whale Tail WRSF Dike once water quality monitoring results meet discharge criteria to allow water to naturally flow to the receiving environment • Remove non-essential site infrastructure

WRSF = Waste Rock Storage Facility; N/A = not applicable.

3.3.1 Open Pit and Refilling of Whale Tail Lake (North Basin)

Following completion of mining, the open pit will be filled with natural runoff and water pumped from Whale Tail Lake (South Basin) and treated water from the Whale Tail WRSF. During the summer of the

Year 4 (2022), the water accumulated in Whale Tail Lake (South Basin) over the years of operations will be pumped in the open pit. It will take approximately 4 years to refilling the pit with an assumed pumping rate of 45,000 m^3/day. Following this first pumping summer, the water elevation in Whale Tail Lake (South Basin) will be back to the baseline value (152.5 masl) and no outlets will be available for this basin as the Whale Tail Lake (South Basin) Diversion Channel is at the elevation 156 masl and the Whale Tail Dike is maintained in place. During the following years and until Whale Tail Lake (North Basin) reaches the same water elevation as Whale Tail Lake (South Basin) (i.e., baseline water surface elevation of 152.5 masl), the yearly accumulated water in Whale Tail Lake (South Basin) (i.e., over the baseline water surface elevation of 152.5 masl) is pumped to Whale Tail Lake (North Basin). At an assumed pumping rate of 45,000 m^3/day, the north and south parts of the Lake A17 (Whale Tail Lake) will be at the same elevation 8 years after the end of the operational phase and then the Whale Tail Dike and the Mammoth Dike will be reconnected when the water quality monitoring results meet discharge criteria to allow water to naturally flow to the receiving environment. Results from the 2018 modelling (Golder, 2018a) show that effluent discharge into Mammoth Lake will be well mixed. Steady-state untreated WRSF contact water released is predicted to meet SSWQO for arsenic at the edge of the mixing zone in the long-term, under the anticipated cover performance scenario (from the 4.7 meters cover of low arsenic leaching waste rock). The mixing zone in the Lake is predicted to range from 5 meters (under calm conditions in July when 6% of the seasonal seepage flow occurs), to 60 meters (under medium current conditions in June when 65% of the seasonal flow is predicted to occur at a more dilute arsenic concentration) from the entry point of this seepage into the Lake and along the plume centre line. Mammoth Lake is sensitive to cover material seepage quality, in turn sensitive to cover composition and WRSF pile contact water volume. Observational data at Meadowbank WRSF suggest that pile contact water volumes are substantially lower than originally predicted (Portage is 20 to 40% lower, Vault WRSF contact water is minimal compared to 178,000m^3 predicted at maximum footprint year) using similar modelling assumptions. Modelling results reflect a conservative chemical load estimate to Mammoth Lake in WRSF seepage that will be verified with monitoring.As per Type A Water Licence 2AM-WTP1826 Part E, conditions 7 and 8 , Agnico Eagle anticipates a site wide water balance and end pit water quality model update will be required for the Whale Tail Pit Site as part of the annual water management plan.

3.3.2 Contact Water Collection System

The complete contact water collection system will remain in place to collect surface runoff water and seepage from the mine site until the open pit is flooded. During this period of 4 years, the Industrial Sector and the Whale Tail Camp will be reclaimed and the non-essential site infrastructure will be removed. Thereafter, water in these sectors will no longer be collected and will contribute to the reestablishment of the natural elevation of Whale Tail Lake (North Basin). Although water might not meet the discharge criteria after 4 years, water will be controlled as the Whale Tail Dike and the Mammoth Dike will remain in place until Year 11 of the Project.

In the Whale Tail WRSF Sector, the contact water collection system will remain in place. Dikes will not be reconnected until the water quality in the flooded area meets Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines, baseline concentrations or appropriate site specific water quality objectives. Contingency for water treatment if required in closure is also accounted for in the closure plan.

Dike breaching will involve the removal of a portion of the dike to original ground levels. Consideration will be given to breach staging, with the above water portions of the dike/berm in the breach area removed during winter periods, when there will be little surface water flow, thereby minimizing the potential release of sediments to the neighbouring waterbodies. The remainder of the breach would be completed during the open water season following freshet so as to allow for the deployment of turbidity curtains to control potential releases of sediment.

Channel and sump closure involve the infrastructure will be re-contoured and/or surface treated according to site-specific conditions to minimize wind-blown dust and erosion from surface runoff, if required. This closure activity is intended to enhance site area development for re-colonization by native plants and wildlife habitat.

3.4 Water Balance

A water balance model was developed to assist in the evaluation of the proposed water management infrastructure, and estimation of the pumping requirements over the life of the mine (SNC, 2015) and under closure conditions (Whale Tail Interim Closure and Reclamation Plan).

The water balance was computed on a monthly time step based on mean annual climate conditions (Section 2.1.1) and the following conservative assumptions:

- snow sublimation is subtracted from snowfall on a monthly basis. If snow sublimation is greater than snowfall for a particular month, net snow value us zero for that month;
- snowfall between October and May, net of snow sublimation and rainfall, accumulates as snow and ice, and melts entirely in June;
- runoff is composed of precipitation and snow melt during the summer months (June to September);
- net inflow for a lake or pond is computed as runoff minus evapotranspiration (computed based on the watershed area minus lake or pond area) and lake evaporation (computed based on the lake or pond area); and
- change in storage was not accounted for, and net inflow is equal to net outflow.

The water management flow sheets are presented in Appendix B, and water balance results are presented in Appendix C for mean annual climate conditions during operations.

The estimated mean annual water input/output from each of various water management facilities under mean annual climate conditions during operations are summarized in Table 3.8.

Table 3.8 Estimated Mean Annual Volumes from Mine Site Water Balance

Item	Mean Annual Water Volume (m^3)[1]
Whale Tail Attenuation Pond	455,000
Whale Tail WRSF Contact water to Pond	112,000
Open Pit inflows	111,000
Freshwater Pumped from Lake C38 (Nemo Lake)	74,000
Treated Water from WTP to be Discharged to the Receiving environment	420,000
Freshwater Diverted from Watershed A to Watershed C	207,000
Freshwater from Whale Tail Lake (South Basin) to Lake A16 (Mammoth Lake)	1,873,000

1: Volume rounded to the nearest thousand.
WRSF = Waste Rock Storage Facility.

SECTION 4 • REFERENCES

Agnico Eagle (Agnico Eagle Mines Limited). 2018a. Water Management Report and Plan, version 6, Meadowbank Division, March 2018.

Agnico Eagle (Agnico Eagle Mines Limited). 2018b. Whale Tail Project - Erosion Management Plan, Version 1, Meadowbank Divison, June 2018.

Agnico Eagle (Agnico Eagle Mines Limited). 2018c. Amaruq Stage 1 WRSF, Ore Stockpile 1 and Starter Pit Design Report and Drawings. Meadowbank Divison, June 2018.

Agnico Eagle (Agnico Eagle Mines Limited). 2017. Dewatering Dikes, Operation, Maintenance and Surveillance Manual, , Meadowbank Division, March 2017..

Agnico Eagle (Agnico Eagle Mines Limited). 2016. Final Environment Impact Statement (FEIS) Volumes 1 to 8, Whale Tail Pit Project, Meadowbank Division.

Agnico Eagle (Agnico Eagle Mines Limited). 2015. Water Management Report and Plan, version 3, Meadowbank Division, October 2015.

CCME (Canadian Council of Ministers of the Environment). 1999 (with updates to 2016). Canadian Environmental Quality Guidelines, 1999. Canadian Environmental Quality Guidelines Summary Table, with updates to 2016. Winnipeg, MB, Canada. Available at: http://st-ts.ccme.ca/. Accessed March 2016.

CCME. 2004. Canadian Water Quality Guidelines for the Protection of Aquatic Life: Phosphorus: Canadian Guidance Framework for the Management of Freshwater Systems. In: Canadian Environmental Quality Guidelines, 2004. Canadian Council of Ministers of the Environment, Winnipeg, MB, Canada.

CDA (Canadian Dam Association). 2014. Canadian Dam Association, Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams.

DFO (Fisheries and Oceans Canada). 1995. Freshwater Intake End-of-Pipe Fish Screen Guideline, March, 1995.

Government of Canada. 2015. Historical Climate Data. Available online from: http://climate.weather.gc.ca/index_e.html

Health Canada. 2014. Guidelines for Canadian Drinking Water. Prepared by the Federal-Provincial-Territorial Committee on Drinking Water. Ottawa, ON, Canada.

ICOLD (International Commission of Large Dams) 1998. Dam Failures and Statistical Analysis. Bulletin 99.

IPCC. 2014. Summary for Policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32

Knight Piesold. 2015. Agnico Eagle Mines Ltd.: Meadowbank Division – Whale Tail Pit – Permafrost and Hydrogeological Characterization, File No.:NB101-00622/04-A.01

NWT Water Board. 1992. Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories.

Overland, J.E., M. Wang, J.E. Walsh, and J.C. Stroeve. 2013. Future Arctic climate changes: Adaptation and mitigation time scales, Earth's Future, 2, doi:10.1002/2013EF000162.

PhotoSat Information Ltd. (PhotoSat). 2015. PhotoSat Stereo Satellite Elevation Mapping Project Report. Reference No. 3631.

SNC (SNC Lavalin Inc.). 2018a. Whale Tail Dike Detailed Design Report.

SNC (SNC Lavalin Inc.). 2018b. Design criteria – Basins and Pumps. Technical note no. 651298-8000-40EC-0001_00, April 2018.

SNC (SNC Lavalin Inc.). 2018c. Amaruq Freeboard Study. Technical note no. 651298-2600-4HER-0002_01, June 2018.

SNC (SNC Lavalin Inc.). 2017. Preliminary design of Mammoth Dike. Technical note no. 645003-3000-4GER-0001_01, August 2017.

SNC (SNC Lavalin Inc.). 2015. Whale Tail Pit Project Permitting Level Engineering, Geotechnical and Water Management Infrastructure, A Technical Report Submitted to Agnico Eagle Mines Ltd. by SNC Lavalin, December 2015.

APPENDIX A • YEARLY SITE LAYOUT PLANS

Figure A.1 Yearly Site Layout Plan (Year -1: 2018)

Figure A.2 Yearly Site Layout Plan (Year 1: 2019)

Figure A.3 Yearly Site Layout Plan (Year 4: 2022)

Figure A.4 Yearly Site Layout Plan (Year 11: 2029)

Figure A.5 WRSF, Starter Pit and Ore Stockpile Plan View, Roads and Pads Construction

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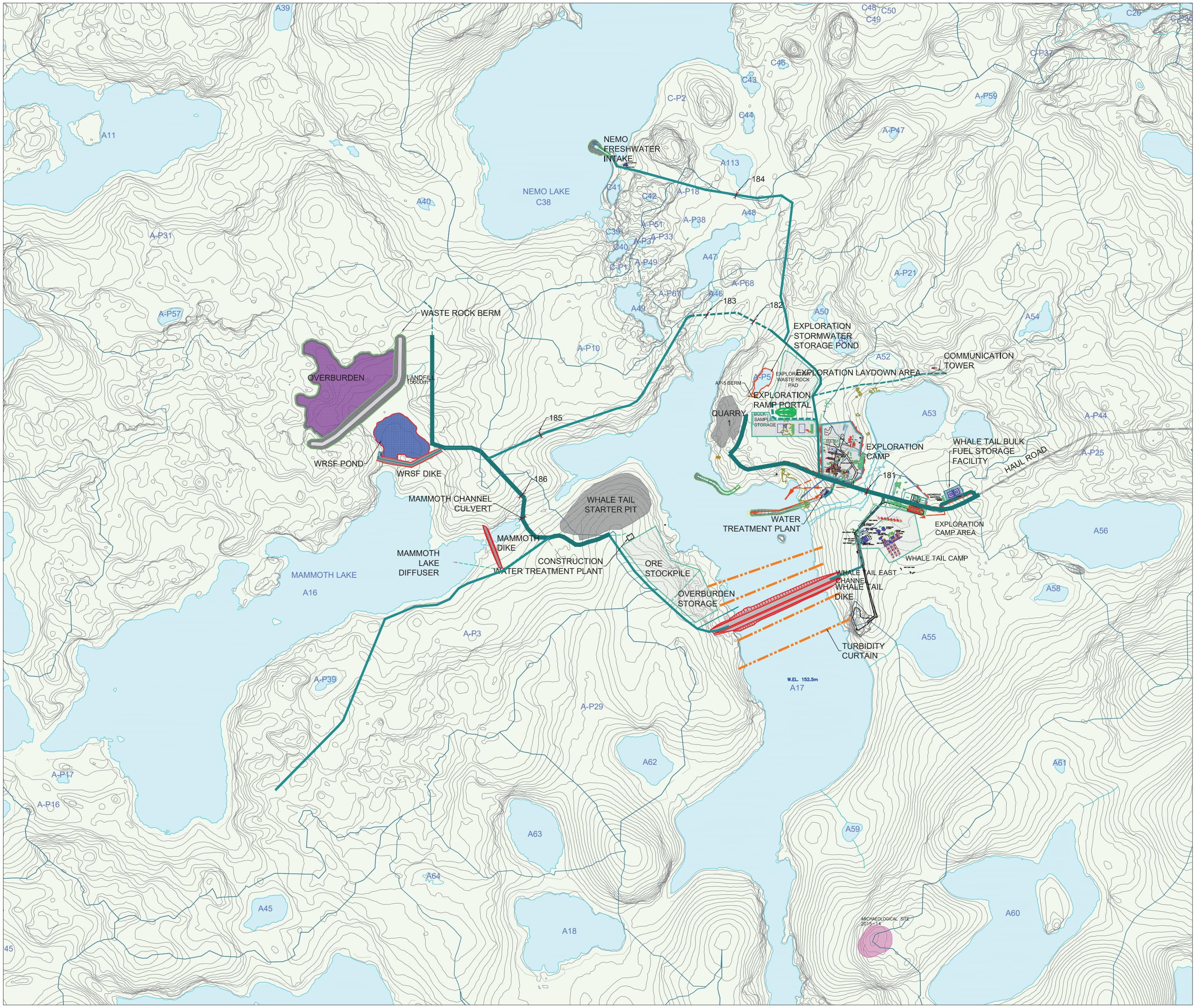
DRAWING NO.

FORMAT ANSI C



PLAN CLÉ
KEY PLAN

NOTES GÉNÉRALES / GENERAL NOTES

LEGEND

- ROAD
- TEMPORARY ROAD
- NATURAL WATERSHED
- COLLECTION CHANNEL
- CULVERT
- INTAKE WATER PIPE
- CONTACT WATER PIPE
- FRESHWATER PIPE
- TURBIDITY BARRIER
- DIKE
- ARCHAEOLOGICAL SITE
- POND / SUMP

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

TITRE / TITLE	# DWG
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AGNICO EAGLE

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT

REVISIONS

TITRE / TITLE
AGNICO–EAGLE – MEADOWBANK DIVISION
WHALE TAIL PROJET
WM

YEARLY SITE LAYOUT PLAN
(YEAR –1:2018)

DESSINÉ PAR / DRAWN BY	J.CRETE	DATE 2018-05-04
VÉRIFIÉ PAR / CHECKED BY		
APPROUVÉ PAR / APPROVED BY		
ÉCHELLE / SCALE		DATE
NO. DESSIN / DRAWING NO.	2018	
NO. PROJET / PROJECT NO.	REVISION	FEUILLE / SHT 1 / 1

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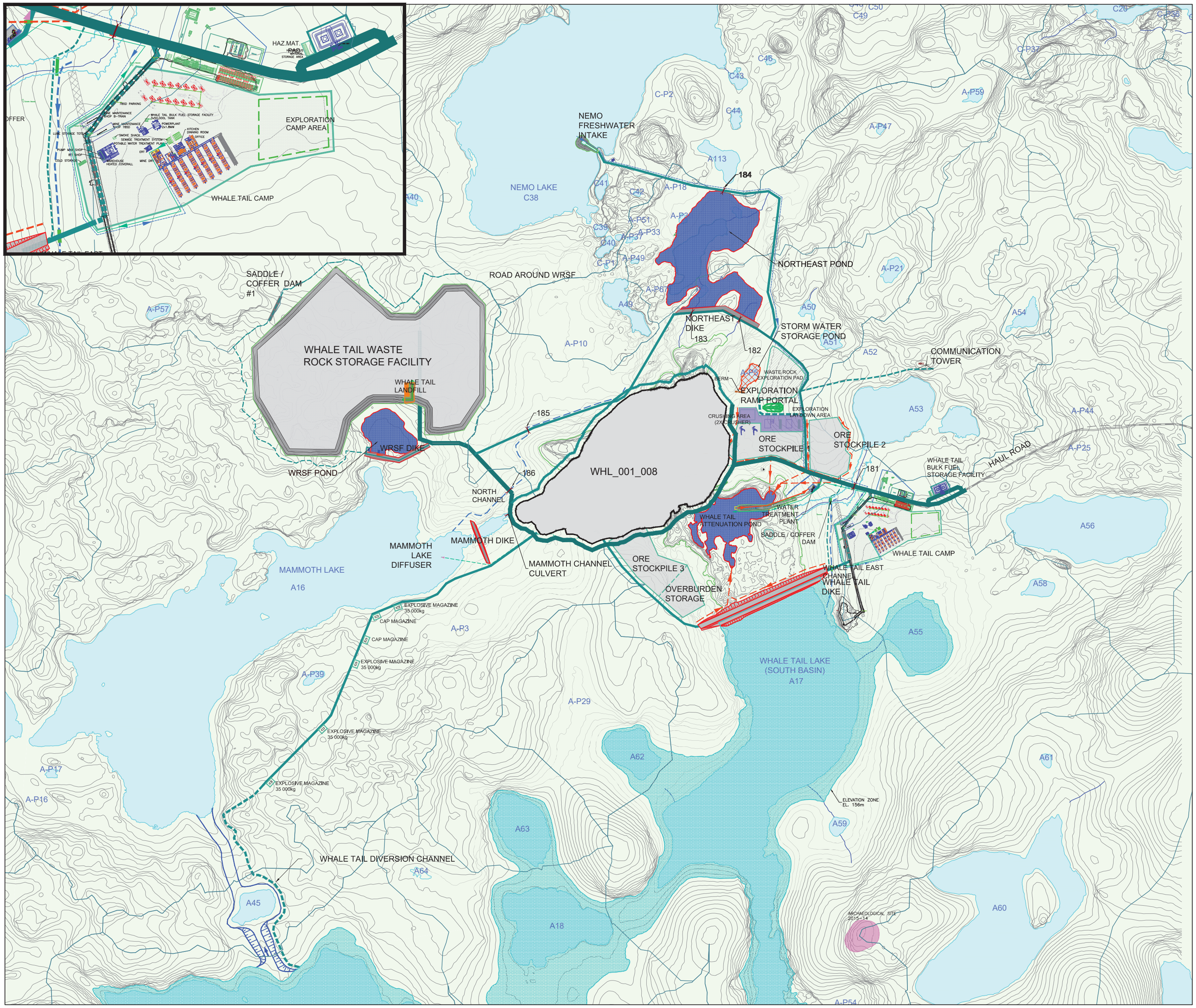

PLAN CLÉ
KEY PLAN

NOTES GÉNÉRALES / GENERAL NOTES

LEGEND

- WHALE TAIL LAKE(SOUTH BASIN) FLOODED LIMIT (WATER LEVEL 156.0m)
- ROAD
- TEMPORARY ROAD
- NATURAL WATERSHED
- DIVERSION CHANNEL
- COLLECTION CHANNEL
- CULVERT
- INTAKE WATER PIPE
- CONTACT WATER PIPE
- FRESHWATER PIPE
- DIKE
- POND / SUMP
- ARCHAEOLOGICAL SITE

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

TITRE / TITLE	# DWG
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AGNICO EAGLE

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT

REVISIONS

TITRE / TITLE
AGNICO–EAGLE – MEADOWBANK DIVISION
WHALE TAIL PROJET
WM

YEARLY SITE LAYOUT PLAN
(YEAR 1:2019)

DESSINÉ PAR DRAWN BY	J.CRETE	DATE	2018–05–04
VÉRIFIÉ PAR CHECKED BY			
APPROUVÉ PAR APPROVED BY			
ÉCHELLE SCALE		DATE	
NO. DESSIN DRAWING NO.	2019		
NO. PROJET PROJECT NO.		REVISION	FEUILLE / SHT 1 / 1

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