Core Receiving Environment Monitoring Program (CREMP) 2021 Plan Update

Meadowbank Complex

Prepared for:

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FINAL

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DOCUMENT CONTROL

There have been multiple updates to CREMP Plan over the years. Past iterations of the document are listed below, followed by an overview of each document.

Document	**Date**
Aquatic Effects Management Program	September 2005
CREMP: 2010 Plan Update	June 2010
CREMP: Design Document 2012	December 2012
CREMP: 2015 Plan Update	November 2015
CREMP: 2015 Plan Update – Whale Tail Pit Addendum	May 2016 May 2018 (minor update)
CREMP: 2015 Plan Update – Whale Tail Pit Expansion Addendum	December 2018
CREMP: 2021 Plan Update	December 2021

2005 Aquatic Effects Management Program (AEMP)

The precursor to the current iteration of the CREMP was the Aquatic Effects Management Program (AEMP, 2005). The 2005 AEMP was prepared as part of the Environmental Assessment (EA) and described the rationale, scope, strategy, and methods for monitoring changes in the aquatic receiving environment for the Meadowbank Project. The AEMP was designed to monitor changes during all phases of development, from construction through operations and post-closure. The annual aquatic receiving environment monitoring reports in 2006 and 2007 used the term AEMP in the report titles[1].

As a requirement of the original Type A Water License (2AM-MEA0815) issued in 2008, the Nunavut Water Board (NWB) advised Agnico Eagle to broaden the mandate of the AEMP from the original scope of receiving environment monitoring to include other programs such as Fisheries Authorizations, Environmental Effects Monitoring (EEM), and groundwater monitoring, to name a few. The restructured AEMP (Azimuth, 2020a [version 5 in prep for 2021]) integrates and evaluates findings from various

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[1] The Nunavut Water Board Type A License, issued in 2008 and renewed in 2015, defines the "AEMP" as the *Aquatic Effects Monitoring Program*; annual receiving environment monitoring reports since 2008 reflect this subtle change.

independent monitoring programs using a site-specific conceptual model framework. The AEMP is the mechanism for providing recommendations on specific management actions to address potential issues.

Considering the AEMP's broadened scope, new terminology (i.e., the Core Receiving Environment Monitoring Program) was adopted when referring specifically to aquatic receiving environment monitoring.

CREMP: 2010 Plan Update

After the AEMP was restructured, Agnico Eagle submitted an updated CREMP Plan (Azimuth, 2010) that outlined the technical details of the receiving environment monitoring program for the NWB, including the monitoring components (water, sediment, phytoplankton, zooplankton, and benthic invertebrates), the sampling locations, and the timing and frequency of sampling. The following changes to the CREMP study design were included in the CREMP: 2010 Plan Update:

- Meadowbank CREMP – Initially, the CREMP focused solely on monitoring changes in water quality at the Meadowbank study area lakes during the open water season. As dike construction and mineral exploration continued to expand in 2009, adaptive management was initiated in response to the release of total suspended solids (TSS) from dike construction. This led to the addition of two new references areas for the CREMP: Tehek Farfield (TEFF), which is located well downstream of the maximum extent of observed changes in water quality, and Pipedream Lake (PDL). Winter water sampling was also added to the CREMP in 2009 to provide water quality data across all four seasons.
- Baker Lake CREMP – The CREMP was expanded to Baker Lake in 2008 to monitor potential changes in the aquatic environment caused by increased barge activity bringing fuel and supplies for the Meadowbank Project.

CREMP Design Document 2012

Agnico Eagle conducted a two-year consultative process at the same time as the CREMP Plan was updated in 2010 to determine the effectiveness of the CREMP at identifying changes in the aquatic environment. During this process, the study design of the CREMP was reviewed, and recommendations were put forward on the timing, frequency, and the number of samples required for the various monitoring components (e.g., water, phytoplankton, etc.). These recommendations (which were subsequently approved) were derived from statistical testing and used power analysis to determine the adequacy of statistical power to detect a change in a particular variable from baseline levels to the relevant trigger value. In the interest of transparency, this review included zooplankton (based on data collected in 2010 and 2011) and periphyton to formally assess their suitability as monitoring components in the CREMP. The review concluded that zooplankton and periphyton were not suitable monitoring components due to the low statistical power to detect effects.

The CREMP Design Document 2012 (Azimuth, 2012) documented the trigger and threshold derivation process, established trigger and threshold values for individual parameters and formalized the experimental design.

CREMP: 2015 Plan Update

The NWB granted Agnico Eagle a renewed Type A Water Licence (2AM-MEA1525) in 2015 subject to certain conditions, one of which was an update of the CREMP Plan. The CREMP: 2015 Plan Update included a new chapter outlining at a high level, the conceptual framework to monitor conditions in the mined-out pits at Meadowbank once the pits are flooded. A new results-based monitoring strategy was also recommended to improve the efficiency of the CREMP. Leveraging the monitoring results available at the time, scaled-back monitoring at the mid-field (MF) and far-field (FF) monitoring areas at Meadowbank was recommended if only minor changes in water quality were detected at the near-field (NF) areas. Minor changes in water quality are defined as statistically significant changes exceeding the early warning trigger values for parameters without effects-based guidelines for the protection of aquatic life.

Whale Tail Pit CREMP Addendum

An addendum to the CREMP: 2015 Plan Update was prepared in May 2016 to integrate the Whale Tail Pit Project into the CREMP in accordance with NIRB Project Certificate No .008 and NWB Type A Water Licence 2AM-WTP1826 (Azimuth, 2016). As part of the original Whale Tail Pit Project (referred to as the Approved Project), six study areas were added to the CREMP according to the study design objectives, methods, and sampling strategy for Meadowbank and Baker Lake.

In 2018, Agnico Eagle proposed an increase in gold production by way of a larger Whale Tail open pit, IVR Pit (and associated waste rock storage facility and attenuation pond), and an underground mining operation. These additions to the Approved Project, collectively termed the Expansion Project, expand the footprint of the Project, generating water requiring management, treatment, and discharge during the operations phase, and will extend the duration of the closure phase to refill the pits and underground mine. Minor updates to the Whale Tail Pit CREMP Plan were issued in May and December 2018 describing the scope of the Expansion Project, but there were no substantial changes to the study design. Two additional lakes (Lake D1 and Lake D5) were identified in 2018 as alternate discharge locations for the Expansion Project. CREMP monitoring was conducted from 2018 through 2021 to characterize baseline conditions in each lake, but these lakes have not been formally incorporated into the CREMP Plan.

CREMP: 2021 Plan Update

The CREMP: 2021 Plan Update was undertaken to amalgamate the CREMP Plan for Meadowbank, Baker Lake, and Whale Tail into one document. Minor updates to the Project description were also completed to reflect the changes that have occurred at Meadowbank and Whale Tail over the past 6 years. Two modifications to the sampling strategy are proposed for the CREMP moving forward. First, winter water sampling in Third Portage Lake east basin (TPE), north basin (TPN), and Wally Lake (WAL) is no longer recommended now that several years have passed since discharge occurred (2014 for TPN; 2017 for WAL). Second, the long-term benthic invertebrate data from TPN, WAL, and Baker Lake support reducing the frequency of monitoring from annually to once every 3-years. If adopted, the next monitoring cycle for benthic invertebrates at TPN, WAL, and Baker Lake would occur in August 2023, coinciding with the timing of sediment coring.

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ACRONYMS AND ABBREVIATIONS

AEMP	Aquatic Effects Management Program
ANOVA	Analysis of variance
AWAR	All weather access road
BACI	Before/after control/impact
BACIP	Before/after control/impact paired
BAER	Baseline Aquatic Ecosystem Report (for Meadowbank)
BAP	Baker Lake – Akilahaarjuk Point
BBD	Baker Lake – barge dock
BES	Baker Lake – east shore
BPJ	Baker Lake – proposed jetty
CCME	Canadian Council of Ministers of the Environment
CoC	Chain of custody
CREMP	Core Receiving Environment Monitoring Program
CRM	Certified reference material
DFO	Fisheries and Oceans Canada
DL	Detection limit
DQO	Data quality objective
EAS	Effects assessment study
EB	Equipment blank
ECCC	Environment and Climate Change Canada
EEM	Environmental effects monitoring
EIA	Environmental impact assessment
FB	Field blank (also referred to as a deionized water blank [DI])
FEIS	Final Environmental Impact Statement
FF	Far-field
FWAL	Freshwater aquatic life guidelines (e.g., CCME)
GPS	Global positioning system
INUG	Inuggugayualik Lake
KIA	Kivalliq Inuit Association
MDMER	Metal and Diamond Mining Effluent Regulations
MF	Mid-field area
NEM	Nemo Lake
NF	Near-field

NIRB	Nunavut Impact Review Board
NPAG	Non-potentially acid generating (waste rock)
NWB	Nunavut Water Board
PAG	Potentially acid generating (waste rock)
PAHs	Polycyclic aromatic hydrocarbons
PDL	Pipedream Lake
QA/QC	Quality assurance / quality control
REF	Reference
RPD	Relative percent difference
RSF	Rock storage facility
SOP	Standard operating procedure
SP	Second Portage Lake
TDS	Total dissolved solids
TE, TEFF	Tehek Lake sampling areas
TPE, TPN, TPS	Third Portage Lake sampling areas
TSF	Tailings Storage Facility
TSS	Total suspended solids
UTM	Universal Transverse Mercator
TSS	Total suspended solids
WAL	Wally Lake
WRSF	Waste rock storage facility
WTN, WTS	Whale Tail Lake – North and South Basins

1 INTRODUCTION

Azimuth Consulting Group Inc (Azimuth) was retained by Agnico Eagle Mines Ltd. (Agnico Eagle) to update the technical details of the Core Receiving Environment Monitoring Program (CREMP) outlined in the CREMP Plan document. The CREMP Plan is the “how-to” manual for conducting aquatic receiving environment monitoring at the Meadowbank Complex, and the last substantial update occurred in 2015 (Azimuth, 2015) as part of the Type A Water Licence renewal (2AM-MEA1526). The CREMP: 2015 Plan Update included refinements to the sampling design and an overview of the general risk-based framework for monitoring in the flooded pits at Meadowbank during the closure phase.

An addendum to the CREMP Plan was prepared in 2016 to incorporate monitoring areas in the vicinity of the Whale Tail Pit Project into the overall CREMP Plan as a condition of the Nunavut Impact Review Board (NIRB) Project Certificate No .008 (the Approved Project) and the Nunavut Water Board (NWB) Type A Water Licence (2AM-WTP1826). The 2016 version of the CREMP Plan for Whale Tail Pit was re-issued (with minor updates) in May and December 2018 as part of the proposal to expand gold production in the form of a larger Whale Tail open pit, IVR Pit (and associated waste rock storage facility and attenuation pond), and an underground mining operation. The Expansion Project, as it is referred to, was approved by the NIRB on February 19th, 2020 (Project Certificate amendment No. 1). The amended Water Licence (2AM-WTP1830) was issued by the NWB on May 12th, 2020.

1.1 Overview of Changes in the CREMP Plan

The CREMP is an adaptive program, meaning results from previous monitoring cycles or changes in the scope of the development are used to make informed decisions on how to effectively monitor changes the aquatic environment caused by mining activities. When exploration activities expanded into Whale Tail Pit study area, additional monitoring locations were added to the CREMP Plan to ensure protection of lakes downstream from the Mine. There have also been occasions where the frequency of sampling was reduced based on multiple years of data that confirmed negligible risk to aquatic life. In rare cases, an entire component or study area may be omitted from future monitoring, as was the case for zooplankton during the redesign of the CREMP (Azimuth, 2012).

This update to the CREMP Plan was undertaken, in part, to amalgamate the CREMP Plans for Meadowbank and Baker Lake study areas (Azimuth, 2015) and the Whale Tail Pit study area (Azimuth, 2018) into one document. Other minor updates to the project description and study areas were completed to reflect the current state of development at Meadowbank, Whale Tail, and Baker Lake.

Significant changes to the CREMP Plan require approval from the NWB as stipulated in Part B section 13 of the most recent amended Type A Water Licence (2AM-MEA1530 and 2AM-WTP1830). An overview of the proposed changes is provided below.

Reduced Frequency of Winter Water Sampling at Selected Meadowbank Study Areas

Winter water sampling (and limnology profiling) at Third Portage Lake North Basin (TPN) and East Basin (TPE) and Wally Lake (WAL) can be suspended now that Third Portage Lake and Wally Lake are no longer receiving environments as of 2014 and 2017, respectively. Open-water sampling in July, August, and September will continue at TPN, TPE, and WAL to track changes related to non-point sources of contaminants (e.g., dust deposition and aerial emissions). No change in the frequency of sampling is recommended at Second Portage Lake, the reference lakes (INUG and PDL), or the Whale Tail Pit study area lakes at this time (i.e., 5 sampling events per year [2 winter events plus July, August, and September]).

3-Year Monitoring Cycle for Benthic Invertebrate Sampling at TPN, WAL, and Bake Lake

Benthic invertebrate monitoring on a 3-years cycle is recommended at TPN, WAL, and Baker Lake. As mentioned above, discharge of treated water to TPN and WAL has not occurred for several years and there is no plan to resume discharge to either lake. Furthermore, fifteen (15) years of benthic invertebrate community monitoring dating back to 2006 indicates the benthic invertebrate communities at TPN and WAL are stable relative to baseline/reference conditions (Azimuth, 2021).

Baker Lake was formally incorporated into the CREMP in 2008 to monitor changes in the receiving environment associated with increased barge traffic, materials handling, and fuel storage. Over the 13 consecutive years that the full scope of the CREMP has been conducted at Baker Lake there has been no evidence suggesting that barge-related activities are impacting water or sediment quality or the health of the phytoplankton and benthic invertebrate communities. Water chemistry and phytoplankton community sampling will continue on a monthly basis during the open water season at TPN, WAL, and the Baker Lake study areas. If there are concerns regarding potential impacts to the benthic community in years where monitoring is not scheduled (e.g., in response to changes in water quality, phytoplankton community or spills to the receiving environment), then follow-up benthic invertebrate sampling may be conducted as a targeted study, leveraging the long-term dataset, to assess potential effects to the benthic invertebrate community.

If the proposed change to a 3-year cycle for benthic invertebrate sampling is approved, the next benthic invertebrate sampling program at TPN, WAL, and Baker Lake is planned for 2023, coinciding with the CREMP sediment coring program and the timing of the Environmental Effects Monitoring (EEM) for the Meadowbank and Whale Tail Pit study areas.

2 AQUATIC RECEIVING ENVIRONMENT MONITORING

2.1 Project Description

Agnico Eagle is the sole owner and operator of the Meadowbank Complex located approximately 75 km north of the hamlet of Qamani'tuaq (also known as Baker Lake) in the Kivalliq region of Nunavut (**Figure 2-1**). The term "Meadowbank Complex" refers to the ore processing facilities and infrastructure at the Meadowbank mine site and the Amaruq property located approximately 50 km to the north, the site of current mining activities. The mine is provisioned primarily with supplies and fuel that arrive by barge during the summer sealift to Baker Lake. Agnico Eagle operates a barge unloading facility and fuel tank farm at the marshalling facility located east of the hamlet.

2.1.1 Meadowbank

Construction at Meadowbank officially started in June 2008, upon receipt of the NWB Type A Water License (2AM-MEA0815; renewed to 2AM-MEA1525 in 2015, amended to 2AM-MEA1526 in 2018 and to 2AM-MEA1530 in 2020). On July 30, 2008, the Department of Fisheries and Oceans Canada (DFO) issued *Fisheries Act* Authorization (NU-03-0191) that allowed the start of in-water construction activities. Dike construction at Second Portage (East Dike) and Third Portage Lake (Bay-Goose Dike) was completed between 2008 and 2010, followed by development of the open pit deposits. The mine officially opened on February 27, 2010, marking the start of the operations period.

Ore was mined from the following deposits over a ten-year period: Portage (Pit A, B, C, D, and E), Goose, and Vault (including Phaser and BB Phaser). Tailings from the Meadowbank deposits were managed within the Tailings Storage Facility (TSF) that was created by dewatering of the northwest arm of Second Portage Lake after construction of the East Dike. From February 2010 to July 2019, approximately 33 million dried tonnes of tailings were deposited to the North and South Cells of the TSF (Agnico Eagle, 2021a). Mining at Meadowbank officially ended in 2019 with the last of the reserves exhausted at Vault, Phaser, and Portage Pit E. Meadowbank remains operational, processing ore from the Whale Tail Pit Expansion Project and managing tailings produced at the mill. The main camp, airstrip, and other mine infrastructure also remain operational.

Throughout the operational phase at Meadowbank, alternatives to tailings disposal in the TSF were evaluated, and in 2016, an Independent Geotechnical Review Panel supported sub-aqueous disposal of tailings in Portage Pit A, Portage Pit E, and Goose Pit as the "best available technology" for managing tailings. On May 24th, 2019, Agnico Eagle was granted an amendment (No.3) to the Water Licence 2AM-MEA1526 authorizing water uses and waste disposal for in-pit tailings disposal. Disposal of tailings in Goose pit started in July 2019 and continued until July 2020. In-pit tailings disposal transitioned to Portage Pit E in August 2020. As outlined in the Pore Water Quality Monitoring Program (Agnico Eagle, 2020), tailings are deposited below the surface at a water depth of approximately 3 m. The final design recommended a minimum of 8 m water cover once the mined-out pits reach capacity. The total maximum capacity of the pits is approximately 44 million tonnes (Mt) of dry tailings (Agnico Eagle, 2021a).

A progressive reclamation and closure strategy is being implemented to reclaim components of the mine and decommission facilities that are no longer operational, while continuing to operate the mill and other infrastructure as new deposits enter production. Progressive closure while the mine remains operational has several advantages, including cost efficiencies by leveraging resources and equipment currently on site, minimizing environmental exposure, and enhancing environmental protection (SNC, 2020). The progressive closure strategy applies to flooding of the open pits, capping of the Portage rock storage facility (RSF) and tailings storage facility (TSF), as well as decommissioning of other infrastructure no longer in use. An overview of the progressive closure strategy is provided below. For a more detailed discussion refer to the *Meadowbank Interim Closure and Reclamation Plan (CRP) Update – 2019* (SNC, 2020).

- **Open pit flooding** – the mined-out open pits (e.g., Goose Pit, Portage, Vault and Phaser/BB Phaser pits) are filling with water naturally, or through both natural inflow and active pumping (e.g., Portage Pits). Goose Pit began filling with natural runoff and groundwater infiltration in 2015. Natural reflooding at the Vault, Phaser and BB Phaser pits started in 2019 and continued in 2020. The Portage Pits are being flooded with reclaim water from Goose Pit now that in-pit disposal of tailings at Goose Pit is complete.
- **In-pit tailings disposal** – The current plan is to alternate tailings deposition between Pit E and Pit A between January 2021 and July 2026:

January ’21 – July ‘22	August ’22 – July ‘23	August ’23 – July ‘25	August ’25 – July ‘26
Pit E – 5.7 Mt	Pit A – 4.18 Mt	Pit E – 8.5 Mt	Pit A – 3.4 Mt

  Water quality of all water sources to the pits (e.g., seepage water, groundwater, TSF reclaim water, and lake water) will be monitored carefully prior to, during and after flooding; the results will be compared to modelled predictions and managed accordingly (see **Section 3**).

- **Portage Rock Storage Facility** – closure and reclamation for the Portage RSF occurred throughout operations with the placement of non-potentially acid generating (NPAG) rock over the side slopes of the potentially acid generating (PAG) RSF. As of 2020, approximately 90% of the Portage RSF has been covered.

- **Tailings Storage Facility** – progressive reclamation (capping) of the TSF started in the winter of 2015 in the North Cell and continued in the North Cell in the winter of 2018 and 2019 (SNC, 2020). Agnico Eagle is exploring options for progressive closure of the South Cell of the TSF taking into consideration current and future operating conditions and capacity for in-pit disposal of tailings.

2.1.2 Whale Tail

The Whale Tail Pit Project is situated within the Amaruq property, a 408 km^2 exploration area on Inuit and federal crown land. Agnico Eagle proposed the Whale Tail Pit Project as a satellite deposit to make use of existing infrastructure at Meadowbank (camp, airstrip, mill, etc.) and extend the life of the operation. Additional infrastructure has been developed at Amaruq to facilitate development of the deposits in the region. The Project was permitted under a separate NWB license, 2AM-WTP1826. The deposit was mined as an open pit in 2019 and commercial production was achieved on September 30th, 2019. Ore is transported using long haul off-road type trucks to the mill at the Meadowbank site for processing.

In 2018, Agnico Eagle submitted a proposal to expand the Whale Tail Pit Project (The Expansion Project) to include a larger footprint for the Whale Tail Pit, the IVR open pit and underground operations. The underground mine will provide access higher grade ore. Construction of the underground mine is on-going, with production slated to start in 2022[2]. Known reserves as part of the Expansion Project are predicted to extend commercial production to 2026.

Major construction activities at Whale Tail from 2018 to 2020 included the following:

- Dike construction in Whale Tail Lake, and subsequent formation of the Impoundment connecting the South Basin of Whale Tail Lake with Lake A65, Lake A20, and A63 (**Figure 2-3**). Changes in mercury are evaluated within the Mercury Monitoring Plan (Agnico Eagle, 2019).
- Fishout of the isolated north Basin of Whale Tail Lake
- Road construction between the Whale Tail dike and the waste rock storage facility (WRSF) north of Mammoth Lake
- Expansion of the camp infrastructure
- Dike and road construction around Mammoth Lake
- Dewatering and surface water management at Whale Tail Lake and Mammoth Lake

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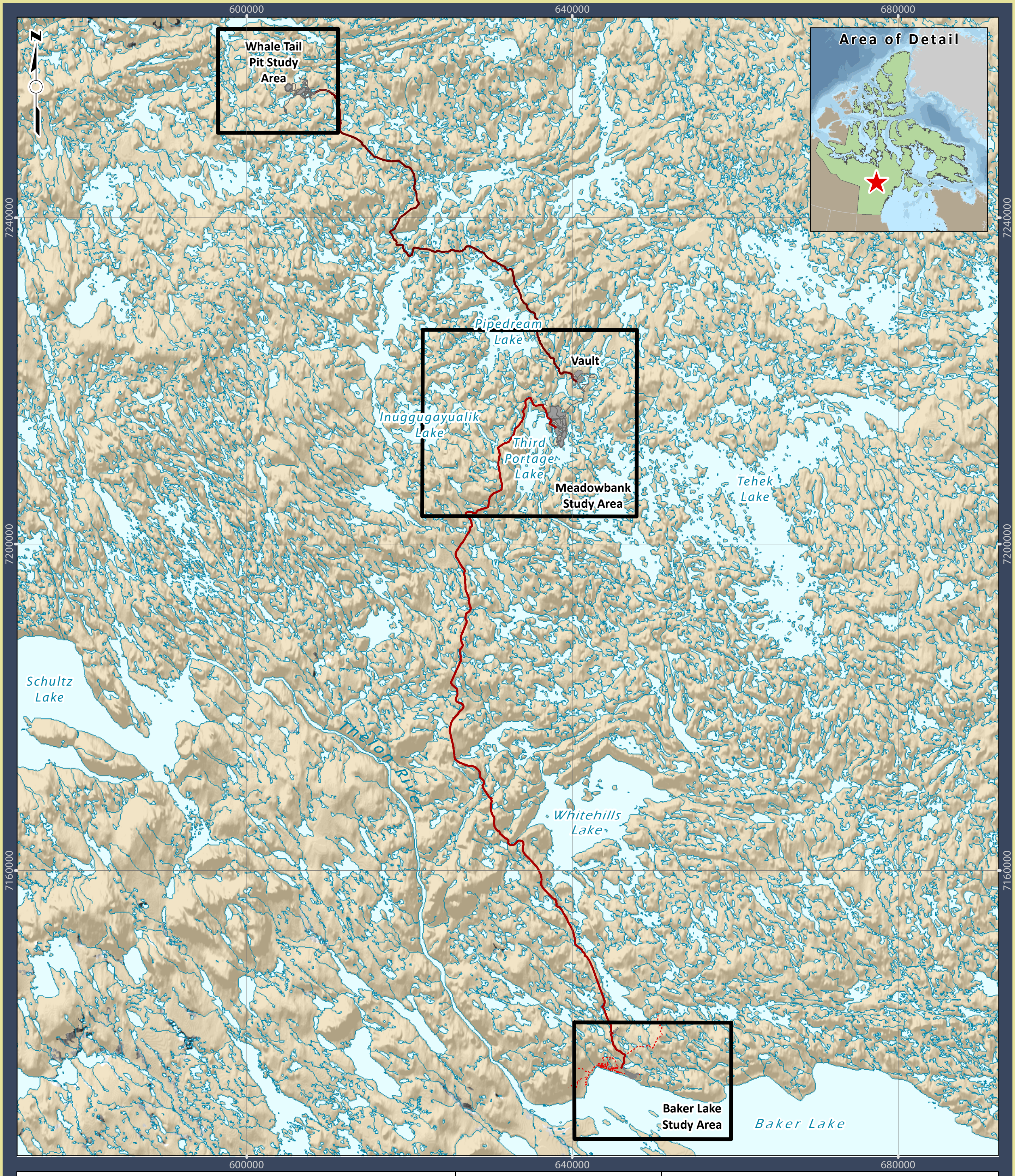
[2] https://www.agnicoeagle.com/English/operations/operations/meadowbank/default.aspx

- Construction of the South Whale Tail Channel between the newly formed Impoundment and Mammoth Lake to manage water levels
- Dewatering and fishout of lakes in the footprint of the IVR Pit and IVR WRSF and the future attenuation pond
- Completion of the IVR diversion channel

2.1.3 Baker Lake

The hamlet of Qamani’tuaq, or Baker Lake, is located on the northwest shore of Baker Lake and is the point of entry for fuel, equipment and goods arriving by barge. Open water access to the hamlet from Chesterfield Inlet on Hudson Bay is limited to approximately 2.5 months from the end of July through to mid-October, depending on annual ice conditions. Goods and fuel typically travel from Quebec, around Labrador, and through Hudson Straight. Cargo and fuel tanker vessels moor in Chesterfield Inlet and shallow draft ships or barges pulled by tugs are used to navigate the channel that connects Baker Lake with Chesterfield Inlet. Dry goods are transferred at a floating dock located at Agnico Eagle’s Marshalling Facility east of the hamlet. Fuel is transferred from the barges to an 80-million-liter capacity tank farm located upgradient from the floating dock. Equipment, goods, and fuel are trucked year-round from the hamlet to Meadowbank via 110 km all-weather access road (AWAR) completed by Agnico Eagle in 2008.

Monitoring at Baker Lake began in 2008, coinciding with the first barge season. The number of barge trips for fuel and goods have increased from less than 30 in 2008 and 2009 to between 35 and 40 over the eight-year period from 2010 to 2017. The number of shipments increased in 2018 (36 goods; 19 fuel) and 2019 (34 goods; 24 fuel) coinciding with construction of mine infrastructure at Amaruq. In 2020 there were a total of 43 shipments (22 goods; 21 fuel) arrived at the Marshalling Facility (Azimuth, 2021).



Legend

▭ Figure Extents

▨ Mine Sites

— All-Weather Access Road

— Whale Tail Haul Road

~ River

Lake

0 5 10 15 20

Kilometres

Projection: UTM Zone 14 NAD83

Data Sources:
Natural Resources Canada, GeoBase®
National Topographic Database
Agnico-Eagle Mines Limited.
Azimuth Consulting Group Inc.

Figure 2-1. Meadowbank Complex Study Area Overview CREMP – 2021 Plan Update

Meadowbank Complex

Prepared for: AGNICO EAGLE

By: CASLYS CONSULTING

June 2021

2.2 Potential Impacts to the Aquatic Environment

The CREMP was designed to identify impacts to the aquatic receiving environment from activities related to construction and operation of the Project. Key mining activities and their potential impact to the aquatic environment were described in detail in the 2005 AEMP. An overview of recent development and key mining activities are presented in the annual CREMP report to provide context for interpreting potential changes in water quality, sediment quality, and biological community metrics. Activities with the greatest potential to affect the aquatic environment are summarized below.

- Dike construction (East Dike [2008], Bay-Goose Dike [2009-2010], Vault Dike [2013], Whale Tail and Mammoth Dikes [2019], IVR Dike [2021])
- Dewatering – recent dewatering activities are limited to the Whale Tail Pit Expansion Project:
    - Dewatering of the North Basin of Whale Tail Lake to the South Basin started in March 2019 and concluded in May 2020.
    - Several small lakes in the vicinity of the IVR deposit were dewatered in August and September 2020 prior to developing the open pit.
- Effluent Discharge
    - Meadowbank – East Dike Seepage Discharge in Second Portage Lake became subject to the MDMER on January 6th, 2014. Seepage is collected from two locations (South and North seepage) and discharged through a common diffuser in Second Portage Lake. As of 2020, the East Dike discharge to Second Portage Lake is the only MDMER receiving environment at Meadowbank.
    - Whale Tail – During the operations phase, treated water is discharged to Mammoth Lake and Whale Tail Lake (South Basin) from the Whale Tail and IVR Attenuations Ponds. Seepage through the Whale Tail Dike is collected in a sump. The seepage is not currently discharged back into Whale Tail Lake but may be discharged to the lake in the future.
- Dust from general site-related activities (e.g., rock crushing, road building, pit blasting, ore and waste hauling, ground preparation, vehicle (truck and aircraft) traffic, infrastructure construction)
- Barge traffic (specific to Baker Lake)
- Spills

A chronological overview of these activities will continue to be included the annual CREMP report. The list of activities up to the end of 2020 are presented in the 2020 CREMP Report (Azimuth, 2021).

2.3 Study Design

2.3.1 Objective

The CREMP is the broad-scale monitoring program designed to detect potential short-term and long-term impacts to the aquatic receiving environment related to activities at the Site. The sampling program is designed to detect changes at the scale of lakes or basins within large lakes and define the extent (both spatially and temporally) of changes in water quality, sediment chemistry, or biological communities (phytoplankton and benthic invertebrates) downstream of mining activities. In this regard, the CREMP is the most important monitoring program for evaluating potential impacts to the aquatic receiving environment and verifying impact predictions presented in Environmental Impact Statements for Meadowbank (Cumberland, 2005) and the Whale Tail Pit Expansion Project (Agnico Eagle, 2018).

2.3.2 Sampling Areas and Designations

The CREMP study design is based on a before-after-control-impact (BACI) approach but also incorporates a gradient design with monitoring locations positioned close to potential impacts as well as farther downstream. Tracking spatial and temporal differences related to mining activities involves categorizing areas based on two considerations: 1) the proximity of the area to the mine (i.e., Area Type) and 2) when the area transitioned from the baseline period to the exposure period (i.e., Area Status).

- **Area Type** – this concept relates to an area's spatial proximity to the planned mine development (i.e., whether built or not); categories include near-field (NF), mid-field (MF), far-field (FF), and reference. Near-field areas provide the first line of early warning for introductions of stressors into the receiving environment. These areas are situated closest to potential sources of impact to the aquatic environment such as dikes and point-source discharges from dewatering and effluent sources. The MF designation was added in 2011 to be consistent with the area categorizations used in the CREMP Design Document 2012 (Azimuth, 2012). The MF and FF areas are located farther downstream from the NF monitoring areas and provide insights into the spatial extent of any observed changes in chemistry or biological communities closer to the source.
- **Area Status** – this concept is temporal and has two levels: control (not exposed to mine-related activity) or impact (exposed to mine-related activity). The term "impact" is taken from the BACI statistical study design approach and does not mean that an actual impact has taken place; rather, it designates a time period when potential mine-related impacts may occur for an area (i.e., that an area has been exposed to one or more mining activities).

Together, area categorization by 'type' and 'status' provides a logical framework to identify mining-related changes to the aquatic receiving environment (as opposed to natural regional changes due to climate or other factors).

The onset of construction activities in proximity to a CREMP monitoring area formally ends the baseline phase and changes the status of that area from "control" to "impact". Status changes are also important for any statistical analyses, as they dictate how data are grouped when assessing potential trends. Note that the end of the baseline phase is specific to each area.

The status of the CREMP areas since monitoring started is provided in **Table 2-1**.

Reference Lakes for Meadowbank and Whale Tail Study Areas

Reference areas are sufficiently removed from mine activities that they are presumed to be unaffected by any infrastructure and point sources (e.g., aerial deposition and effluent) associated with mine development and activities. Monitoring of reference areas is important in order to distinguish between possible mine-related changes in water quality or ecological parameters and natural changes, unrelated to the mine. Two reference areas are shared for the Meadowbank and Whale Tail programs: Inuggugayualik Lake (INUG) and Tasirjuaraajuk Lake (aka Pipedream Lake [PDL]). INUG and PDL are headwater lakes and flow north into the Arctic Ocean. Despite being in different drainage basins compared to the Meadowbank and Whale Tail study areas, both these lakes satisfy the requirements of an external reference lake from a physical/chemical perspective given they are 1) located at a similar latitude, 2) have similar geology and climate, 3) do not have any significant inflows and 4) they have similar limnological features, water chemistry and aquatic biological community structure to the project lakes (BAER, 2005). Pipedream Lake was originally investigated as a potential reference area for fisheries programs in 1998 (EVS, 1999).

INUG has been the core reference area since formal monitoring began in 2006. PDL was added to the Meadowbank CREMP in 2009; while the absence of data at this area from 2006 to 2008 makes it of limited value for the BACI statistical analyses for Meadowbank study areas, the additional reference data does provide insights into the strength of regional patterns (i.e., how well it matches INUG). In the case of the Whale Tail Pit study lakes, INUG and PDL are both used in the BACI statistical analysis (year 1 of baseline monitoring occurred in 2015 for the Whale Tail Pit Project).

Meadowbank

Four lakes in the vicinity of the Meadowbank mine are monitored as exposure areas for the CREMP: Second Portage Lake, Third Portage Lake, Wally Lake, and Tehek Lake. The NF areas in Second Portage Lake (SP), Third Portage Lake (TPE and TPN), and Wally Lake (WAL) were established because of their proximity to dikes or because they were receiving environments for dewatering during construction, seep water from dikes, or treated contact water. TPN was the receiving environment during the dewatering of the northwest arm of Second Portage Lake and for water from the Portage Attenuation

Pond during the initial years of operations (2009 to 2014)[3]. WAL was the receiving environment for contact water collected during mining of the Vault and Phaser Pits. Discharge to WAL ceased in October 2017. SP is the receiving environment for seepage from the East Dike and is the only receiving environment in operation at Meadowbank. TPE was an important monitoring area during Bay-Goose Dike construction in 2009 and 2010. TPS was an internal reference area in the 2005 AEMP, but given the connectivity to TPN, TPS is more appropriately considered a MF area.

Surface water from Second and Third Portage Lakes and from Wally Lake meet at the southern end of Second Portage Lake and discharge via a single channel into Tehek Lake. As mentioned earlier, the MF and FF areas were established in Tehek Lake to provide insights into the spatial extent of any effects observed at the NF areas. The full CREMP monitoring program (water, sediment, phytoplankton, and benthic invertebrates) was completed annually at TE and TEFF until 2014. Beginning in 2015, an adaptive monitoring strategy was implemented for Tehek Lake (and TPS) that factored in the results at the upstream NF areas when deciding the frequency of monitoring downstream. The revised sampling strategy was put forward in the CREMP: 2015 Plan Update (details in **Section 2.3.5** below).

The Meadowbank sampling areas are shown in **Figure 2-2.**

Whale Tail

The Whale Tail Pit Expansion Project is in an upland area surrounded by several small headwater lakes. There are currently six lakes included in the Whale Tail Pit CREMP: the south basin of Whale Tail Lake (WTS), Mammoth Lake (MAM), Lake A20, Lake A76, Lake DS1, and Nemo Lake (NEM). WTS and MAM are NF areas closest to the development and are the early warning monitoring locations for impacts related to dike construction, dewatering, and discharge of treated contact water. Permanent diffusers are in Mammoth Lake and Whale Tail Lake south basin as part of the water management plan for Whale Tail. Construction of the Whale Tail Dike raised the water level in the south basin of Whale Tail Lake and connected Lake A20 and other headwater lakes. Lake A20, which was upstream of Whale Tail Lake south basin, is now downstream from Whale Tail Lake and is considered a NF for the CREMP and Mercury Monitoring Plan (Agnico Eagle, 2019). Nemo Lake (NEM) is located north of the Project in a separate drainage from Whale Tail Lake and Mammoth Lake. Nemo Lake is the freshwater source for water used at the camp. For the purpose of the CREMP, NEM is considered a NF area because of its proximity to the IVR deposit. Lake A76 is located downstream from MAM and serves as the MF monitoring area. Lake A76 is situated at the junction of the two flow paths leading to Amur Lake (referred to herein as Lake

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[3] The last day of discharge to the north basin of Third Portage Lake occurred on July 5, 2014. ECCC was informed in 2019 that the final discharge point (ST-MMER-1 / ST-9) for the Water Treatment Plant was no longer in use and has been permanently dismantled.

DS1). Lake DS1 is the FF location and provides information on the spatial extent of potential changes detected farther upstream at Mammoth Lake and Lake A76.

The Whale Tail sampling areas are shown in **Figure 2-3**.

Baker Lake

There are two NF areas for the Baker Lake CREMP, one targeting the hamlet's barge landing area (Baker Barge Dock [BBD]) and the Baker Proposed Jetty[4] (BPJ) located adjacent to the Marshalling Facility. The primary reference area for Baker Lake is located approximately 8 kilometers to the east of the hamlet along the north shore of the lake (Baker Akilahaarjuk Point [BAP]). A second reference area on the East Shore of Baker Lake (BES) between BAP and BPJ was added in 2011 to provide additional context for interpretation of sediment chemistry and benthic invertebrate data.

The sampling areas for the Baker Lake CREMP are shown in **Figure 2-4**.

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[4] Note that while a jetty was initially considered, the idea was abandoned in favor of continued use of the existing barge landing.

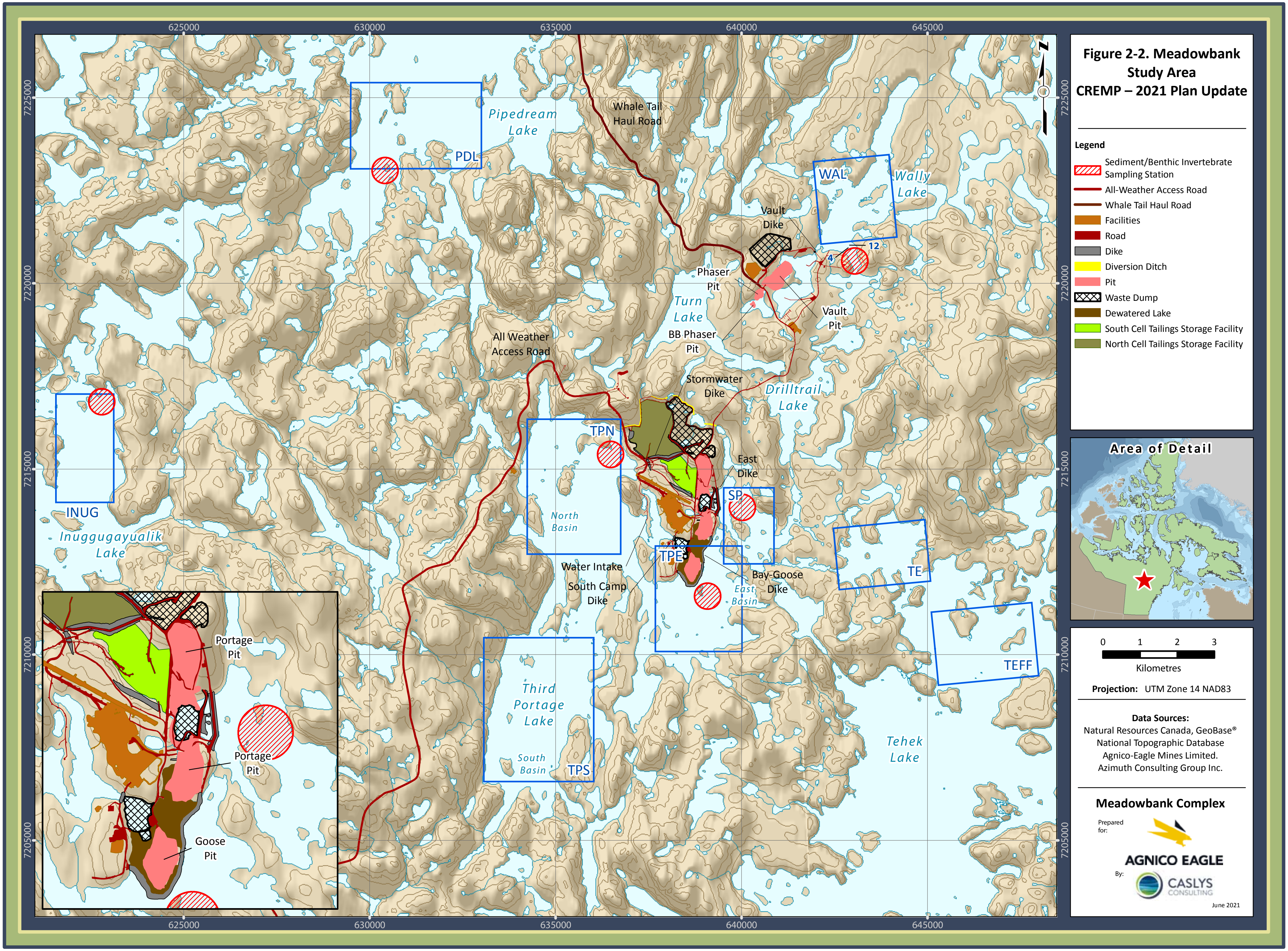

Figure 2-2. Meadowbank Study Area CREMP – 2021 Plan Update

Projection: UTM Zone 14 NAD83

Data Sources:
Natural Resources Canada, GeoBase®
National Topographic Database
Agnico-Eagle Mines Limited.
Azimuth Consulting Group Inc.

Meadowbank Complex

Prepared for:
AGNICO EAGLE

By:
CASLYS CONSULTING

June 2021

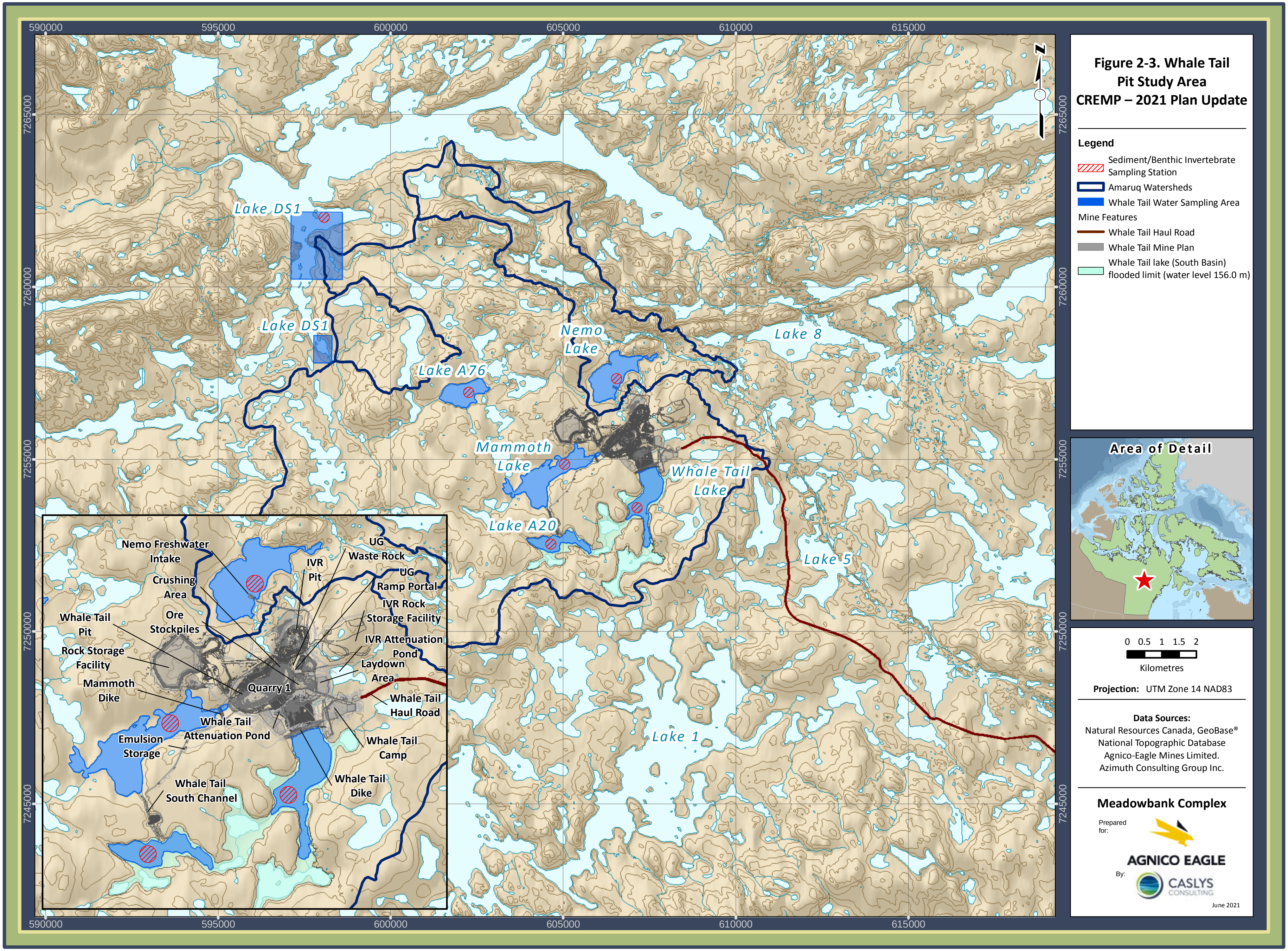

Figure 2-3. Whale Tail Pit Study Area CREMP – 2021 Plan Update

Legend

- ▨ Sediment/Benthic Invertebrate Sampling Station
- ▭ Amaruq Watersheds
- 🟦 Whale Tail Water Sampling Area

Mine Features

- — Whale Tail Haul Road
- ■ Whale Tail Mine Plan
- ▭ Whale Tail lake (South Basin) flooded limit (water level 156.0 m)

Projection: UTM Zone 14 NAD83

Data Sources:
Natural Resources Canada, GeoBase®
National Topographic Database
Agnico-Eagle Mines Limited.
Azimuth Consulting Group Inc.

Meadowbank Complex

Prepared for:
AGNICO EAGLE

By:
CASLYS CONSULTING

June 2021

Legend

- ☐ Baker Lake Water Sampling Area
- ▨ Sediment/Benthic Invertebrate Quality Sampling Area
- — All-Weather Access Road
- — Whale Tail Haul Road

0 5 10 15
Kilometres

Projection: UTM Zone 14 NAD83

Data Sources:
Natural Resources Canada, GeoBase®
National Topographic Database
Agnico-Eagle Mines Limited.
Azimuth Consulting Group Inc.

Figure 2-4. Baker Lake Study Area CREMP – 2021 Plan Update

Meadowbank Complex

Prepared for: AGNICO EAGLE

By: CASLYS CONSULTING

June 2021

Table 2-1. Status of all CREMP areas since the beginning of monitoring

	Meadowbank Areas									Baker Lake Areas				Whale Tail Pit Areas					
Designation	REF		NF				MF		FF	REF		NF		NF				MF	FF
Area	INUG	PDL	TPN	SP	TPE	WAL	TPS	TE	TEFF	BAP	BES	BBD	BPJ	WTS	MAM	NEM	A20	A76	DS1
2006	C		C	C	C	C	C	C											
2007	C		C	C	C	C	C	C											
2008	C		C	I (Aug)	C	C	C	I (Aug)		C		I	I						
2009	C	C	I (Mar)	I	I (Aug)	C	C	I	C	C		I	I						
2010	C	C	I	I	I	C	C	I	C	C		I	I						
2011	C	C	I	I	I	C	C	I	C	C	C	I	I						
2012	C	C	I	I	I	C	C	I	C	C	C	I	I						
2013	C	C	I	I	I	I (Jul)	C	I	C	C	C	I	I						
2014	C	C	I	I	I	I	C	I	C	C	C	I	I	C	C	C			
2015	C	C	I	I	I	I	C	I	C	C	C	I	I	C	C	C			
2016	C	C	I	I	I	I	C	I	C	C	C	I	I	C	C	C	C	C	C
2017	C	C	I	I	I	I	C	I	C	C	C	I	I	C	C	C	C	C	C
2018	C	C	I	I	I	I	C	I	C	C	C	I	I	I (Aug)	I (Nov)	C	C	C	C
2019	C	C	I	I	I	I	C	I	C	C	C	I	I	I	I	I (Aug)	I	I	I
2020	C	C	I	I	I	I	C	I	C	C	C	I	I	I	I	I	I	I	I
2021	C	C	I	I	I	I	C	I	C	C	C	I	I	I	I	I	I	I	I

Notes:

Area designations:

C=Control; I=Impact; REF=reference (in grey shading); NF=near-field (in blue shading); MF=mid-field (in pink shading); FF=far-field (in teal shading).

Blank cells indicate the area was not part of the monitoring program that year.

Area IDs:

Meadowbank and Whale Tail Pit Reference areas: INUG = Inuggugayualik Lake; PDL = Pipedream Lake.

Meadowbank: TPN, TPE, TPS = Third Portage Lake - North, East, South basins; SP = Second Portage Lake; WAL = Wally Lake; TE, TEFF = Tehek Lake (Mid-and Far-field).

Baker Lake areas: BAP, BES, BBD, BPJ=Baker Lake - Akilahaarjuk Point, East Shore, Barge Dock, Proposed Jetty.

Whale Tail Pit areas: WTS = Whale Tail Lake South Basin; MAM = Mammoth Lake; NEM = Nemo Lake; A20 = Lake A20; A76 = Lake A76; DS1 = Lake DS1.

2.3.3 Monitoring Components

CREMP monitoring has included the following components in one or more years since 2006: limnology, water chemistry, sediment chemistry, phytoplankton, periphyton, benthic invertebrates, and zooplankton. Fish are monitored as part of the Environment Effects Monitoring (EEM) Program on a 3-year cycle; findings from the EEM are included as a component of the AEMP. The CREMP Design Document 2012 (Azimuth, 2012) included recommendations on sample timing, frequency, and the number of samples required (sampling effort). These recommendations (which were subsequently approved) were based on statistical testing and power analysis that determined the statistical power to detect a change in a particular variable from baseline levels to the relevant trigger value. Zooplankton and periphyton[5] were dropped from the CREMP, as both had low statistical power to detect effects.

Limnology, water chemistry, sediment chemistry, phytoplankton, and benthic invertebrates are the core monitoring components for CREMP and are described below.

- **Limnology** – Water quality profiles are completed as part of the routine water quality monitoring program. Measurements of water temperature (°C), dissolved oxygen (mg/L), pH, and conductivity (µS/cm) are recorded at 1 m intervals from the surface to within approximately 1 m of the sediment. Other information recorded at the time of sampling includes weather observations, coordinates, total water depth, and Secchi depth (m).
- **Water Chemistry** – Water sampling for the Meadowbank and Whale Tail Pit CREMP is conducted up to five times per year at reference and exposure areas. (**Section 2.3.4**). Areas where winter (through-ice) sampling is recommended are preferentially sampled in March and May. Open water sampling is conducted monthly in July, August, and September. The Baker Lake water quality program is conducted during the open-water season, coinciding with the barge season.
- **Phytoplankton Community** – Phytoplankton sampling and water sampling occur at the same locations. Analysis of the phytoplankton community data is limited to samples collected during the open water period (July, August, and September). Samples from Meadowbank and Whale Tail study areas collected during the winter sampling events are archived for possible analysis depending on the results of the open water data.
- **Sediment Chemistry** –Sediment coring is conducted on a 3-year cycle to assess changes in metals concentrations. Sediment coring is undertaken the same general area as benthic invertebrate sampling. Ten independent samples per impact area should be collected, and 5 samples submitted for analysis. Analysis of the remaining replicate samples can be determined

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[5] Periphtyon sampling is conducted on a 2-year cycle (odd years) as part of the Habitat Compensation Monitoring Program at Meadowbank.

on a station-by-station basis depending on the outcome of the first set of analyses. Collecting 5 independent replicate samples at the reference areas is sufficient as changes are assessed using a BA (before-after) design (i.e., as temporal changes in sediment chemistry are not expected to occur naturally in these low sedimentation environments).

- **Benthic Invertebrate Community** – Benthic invertebrate community sampling is conducted in early to mid-August as per the sampling strategy specific to each area. Five replicate samples are collected in each area along with sediment for particle size and total organic carbon.

2.3.4 Sampling Methods

Sampling for the CREMP program is undertaken according to the Standard Operating Procedures (SOPs) for each of the monitoring components. The SOPs are appended herein and include general information on field collections, as well as detailed information on the location and timing of sampling, pre-trip planning, field collection materials, field quality assurance/quality control protocols, step-by-step instructions on sample collection, bottle requirements and list of parameters, sample preservation, and sample handling and transportation.

Proposed changes to the frequency of sampling for the various monitoring components are outlined in **Section 2.3.5**.

Limnology, Water Chemistry and Phytoplankton

During each sampling event, limnology data, water chemistry samples, and phytoplankton samples are collected from two locations in each sampling area (i.e., lake or basin within a lake). The specific location coordinates are selected randomly for each sampling where the total water depth is at least 5 m. Sampling locations for Meadowbank and Baker Lake are generated randomly within defined areas (blue polygons) shown in **Figure 2-2** (Meadowbank) and **Figure 2-4** (Baker Lake). Random-selection of coordinates occasionally results in sampling locations being selected in areas with less than 5 m total water depth. In these situations, the field crew will move the sampling location away from shore to ensure a depth of at least 5 m is obtained.

Lakes monitored for the Whale Tail Pit CREMP are generally shallower, and more variable in their depth, which isn't conducive to randomly selecting sampling locations with a high probability of being in at least 5 m of water. Instead, a few fixed monitoring locations were established in each lake, and for each sampling event, two of the locations are randomly selected.

Limnological parameters include a Secchi depth measurement and vertical profiling for temperature (°C), dissolved oxygen (mg/L), specific conductivity (µS/cm), and pH at every meter from surface to 1 m off the bottom (or up to 20 m). If, during an open-water sampling month (July-September), a vertical profile shows abnormally low dissolved oxygen, or abnormally high conductivity or temperature for a particular depth, then a water chemistry sample is collected from that depth and analyzed alongside the other water chemistry samples (see below).

Water chemistry samples are collected from approximately 3 m depth[6] by pumping lake water through a flexible (food-grade silicone) tube using a 12-V diaphragm pump. Water is pumped directly into sample bottles or filtered using a 0.45 µm syringe disc filter for dissolved parameters (sample bottle and preservative requirements are listed in Table 1 of **Appendix A1**). Water chemistry parameters include physical tests, anions and nutrients, organic and inorganic carbon, chlorophyll-a, cyanide, and total and dissolved metals. A full detailed list of parameters is shown in Table 2 of **Appendix A1**. Cyanide use is limited to the mill at Meadowbank, and therefore is not included in the suite of analyses for water samples collected from the Whale Tail Pit and Baker Lake study areas.

Phytoplankton samples are collected from the same depth (3 m) and pump system used for water chemistry samples, prior to attaching a filter. Samples are preserved with a few drops of Lugol's solution and sent for taxonomic identification and biomass analyses.

Sampling procedures for limnology, water chemistry, and phytoplankton are addressed together in one SOP (**Appendix A**).

Benthic Invertebrates and Sediment Grab Chemistry

Benthic invertebrates and sediment chemistry grab samples are collected concurrently from five locations (replicates) in each sampling area in August. Sampling locations are selected in areas where the water depth is 8.0 m ± 1.5 m. The sampling areas are shown in **Figure 2-2** (Meadowbank), **Figure 2-3** (Whale Tail), and **Figure 2-4** (Baker Lake). The depth zone is limited to this narrow range to reduce the influence of depth-related variability on the analyses.

Benthic invertebrates are collected first in the sequence, using a Petite Ponar grab (6”x6”; 0.023 m^2) and a 500-µm sieve. Two independent grabs per replicate are composited to form a single sample to reduce sampling variation within areas and to increase the surface area sampled. Samples are preserved in the field with a 10% buffered formalin solution and sent for taxonomic identification and analysis.

Sediment grab chemistry samples are collected second in the sequence, from the same depth and grab sampler used for benthic invertebrates. The top 3-5 cm of sediment from two independent grabs per replicate are homogenized in a bowl. Sediment is scooped into sample jars for analysis of pH and moisture, particle size and organic carbon. In previous years, sediment grab samples were also submitted for metals analysis to help inform temporal changes in sediment chemistry in years when coring wasn't completed. This adaptive approach to sediment sampling was particularly useful in the

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[6] This depth was selected to provide a consistent depth at which to sample during any season, including during winter months when ice thickness can exceed 2 m.

targeted study looking at potential changes in sediment chromium concentrations in the East Basin of Third Portage Lake caused by erosion of ultramafic waste rock from the Bay-Goose Dike (Azimuth, 2020b).

Another scoop of sediment is set aside from each of the 5 replicate locations, homogenized and placed into a sample jar for the following chemistry parameters: aggregate organics, hydrocarbons, and polycyclic aromatic hydrocarbons (PAHs). A full detailed list of parameters is shown in Table 1 of **Appendix A2**.

Sampling procedures for benthic invertebrates and sediment grab chemistry are addressed together in one SOP **Appendix A2**.

Sediment Coring Chemistry

Sediment coring is conducted every three years in August, coinciding with the timing of the EEM cycle (2020, 2023, etc.). Sediment cores are collected in the vicinity of where benthic invertebrate sampling is completed. Ten replicate samples are collected from each area. A minimum of five replicate samples are submitted for analysis, but all 10 samples may be submitted to achieve better statistical power or provide a more accurate understanding of small spatial differences in sediment chemistry within the basin.

Sediment cores are collected using a hand-operated gravity corer (barrel diameter of 7 cm). The top 1.5 cm of sediment from one independent core per replicate is sampled. Sediment is transferred into a sample jar for the following chemistry parameters: pH, total organic carbon, and metals.

The procedure for collecting sediment cores for chemistry is included as **Appendix A3**.

2.3.5 Sampling Strategy

The original monitoring strategy in the 2005 AEMP clearly stated that future monitoring results would be used to make informed decisions about how to improve the program without compromising early detection of changes in the environment:

> *By critically examining the ongoing results of the AEMP over time, those components of low value should be eliminated and additional components (to reflect findings or new activities) should be added if required. This streamlining will ensure that the monitoring program focuses on issues that are relevant to the program objectives.*

The full complement of CREMP sampling was completed at the NF, MF, and FF areas during the construction and early operations phases until the spatial and temporal extent of potential impacts to the receiving environment from dike construction and discharge of effluent and dewatering activities were better understood. By 2014, monitoring data from the ‘after period’ showed only minor episodic changes in water quality at the MF areas for parameters without effects-based thresholds (e.g., major ions). Furthermore, biological communities at NF areas closer to the mine were similar to baseline/reference conditions, which provided additional evidence in support of an update to the CREMP sampling strategy.

An update to the sampling strategy for the Meadowbank study areas was presented in the CREMP: 2015 Plan Update (Azimuth, 2016). The sampling strategy was based on the expectation that changes in the aquatic receiving environment caused by activities at the mine will be detected at the NF area(s) before the MF and FF areas. A more focused and efficient monitoring strategy was developed where the frequency of monitoring at the MF and FF areas was determined based on results at the upstream monitoring areas in the previous year (e.g., results at SP determines the monitoring strategy at TE). The strategy was implemented from 2015 through 2021 according to the following criteria:

- **No changes** – no statistical changes above any trigger values at the NF areas meant no further sampling was required at the MF and FF areas.
- **Minor changes** – statistically significant changes exceeding the early warning trigger values for parameters without effects-based threshold values (i.e., trigger values are based on the 95th percentile of the baseline distribution). Spot sampling through-ice is required to determine if changes extend to MF area (or to FF if such changes are seen at an MF area).
- **Moderate changes** – statistically significant changes exceeding the early warning trigger values for parameters with effects-based thresholds (e.g., CCME water quality guidelines for water chemistry parameters). Full CREMP water sampling (all events) is required to determine if changes extend to MF area (or to FF if such changes are seen at an MF area).
- **Major changes** – statistically significant changes exceeding the effects-based threshold values. Full CREMP program (i.e., including sediment and biological components) is required to determine if changes extend to MF area (or to FF if such changes are seen at an MF area).

Between 2015 and 2021, ‘minor changes’ in water quality at the NF areas (SP, WAL, TPN, and TPE) triggered 1 sampling event at TE, TEFF, and TPS, typically in March, to verify there were no substantial changes in water quality downstream. Winter was selected as the optimal time to sample to get an early indication of water quality each year and avoid having to sling a boat by helicopter to Tehek Lake.

Proposed Changes to the Sampling Strategy Beginning in 2022

The revised sampling strategy for each area by season and month is summarized in **Table 2-2**. Details of the proposed changes to the sampling strategy are provided below.

Meadowbank CREMP

The Meadowbank Project has transitioned from the active mining phase to late operations since the CREMP Plan was update. The end of mining operations at Meadowbank means there are fewer activities with the potential to directly impact the receiving environments in SP, TPN, TPE, and WAL (see

Section 2.3.2). Of the NF areas, SP is most susceptible to mining-related changes due to discharge of seepage from the East Dike. Dust deposition and aerial emissions are considered minor sources relative to impacts associated with dike construction and effluent discharge, and in both cases the potential impacts are confined to the open-water period. Overall, the long-term data set for the NF areas has consistently shown only minor changes in water quality relative to baseline/reference conditions. The changes are evident mainly in ionic constituents (e.g., calcium, magnesium, chloride); parameters with effects-based thresholds are typically well below their respective trigger values and there have not been any statistically significant changes relative to baseline/reference conditions for the past several years. Based on the stable water quality dataset, the following changes to sampling strategy at Meadowbank are recommended beginning in 2022:

- **Water Chemistry and Limnology**
    - SP – no change to the frequency of water sampling and limnology profiles; continue collecting 1 limnology profile in January, February, April, November, and December to characterize under-ice conditions in months when water sampling isn’t completed.
    - TPN, TPE, and WAL – The long-term data set supports reducing the frequency of water sampling in Third Portage Lake and Wally Lake from 5 events per year to 3 events per year during the open-water period (July, August, and September). Winter limnology profiles can be discontinued.
    - TPS, TE, and TEFF – Water sampling at the MF and FF areas can be discontinued. Sampling at the MF areas may resume if monitoring data from the NF areas suggest there are “moderate changes” in water quality defined as statistically significant increases exceeding the early warning trigger for parameters with effects-based thresholds (i.e., CCME FWAL).
- **Phytoplankton** – no change to the frequency of phytoplankton sampling is proposed at this time. Sampling will coincide with monthly open-water sampling in July, August, and September.
- **Benthic invertebrates (and supporting sediment chemistry)**
    - SP – annual monitoring of the benthic invertebrate community monitoring at SP is recommended while seepage from the East Dike is discharged to Second Portage Lake.
    - TPE – annual monitoring of the benthic invertebrate community is recommended in 2022 and 2023 to verify that the benthic invertebrate community is unimpacted by chromium that accumulated in sediments after construction of the Bay-Goose Dike. Provided the community remains stable, the frequency of monitoring may be reduced to the same 3-year cycle as TPN and WAL.
    - TPN and WAL – a reduction in the frequency of benthic invertebrate sampling from annually to a 3-year cycle is recommended given discharge to both lakes has ceased and the benthic

invertebrate communities are stable relative to baseline/reference conditions. The next sampling event is scheduled for 2023.

Baker Lake CREMP

The full CREMP program (water, phytoplankton, benthic invertebrates) has been completed annually since 2008. Thirteen years of monitoring data (2008-2020) has demonstrated that barge activity is not contributing to persistent changes in water quality or sediment chemistry or impacting to the health of the phytoplankton and benthic invertebrate communities. Beginning in 2022, the revised sampling strategy for the Baker Lake CREMP is follows:

- **Water chemistry** – no changes are proposed at this time. The monthly sampling events in July, August, and September provide important information on the potential impacts of barge traffic on water quality in Baker Lake.
- **Phytoplankton** – no changes are proposed to the frequency of sampling (monthly in July, August, and September) for phytoplankton community.
- **Benthic invertebrates (and supporting sediment chemistry)** – a reduction in the frequency of sampling from annually to once every three years beginning in 2023 is recommended. The timing of the 3-year cycle was chosen to coincide with EEM Programs at Meadowbank and Whale Tail. Targeted sampling in "off-cycle years" may be undertaken in response to changes in water quality, phytoplankton community, spills reaching the receiving environment, or other concerns.

Whale Tail CREMP

No changes are recommended to the frequency of sampling at the Whale Tail Pit study areas at this time. The simplified MF and FF monitoring strategy developed for Meadowbank may be implemented at in the future, provided the monitoring results from the NF areas are consistent with changes predicted in the FEIS.

Reference Lakes CREMP

The BACI study design requires paired sampling of water, phytoplankton, and benthic invertebrates at the exposure and reference areas. No changes to the frequency of sampling at the reference lakes (INUG and PDL) are proposed at this time.

Table 2-2. CREMP Monitoring Strategy Starting in 2022.

Month	Conditions	Monitoring Component	Meadowbank Areas									Baker Lake Areas				Whale Tail Pit Areas					
			INUG	PDL	TPN	SP	TPE	WAL	TPS	TE	TEFF	BAP	BES	BBD	BPJ	WTS	MAM	NEM	A20	A76	DS1
			REF	REF	NF	NF	NF	NF	MF	MF	FF	REF	REF	NF	NF	NF	NF	NF	NF	MF	FF
January	Ice	Limno				✓										✓	✓	✓			
February	Ice	Limno				✓										✓	✓	✓			
March	Ice	Limno, Water, Phyto	✓	✓		✓	✓		Suspended							✓	✓	✓	✓	✓	✓
April	Ice	Limno				✓										✓	✓	✓			
May	Ice	Limno, Water, Phyto	✓	✓		✓	✓		Suspended							✓	✓	✓	✓	✓	✓
June	**Not safe**																				
July	Open-water	Limno, Water, Phyto	✓	✓	✓	✓	✓	✓	Suspended			✓		✓	✓	✓	✓	✓	✓	✓	✓
August	Open-water	Limno, Water, Phyto	✓	✓	✓	✓	✓	✓	Suspended			✓		✓	✓	✓	✓	✓	✓	✓	✓
		Benthos + TOC&PSA	✓	✓	3yr	✓	3yr	3yr				3yr	3yr	3yr	3yr	✓	✓	✓	✓	✓	✓
		Coring (3 yr cycle)	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
September	Open-water	Limno, Water, Phyto	✓	✓	✓	✓	✓	✓	Suspended			✓		✓	✓	✓	✓	✓	✓	✓	✓
October	**Not safe**																				
November	Ice	Limno				✓										✓	✓	✓			
December	Ice	Limno				✓										✓	✓	✓			

Notes:

✓ = monitoring components collected annually; 3yr = possible change to the frequency of monitoring from annual to 3-year cycle beginning in 2023.

Area designations:

C=Control; I=Impact; REF=reference (in grey shading); NF=near-field (in blue shading); MF=mid-field (in pink shading); FF=far-field (in teal shading)

Area IDs:

Meadowbank and Whale Tail Pit Reference areas: INUG = Inuggugayualik Lake; PDL = Pipedream Lake. Meadowbank areas: TPN, TPE, TPS = Third Portage Lake – North, East, South basins; SP = Second Portage Lake; WAL = Wally Lake; TE, TEFF = Tehek Lake (Mid-field and Far-field). Baker Lake areas: BAP, BES, BBD, BPJ=Baker Lake – Akilahaarjuk Point, East Shore, Barge Dock, Proposed Jetty. Whale Tail Pit areas: WTS = Whale Tail Lake South Basin; MAM = Mammoth Lake; NEM = Nemo Lake; A20 = Lake A20; A76 = Lake A76; DS1 = Lake DS1.

2.4 Data Evaluation

2.4.1 Overview

The objective of the CREMP is to identify changes in the aquatic receiving environment before adverse effects occur. Changes are evaluated using numerical criteria (i.e., triggers and thresholds) to assess the magnitude of change in CREMP monitoring variables (e.g., water quality, sediment chemistry, lower trophic level communities [i.e., phytoplankton and benthos]). The CREMP Design Document 2012 (Azimuth, 2012) described a two-tiered approach based on triggers and 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. The triggers may be based on absolute numbers (e.g., an increases half-way from baseline to an identified effects-based threshold) or statistical criteria (e.g., statistically significant difference from baseline-reference conditions; these are used in the absence of an effects-based threshold for a substance and may be very conservative).
- **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. In such cases, if triggers are exceeded then the implications of such exceedances can only be understood through the integration of results from other AEMP monitoring programs, or, if important information gaps still exist, through prescribed EEM studies or targeted studies.

Methods used to derive the triggers and thresholds were originally presented in the CREMP Design Document 2012 (Azimuth, 2012). The derivation methods apply equally across all study areas, except for the sediment chemistry triggers for the Whale Tail Pit study areas that required a slightly revised approach due to naturally elevated metals (described in **Section 2.4.3**). Application of the triggers and thresholds in the evaluation of CREMP monitoring parameters varies by study component, the details of which are presented in the following sections. The evaluation process focused on comparisons to triggers; only when triggers are exceeded are the monitoring results compared to thresholds.

The application of trigger and threshold values complements the spatial-temporal trends assessment that relies on trend plots to identify patterns of change consistent with one or more of the mining activities described in **Section 2.2**. The general rationale for conducting the trend assessment followed these principles:

- **Establish Expected Conditions** – Control data are examined to set expectations for a parameter (e.g., water or sediment metal concentration, etc.) in the absence of mining activity. Baseline data are used to infer relative spatial differences (e.g., between a NF and Ref area) and reference data were used to infer regional temporal changes (e.g., natural variability in benthic invertebrate community abundance in each lake).
- **Compare Patterns of Change** – With expected conditions in mind, impact data (i.e., data collected at NF and MF areas after the onset of mining-related activity in proximity to an area; see **Table 2-1**) are assessed visually for spatial-temporal patterns (e.g., short-term [in any year] spikes [rapid rises that return to baseline] or longer-term trends [gradual or rapid increases that persist]) matching mining activity. Where observed, the spatial and temporal extent and magnitude of the changes are characterized (i.e., do they extend to MF or FF areas, and if so, at what magnitude/duration?).
- **Provide Context for Magnitude of Change** – where applicable and available, results of target studies are used to help interpret changes in biological parameters and endpoints.
- **Identify Parameters for Management** – Identify parameters requiring management action on one of two levels: continued trend monitoring (i.e., to follow low magnitude or weak trends), or active follow-up with more detailed quantitative assessment (i.e., a targeted study to address a potential concern).

2.4.2 Water Chemistry

The CREMP, as discussed previously in the study design chapter, is designed to detect changes at a basin or lake scale to help define the extent (both spatially and temporally) of any changes. The temporal scale of assessment is done on a yearly basis, but to ensure short-term changes in water quality are not overlooked, water quality data are screened against trigger and threshold values after every sampling event. The goal of the interim monthly screening assessment is to alert the Environment Department to any unexpected changes in water quality as soon as possible so an appropriate management action can be implemented. Depending on the situation, the appropriate management action may involve routine sampling on the established schedule (i.e., do nothing), conducting confirmatory sampling to verify the result, expanding the sampling effort to determine the spatial extent, or, if the source is known, implementing mitigation measures.

Water Quality Trigger Assessment

Formal evaluation of long-term changes in water quality are based on comparing the annual mean concentration to trigger values. The most up-to-date water quality triggers are provided in **Appendix B**. The following hierarchical approach to evaluating water chemistry has been in place since 2012.

1. **Computation of Yearly Means** – monthly means calculated first for each parameter, then yearly means on an area-specific (i.e., lake or basin-specific) basis. Note that values less than DL are conservatively set equal to the DL.
2. **Comparisons of Yearly Means to Triggers** – yearly means for each sampling area are compared to the triggers to identify all cases for which the mean equals or exceeds the trigger.
3. **Statistical Testing of Yearly Means Exceeding Triggers** – cases where the yearly means exceed the triggers are formally tested using statistical analyses; this process is conducted differently for Meadowbank and Whale Tail Pit study areas compared to Baker Lake:

Meadowbank and Whale Tail Study Areas

- Before-After-Control-Impact statistical framework with multiple paired "before" and "after" period events (BACIP) is applied.
- INUG is used as the reference ("control") area; the other areas are tested as exposure ("impact") areas. For the Meadowbank study areas, neither PDL nor TEFF can be utilized as controls for BACIP as no data exists for 2006 – 2008 for these areas[7]. Instead, these areas are used to compare reference and exposure area data patterns. PDL can serve as a second reference area in the case of the Whale Tail Pit CREMP.
- True "pre-impact" data (i.e., when both INUG and the test area had "control" ("C") status; see **Table 2-1**) are used for the "before" data; the data for the year being tested are used as the "after" data (only events when both INUG and the test area were sampled).
- All data are log-transformed (natural logs). Thus, the exponent of the BACI interaction term coefficient provides the proportional change in the year being tested relative to the "before" period.
- One-tailed tests of the null hypothesis (i.e., that test areas experienced no relative increase) are conducted; the alternative hypothesis is a relative increase in a parameter at the test area.

Baker Lake (where different from above)

- Baker Lake areas were designated as "control" or "impact" when sampling started in 2008 (i.e., there was no detailed baseline sampling was conducted for Baker Lake; see **Table 2-1**), so there are no true "pre-impact" "before" data. While a spatial "CI" design could be used to test for differences between reference "control" and exposure "impact" areas, the design does not allow for distinguishing natural differences between areas from development-related changes. Rather, since no development-related changes have been identified to date, all years of data up

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[7] This does not apply to WAL, which does have overlapping baseline data with both PDL and TEFF. That said, effects relative to PDL and TEFF will only be looked at to provide additional context should changes be identified at WAL relative to INUG.

to and including the year prior to the year being tested (e.g., 2020) are considered “before” and the year being tested (e.g., 2021) data as “after” period data (i.e., allowing the more robust BACIP analysis). Thus, while the trend plots are used to assess temporal trends at the “impact” areas since monitoring started, the BACIP analyses specifically looks at changes in the year being tested (e.g., 2015) at the two “impact” areas relative to previous years.

- The Akilahaarjuk Point (BAP) area is used as the reference “control” area.

Water Quality Predictions

In addition to the trigger/threshold evaluation, annual CREMP water chemistry results are now compared against predicted changes presented in the respective Final Environmental Impact Statements (FEIS) for the Meadowbank Project (Cumberland, 2005) and the Whale Tail Pit Expansion Project (Golder, 2018). A brief overview of the approach to evaluating water quality relative to predicted changes is presented below for Meadowbank and Whale Tail Pit study areas; water quality predictions were not developed for Baker Lake.

Water Quality Predictions for the Meadowbank Study Area Lakes

As part of the original FEIS for the Meadowbank Project, water quality predictions were developed for lakes in the immediate area of the mine site from drainage from all major mine site sources (Cumberland, 2005). Predictions were developed for the following lakes: Third Portage Lake, Second Portage Lake, and Wally Lake. The model for each lake assumed fully mixed conditions under two scenarios: one without metals leaching from the dikes and a scenario with metals leaching from the dikes. In the case of Third Portage Lake, the two scenarios also different estimates for the total volume of water in the lake. Details regarding the various assumptions used when generating the water quality predictions are presented in Cumberland (2005). For the purpose of the CREMP, the following information is pertinent for evaluating current vs predicted water quality in each lake:

- **Third Portage Lake** – the model for Third Portage Lake includes treated water released from the project in years 1 to 4 and long-term loading of metals from the Bay-Goose dike material. Two mixing scenarios (upper range [169 Mm^3] and mid-range [92 Mm^3] mixing) were evaluated for Third Portage Lake with and without dike leaching.
- **Second Portage Lake** – The Second Portage Lake water quality model includes loading of parameters from the Bay-Goose and East dikes and inflow from Third Portage and Wally lakes. Changes in water quality in Second Portage Lake were modelled for the two different mixing scenarios for water released into Third Portage Lake listed above.
- **Wally Lake** – The water quality model for Wally incorporates long-term loadings from the Vault dike and effluent releases from the Vault Attenuation Pond.

Water chemistry results for a given year are compared against water quality predictions in the FEIS, analogous to the approach used for the trigger assessment (i.e., annual mean compared to predicted concentration). There are several reasons why interpreting changes in water quality above predictions in the FEIS should be made with caution. First, there is a difference in spatial focus between the CREMP (at the basin scale) and the water quality model (at the whole-lake scale). Secondly, the models assume complete mixing of the plume, and in this respect, the predictions do not characterize conditions between effluent discharge and full mixing, where localized elevations in parameter concentrations can occur. Furthermore, predictions for some parameters were based on incomplete baseline water quality data (e.g., silicon and strontium) or detection limits that were higher than aquatic life water quality guidelines in 2005 (e.g., cadmium and arsenic). Consequently, the same assessment criteria used in the FEIS to characterize the model results are used to provide the appropriate context for interpreting water quality results:

- **Negligible**: water quality is consistent with baseline
- **Low**: concentrations are less than CCME freshwater aquatic life guidelines (FWAL)
- **Medium**: concentrations are between 1 and 10-times the CCME FWAL
- **High**: concentrations are less than MDMER but greater than 10-times CCME FWAL
- **Very High**: concentrations exceed MDMER standards

Mammoth Lake and Whale Tail Lake Water Quality Predictions

With additional deposits and mine infrastructure included in the Whale Tail Pit Expansion Project, a revised water quality model was issued to refine predicted future changes in water quality on Site (e.g., Whale Tail Pit and IVR Attenuation Ponds) and at selected lakes and streams in the downstream receiving environment. The most significant input sources for the water quality model include loadings from runoff and seepage from waste rock storage facilities WRSFs and ore stockpiles on Site. The updated water quality model is dynamic, meaning the model inputs change over time to reflect mine development from construction/operations (June 2019 to December 2025), to early closure (where no mine contact water is discharged; January 2026 to 2042), to full closure (where the pit lake is fully flooded; January 2042 and beyond). Readers are referred to Golder (2019) for details regarding the inputs, assumptions, and results of the water quality model update.

The mine plan includes two discharges for surface contact water managed on Site, Mammoth Lake, and the South Basin of Whale Tail Lake. Predictions were developed for both lakes, as well as two streams (Nodes1 and 2) that flow into Lake DS1. The water quality model conservatively assumes fully mixed conditions in the lakes and instantaneous mixing and transfer of effluent to downstream locations. The actual mixing scenario will involve localized areas with higher concentrations that are not fully mixed given there is a lag time between when changes are observed upstream and when they are detected downstream. There are no long-term monitoring stations at Nodes 1 and 2, so for the purpose of the CREMP, the water quality prediction assessment focuses on Mammoth Lake and Whale Tail Lake.

When comparing current vs predicted water quality at Mammoth and Whale Tail Lake, the monthly water quality results were compared to the predicted concentration for that month. For example, the measured concentration of arsenic at Mammoth Lake in March 2020 was compared to the predicted concentration for March 2020. Over the course of the year, the number of monthly exceedances is tabulated to provide a qualitative point of comparison for assessing the accuracy of the water quality model.

As part of the water quality prediction assessment for Mammoth Lake and the South Basin of Whale Tail Lake, total phosphorus and total arsenic concentrations will be evaluated according to the water quality management strategy outlined in the Adaptive Management Plan for the Whale Tail Pit Expansion Project (Agnico Eagle, 2021b). The management strategy specifies the thresholds and corresponding management actions that will be undertaken in response to increasing concentrations of total phosphorus and arsenic in Mammoth Lake and Whale Tail Lake. Mitigation measures may include special studies, operational changes, revised or new water and waste management systems, new or expanded conveyance systems, structures and/or facilities, or implementing mitigation activities to prevent, stabilize or reverse a change in environmental conditions or to otherwise protect the receiving environment. Phosphorus and arsenic are the COPCs for Whale Tail, but other parameters may be added to the assessment as part of the Annual Report process based on results of future updates to the water quality forecast.

Water Quality Reporting: Short-List of Water Quality Parameters

Many water quality parameters have concentrations that are routinely below laboratory DLs, thus providing little insight into the assessment of mine-related changes to water quality. Annual CREMP reporting includes a process to limit the number of parameters that get formally evaluated. The following three-step screening process is used to identify parameters for inclusion into the formal trend assessment:

1. **Overall Detection Frequency** – Water quality parameters that exceed DLs in at least 10% of the samples are included in this discussion.
2. **Control-Impact Detection Frequency Comparison** – The proportion of samples exceeding DLs between “control” and “impact” samples are compared to avoid overlooking infrequently detected parameters that were detected more often in association with mining activities. Parameters with <10% detection frequency (i.e., those screened out above) where the proportion of detected values in the exposure areas increases by 0.1 or more are retained for trend assessment.

3. **Apparent Detection Pattern Matching Mining Activity** – Trend plots are used as an additional check to identify parameters with measured values associated with periods/locations of known mining activities. Where such patterns were observed, or where parameters were measured at greater than 5-times the DL at NF sampling areas in at least one event, these parameters were added back into the trend assessment process.

2.4.3 Sediment Chemistry

Trends in sediment chemistry are evaluated by comparing the yearly mean parameter concentrations in the core samples to the trigger values applicable to the Meadowbank study area lakes, Wally Lake, and the Whale Tail study area lakes. Sediment chemistry triggers for Meadowbank and Baker Lake were developed using the same methodology as the water quality triggers, namely, the triggers for each metal were set as the maximum of one of two methods:

- **Method A**: the value halfway between the baseline median and the threshold (CCME ISQG),
- **Method B**: the 95th percentile of the baseline data[8].

For the 2017 CREMP report, control sediment core chemistry data collected in 2012, 2014, and 2017 were used to update the trigger values for the Meadowbank and Baker Lake areas. New sediment chemistry trigger values were also derived specifically for Wally Lake using baseline core chemistry data from 2008 and 2012, before the area designation changed from “before” to “after” in July 2013 (Azimuth, 2018b). The sediment chemistry triggers for Meadowbank, Wally, and Baker Lake study areas are presented in **Table 2-3**.

Lake-specific triggers were developed the six Whale Tail Pit study area lakes because strong differences in sediment concentrations were evident among for most of the metals examined (Azimuth, 2020b). Adjustments to the trigger methodology were also made to account for the low sample sizes (ten baseline samples were collected in each lake):

- **Method A**: same as above.
- **Method B**: the 90th percentile of baseline concentrations was used instead of the 95th percentile because the latter were more conservative and less sensitive to outliers.
- **Method C**: the value corresponding to a 20% increase above the median value. Method C was added because for some lake-parameter combinations, the distributions were quite narrow and the resulting 90th percentile (Method B) would have been unreasonably low. Method C applied

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[8] Medians and 95th percentiles were chosen as metrics rather than means, standard deviations, or maximums, because the former are generally robust to skewed distributions and potential outliers.

to chromium at all 6 lakes. If Method B was used, the triggers would have been only 2.3% to 12.5% higher than the median values.

The sediment chemistry triggers for the Whale Tail Pit study area lakes are presented in **Table 2-4**.

Table 2-3. Summary of trigger values for Meadowbank, Wally, and Baker Lake study areas.

Parameter	Threshold[1]	DL	N	>DL	Median	95th %ile	Method[2]	Trigger Values		
								New[3]	Old[4]	Change[5]
Meadowbank Study Areas										
Arsenic	5.9	0.1	180	178	26.7	120.9	B	120.9	120.0	Increase
Cadmium	0.6	0.02	180	115	0.27	1.1	B	1.10	1.10	No Change
Chromium	37.3	0.5	180	180	90	135	B	135	114	Increase
Copper	35.7	0.5	180	180	55.7	83.4	B	83.4	126	Decrease
Lead	35	0.5	180	62	15.5	21.7	A	25.3	32.5	Decrease
Mercury	0.17	0.005	180	180	0.034	0.059	A	0.102	0.104	Decrease
Zinc	123	2	180	180	89.9	114.2	B	114.2	121.3	Decrease
Wally Lake										
Arsenic	5.9	0.1	20	20	29.1	44.5	B	44.5	-	n/a
Cadmium	0.6	0.02	20	14	0.51	0.7	B	0.66	-	n/a
Chromium	37.3	0.5	20	20	51.8	61.2	B	61.2	-	n/a
Copper	35.7	0.5	20	20	148	257.1	B	257.1	-	n/a
Lead	35	0.5	20	14	32	36.5	B	36.5	-	n/a
Mercury	0.17	0.005	20	20	0.071	0.087	A	0.12	-	n/a
Zinc	123	2	20	20	105	142.1	B	142.1	-	n/a
Baker Lake Areas										
Arsenic	5.9	0.1	55	43	3.5	7.6	B	7.6	8.3	Decrease
Cadmium	0.6	0.02	55	18	0.04	0.05	A	0.32	0.55	Decrease
Chromium	37.3	0.5	55	55	16.3	22.4	A	26.8	27	Decrease
Copper	35.7	0.5	55	55	4.8	8.3	A	20.3	20.5	Decrease
Lead	35	0.5	55	40	3.9	5.6	A	19.5	32.5	Decrease
Mercury	0.17	0.005	55	30	0.005	0.009	A	0.088	0.088	No Change
Zinc	123	2	55	55	23.2	31.1	A	73.1	73.6	Decrease

Notes:

1. Threshold values set equal to the CCME interim sediment quality guideline except in cases (*) where the trigger value is greater than the threshold.
2. Method used to determine the new trigger value:
   A = midpoint value between the median concentration and the threshold value.
   B = 95th percentile of the baseline data.
3. New = trigger values developed for the 2017 CREMP.
4. Old = trigger values developed in the CREMP Design Document 2012 (Azimuth, 2012).

"-" no Wally Lake specific trigger values were previously in place. The same sediment trigger values (i.e., "Old") shown for the Meadowbank project lakes were previously applied to Wally Lake.

5. Comparison of "New" vs "Old" sediment chemistry triggers.

n/a = not applicable given there were no Wally Lake specific trigger values prior to the 2017 CREMP.

Table 2-4. Summary of trigger values for the Whale Tail Pit study area lakes.

Metric	Parameter	Threshold[1]	Whale Tail Pit Study Area Lakes					
			WTS	MAM	A20	A76	DS1	NEM
Median	Arsenic	5.9	27.0	88.5	27.5	384.5	140.5	37.8
	Cadmium	0.6	0.27	0.25	0.13	0.29	0.30	0.22
	Chromium	37.3	67.2	162.0	44.3	86.2	66.7	108.5
	Copper	35.7	38.2	64.1	34.9	62.9	16.1	36.0
	Lead	35	12.9	17.6	15.7	16.2	16.9	9.1
	Mercury	0.17	0.076	0.086	0.042	0.052	0.070	0.030
	Zinc	123	85.1	115.5	83.8	89.2	78.9	55.1
90th %ile	Arsenic	5.9	83.1	140.0	42.8	443.0	198.0	61.1
	Cadmium	0.6	0.93	0.43	0.27	0.43	0.42	0.27
	Chromium	37.3	75.0	176.0	48.0	96.9	71.4	111.0
	Copper	35.7	48.5	68.5	38.8	72.7	18.6	42.7
	Lead	35	13.9	19.1	17.5	20.2	17.1	9.8
	Mercury	0.17	0.092	0.102	0.047	0.067	0.078	0.035
	Zinc	123	196.0	129.0	87.9	112.0	86.2	59.8
Trigger	Arsenic	5.9	83.1	140.0	42.8	461.4	198.0	61.1
	Cadmium	0.6	0.93	0.43	0.37	0.44	0.45	0.41
	Chromium	37.3	80.6	194.4	53.1	103.4	80.0	130.2
	Copper	35.7	48.5	76.9	41.8	75.5	25.9	43.2
	Lead	35	24.0	26.3	25.4	25.6	26.0	22.0
	Mercury	0.17	0.123	0.128	0.106	0.111	0.120	0.100
	Zinc	123	196.0	138.6	103.4	112.0	100.9	89.0
Method[2]	Arsenic		B	B	B	C	B	B
	Cadmium		B	B	A	A	A	A
	Chromium		C	C	C	C	C	C
	Copper		B	C	C	C	A	C
	Lead		A	A	A	A	A	A
	Mercury		A	A	A	A	A	A
	Zinc		B	C	A	B	A	A

Notes:

1. Threshold values set equal to the CCME interim sediment quality guideline.
2. Method used to determine the new trigger value:
   A = midpoint value between the median baseline concentration and the threshold value.
   B = 90th percentile of the baseline data.
   C = 20% increase above the median baseline concentration.

Sediment Chemistry Trigger Assessment

The approach to assessing changes in sediment chemistry are as follows:

1. **Computation of Yearly Means** – the sediment coring data for the year being tested are used to calculate means for each parameter at each sampling area. Note that values measured at less than DL are conservatively set equal to the DL.
2. **Comparisons of Yearly Means to Triggers** – yearly means for core samples from each sampling area are compared to the triggers to identify all cases for which the mean equals or exceeds the trigger.
3. **Statistical Testing of Yearly Means Exceeding Triggers** – cases where the yearly means exceed the triggers are formally tested using statistical analyses. Unlike water chemistry, as sediment concentrations are not expected to vary annually due to climatic changes, a "before" – "after" (BA) analysis is used to test for temporal differences at each exposure "impact" area. Sediment is inherently much more variable than water however, and greater natural variability is to be expected

Those parameters where the yearly mean was equal to or exceeded triggers were formally tested using a before-after (BA) statistical model[9]. Sediment chemistry can be quite variable over a small spatial scale within a given basin, but natural seasonal variability in sediment chemistry is assumed to be low given the low rates of natural sediment deposition in Arctic lakes (Azimuth, 2012). The BA statistical model assumes that, in absence of mining-related inputs, annual variability in sediment chemistry is negligible.

2.4.4 Phytoplankton

As discussed in the CREMP Design Document 2012 (Azimuth, 2012), triggers and thresholds are set to relative changes (increases or decreases of 20% and 50%, respectively) in total biomass and species richness at test areas using the BACIP framework (i.e., paired monthly sampling events at "control" [INUG or BAP] and "impact" [i.e., NF or MF areas] areas over two periods ["before" and "after"], with "months" as the unit for temporal replication). The evaluation procedure is analogous to that used for water chemistry, except that area means for the year being tested are not directly comparable to triggers (i.e., since the triggers/thresholds are based on the relative change over time in a parameter rather than on a finite value), so the process started with the BACIP testing. Two-tailed tests of the null hypothesis (i.e., that test areas experienced no relative change up or down) are conducted.

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[9] One-tailed test of the null hypothesis that concentrations are not different (or lower) in the after period relative to the before period (significance level of p=0.05); the alternate hypothesis is that concentrations have increased in relation to mining.

2.4.5 Benthic Invertebrates

Triggers and thresholds for benthic invertebrates are set to relative changes (decreases of 20% and 50%, respectively) in total biomass and species richness at test areas using the BACI framework. As discussed in the CREMP Design Document 2012 (Azimuth, 2012), statistical power increases with consideration of more “after” period years (Note: benthic invertebrates are sampled yearly in August). Consequently, BACI analyses (analogous to phytoplankton, except that unit of temporal replication is “years” instead of “months”) are conducted on four “after” data period lengths: one year (e.g., 2020 only), two years (e.g., 2019-2020), three years (e.g., 2018-2020), and four years (e.g., 2017-2020).

There is no baseline benthic community data for Baker Lake, meaning there are no true “pre-impact” “before” data. While a spatial “CI” design could be used to test for differences between reference “control” and exposure “impact” areas, the design does not allow for distinguishing natural differences between areas from development-related changes. Rather, since no development-related changes have been identified to date, the temporal scenarios for Baker Lake use all the data (e.g., 2020 is compared to 2008 – 2019; 2019/2020 is compared to 2008 – 2018…and so on).

2.5 Quality Assurance/Quality Control

The objective of quality assurance/quality control (QA/QC) is to assure that the chemical and biological data collected are representative of the material or populations being sampled, are of known quality, have sufficient laboratory precision to be highly repeatable, are properly documented, and are scientifically defensible. Data quality was assured throughout the collection and analysis of samples using specified standardized procedures, by the employment of laboratories that have been certified for all applicable methods, and by staffing the program with experienced technicians.

2.5.1 Water Chemistry

Field Collection

Careful documentation and handling of samples and data is a key component of QA/QC for the water quality field program. Sample containers are labeled with the sample ID, the date, and project identification and are kept or stored according to laboratory handling instructions as necessary. Field data are recorded on data sheets and entered in Agnico Eagle’s EQuIS database. Field data are sent to Azimuth at the end of each sampling event and used to validate data entry in EQuIS.

Chain-of-custody forms are included in each shipment. Electronic copies are emailed to the account manager when samples leave the Site. Samples are typically shipped within 1 week of collection, typically on Monday, Tuesday, or Wednesday to avoid having samples in transit over a weekend.

Laboratory QA/QC

ALS Environmental is a CALA[10] certified laboratory with a rigorous QA/QC system that includes:

- Setting holding times according to test methods and any exceedances are flagged.
- Determining detection limits (DL), which is the minimum concentration of an analyte detectable by a test method in a medium and values below this limit are reported as less than DL.
- Including several QA/QC samples in their standard analytical procedures:
    - Matrix spikes are a quality assurance measure used to determine the resolution of a test method to detect an analyte in a specific medium (matrix) and assess matrix interferences.
    - Matrix blanks are analyzed to assess background contamination that exists in the analytical system that could lead to elevated concentrations or false positive data. These samples are comprised of analyte-free water.
    - Laboratory control samples are comprised of a mixture of analyte-free water to which known amounts of the method analytes are added. They are essentially an internal version of certified reference material.
    - Certified/standard reference materials are commercially-made with pre-determined analyte concentrations and are sampled systematically to ensure accuracy.
- Analysis of laboratory replicate samples to determine variability in reported analyte concentrations.
- Verifying reports by repeat analysis of a sample if the original result is unexpected (e.g., detecting a parameter in blank samples and deviations from historical results). Repeat analysis may be requested by the client or consulting team.

Data Quality Objectives (DQOs) are numerically definable measures of analytical precision and completeness. Analytical precision is a measurement of the variability associated with duplicate analyses of the same sample in the laboratory. Laboratory duplicate results are assessed using the relative percent difference (RPD) between measurements. The equation used to calculate the RPD is:

$$RPD = \frac{(A - B)}{(\frac{A + B}{2})} x\ 100$$

where: A = analytical result; B = duplicate result.

RPD values may be either positive or negative, and ideally should provide a mix of the two, clustered around zero. Consistently positive or negative values may indicate a bias. Large variations in RPD values

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[10] Canadian Association for Laboratory Accreditation

are often observed between duplicate samples when the concentrations of analytes are very low and approaching the detection limit; and therefore, a difference (DIFF) metric is often relied upon in these cases. The DIFF metric is defined as the absolute difference between a sample result and the sample duplicate result for each analyte.

$$DIFF = ABS\,[A - B]$$

where: A = analytical result; B = duplicate result; ABS = Absolute value (i.e., positive)

The chemistry laboratory DQOs for this project are:

- Analytical precision targets set by the lab are parameter-specific but typically are approximately 20% RPD or a difference (DIFF) between the laboratory replicates of greater than 2-times the DL (or in some cases 3-times the DL); meeting either metric is acceptable. If the RPD or DIFF metrics are not met, the result is flagged.
- Other QA/QC metrics flagged by the laboratory are evaluated to determine any implications on chemistry results. These include: laboratory holding time, laboratory control sample, matrix spike, method blank, certified/standard reference materials, detection limit, and reported result verified by repeat analysis.

Field QA/QC

The standard QA procedures included thoroughly flushing the flexible tubing and pump to prevent cross-contamination between areas and thoroughly rinsing the sample containers with site water prior to sample collection. Field QC procedures include collecting and analyzing field duplicates, and three types of *blank* samples: travel blanks, field blanks (de-ionized water), and equipment blanks.

Field Duplicates

An independent collection of water samples at the same time and location as the original, as a measure of consistency in sampling methodology and heterogeneity of chemical parameters at discrete locations. One field duplicate is collected for every 10 samples (approximately 10% frequency).

The DQOs for field duplicates were 1.5-times the laboratory RPDs or the DIFF between field duplicate results of less than 3-times the DL (i.e., 1.5x the difference objective for laboratory duplicates). This approach has been adopted for both water chemistry and sediment chemistry since 2019. The adjustment of field DQOs above laboratory RPD levels accounts for the fact that field duplicates are inherently more variable compared to laboratory duplicates partly because field duplicate samples are collected from a large sample volume as opposed to a small well-mixed sample volume (i.e., the single sample container in the laboratory). The Canadian Council of Ministers of the Environment (CCME) states that acceptance limits for field-based QC are broader than laboratory QC and are typically 1.5 to 2 times the laboratory QC limits (CCME, 2016).

Blanks

The CREMP uses three different types of "blanks" as part of water quality QC assessment:

- **Travel Blanks** – Laboratory supplied bottles of distilled water that are transported to the Site, carried back and forth into the field, and returned to the laboratory to test for inadvertent contamination during the transport and field sampling process.
- **Field Blank** *(aka deionized water blank [DI blank])* – Laboratory-supplied deionized water is poured directly into the sample bottles. The goal of collecting these blanks is to test the quality of the DI water batch and variability in laboratory analytical methods.
- **Equipment Blanks** – At the beginning or end of a field sampling episode, after routine rinsing of the pump and tubing, distilled water is run through the equipment and placed in sampling bottles for analysis of a wide suite of parameters (e.g., metals, nutrients, and major ions). This sample tests for possible cross-contamination of samples from the water sampling equipment.

Blank sample collection, particularly equipment blank samples, required careful planning, attention to detail, focus on the importance of cleanliness, and generally provided a good opportunity to refine sample collection skills. Blank samples are collected once per sample event and submitted blind to the laboratory to ensure they were treated the same as field-collected samples during analysis.

Blanks are examined for detectable concentrations of any of the parameters measured. Ideally, no parameter in either blank should exceed laboratory DLs. If a parameter in either blank is detectable, the corresponding field sample results are assessed for their reliability in the water chemistry dataset. The approach utilized is a "5 x blank censoring approach", relying primarily on the EB[11] for each event, and using the following rating system for detected analytes in blanks:

- **Unreliable** – When the concentration in a field sample is within 5-times the concentration in the EB blank, and the field result is elevated relative to historical data for the station, results are deemed unreliable (potentially impacted by cross-contamination). These data are excluded from data analysis and interpretation.
- **Cautionary** – When the concentration in a field sample is less than 5-times higher than the detected analyte concentration in the EB blank, but the field result appears consistent with historical data for this lake/basin, results are flagged as cautionary. Results are considered within natural variability and are retained for data interpretation.
- **Reliable** – When the concentration in a field sample is more than 5-times higher than the detected analyte concentration in the EB blank or is less than the DL, the field result is

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[11] If a parameter was detected in both the EB blank and DI blank, then the detected concentration in the DI blank was subtracted from the EB blank, before comparing EB blank concentrations to field sample results.

considered reliable. These data are retained for data interpretation with no denotation in the tables and figures. If only the DI has a detected parameter (not EB), results are considered reliable. Reliable flags are documented in the QA/QC screening table.

The approach to evaluating blanks has been standardized to the extent possible, but ultimately best professional judgement is used to determine which data get excluded from analysis.

2.5.2 Sediment Chemistry

Field Collection

Similar sample collection procedures are implemented to ensure high-quality data from the sediment sampling program as outlined for water sampling (e.g., use of standardized field datasheets, sample naming conventions, etc.).

Laboratory QA/QC

Laboratory QA/QC procedures for sediment are described above for water.

Field QA/QC

Field QA consisted of taking care between sampling areas by rinsing and cleaning the sampling gear for sediment grabs (Petite Ponar grab, stainless steel compositing bowls and spoons) and sediment cores (corer and spatula) using site water and phosphate-free cleaning detergent, to avoid the possibility of cross-contamination.

Field QC measures include collection and analysis of field duplicates and filter swipes:

- **Field Duplicates** – Field duplicate samples are collected in the immediate vicinity of original samples from randomly selected locations as a test of consistency in field methodology and to characterize the heterogeneity of sediment chemistry within discrete areas. The number of field duplicates is approximately 10% of the total number of samples. The DQOs for field duplicates were 1.5-times the laboratory RPDs or between field duplicate results of less than 3-times the DL (i.e., 1.5x the difference objective for laboratory duplicates).
- **Filter Swipes** – Analysis of metals is conducted on an ashless filter that is swiped over the pre-cleaned bowl for ~ 10% of the samples to assess the cleaning procedures. The significance of any metal detected on this filter is evaluated by comparing this amount to the measured concentrations in the sediment samples.

2.5.3 Phytoplankton

Field duplicates are collected for phytoplankton during each sampling event in coordination with water sample duplicates and are taken in order to assess sampling variability and sample homogeneity. A RPD of 50% for density and biomass concentrations is considered acceptable.

As a measure of laboratory QA/QC on the enumeration method, replicate counts are performed on 10% of the samples. Replicate samples are chosen at random and processed at different times from the original analysis to reduce biases. The laboratory replicate is a new aliquot (10 ml) from the sample jar and is counted from the start in the same manner as the original aliquot (10 ml) taken from the jar.

2.5.4 Benthic Invertebrates

Field replicates (5 per area) are collected for benthos to determine natural variability and heterogeneity. Replicates are collected at least 20 m apart from one another, within the defined sampling areas.

The laboratory (ZEAS) incorporates the following set of QA/QC procedures in all benthic projects undertaken by the company to ensure the generation of high quality and reliable data:

- Samples are logged upon arrival, inspected, and enumerated;
- Samples are checked for proper preservation;
- Samples are stained to facilitate sorting;
- Taxonomic identifications are based on the most updated and widely used keys;
- 10% of the samples are re-sorted, and re-counted, targeting >90% recovery;
- Precision and accuracy estimates are calculated;
- A voucher collection is compiled;
- Sorted sediments and debris are re-preserved in 10% formalin and are retained for up to three months. For samples subject to subsampling, sorted and unsorted fractions are re-preserved separately.

3 PIT FLOODING MONITORING

3.1 Background

In 2015, with mining at Meadowbank winding down, a new section was added to the CREMP Plan outlining a conceptual framework for integrating the flooded pits (Goose Pit, Portage Pit, Vault Pit, and the Phaser Pits) into the CREMP after the dikes are breached and the pits are connected to the surrounding receiving environment. At that time, use of the pits for subaqueous tailings disposal was not in the mine plan. As discussed previously in **Section 2.1.1**, a considerable volume of tailings is expected to be produced from ore mined from the Whale Tail, IVR, and underground deposits approved for development under the Whale Tail Pit Expansion Project. Water quality modeling for the pit lakes was completed as part of the pre-feasibility study design of the in-pit tailings deposition (SNC, 2018), and several metals along with ammonia and fluoride were predicted to exceed CCME water quality guidelines. The study predicted that water treatment would be required for 3-to-5 years for water quality to meet CCME guidelines for the protection of aquatic life (SNC, 2018).

Notwithstanding the use of the pits for tailings disposal, the approach to closure remains unchanged, with water quality in the pit lakes needing to meet water quality guidelines (or show that conditions do not pose unacceptable risks to aquatic life through a risk assessment) before the dikes are breached to connect the pit lakes with adjacent lakes. The NIRB, in their 2018 review of the in-pit tailings disposal plan, concluded that “no significant changes to impacts on fish and other aquatic organisms is expected” given water quality objectives are met before dikes are breached (NIRB, 2018).

3.2 Monitoring Strategy

The NWB A Licence (2AM-MEA1530) identifies specific monitoring locations, parameters, and frequencies for operations (early/late) and closure phases for each of the pits (NWB, 2019).

- **Pit Sumps** (Operations) – each of the pit sumps (i.e., the North Portage Pit Sump [ST-17][12], South Portage Pit Sump [ST-19], Goose Sump [ST-20], Vault Pit Sump [ST-23], and Phaser Pits sumps [ST-41 and ST-42]) will be monitored during open water monthly for water quality (for Group 1 parameters, except for ST-23, which is Group 2[13]) and daily for discharge volume.
- **Pit Lakes** (Late Operations/Closure) – Upon flooding, the two Portage Pit basins will join to form Portage Pit Lake, but will still be monitored separately (on a monthly basis during open water for

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[12] As of 2019, there is no more sump associated with the North Portage Pit. The 2020 Annual report now refers to the area as Portage Pit Lake.

[13] The Group 2 parameters are the same as those specified for the CREMP.

the Group 2 parameters) during operations. During closure, ST-17 (North Pit Sump) and ST-19 (South Portage Sump) will become a single station to be monitored bi-annually (the licence does not specify the frequency/parameter details included in this phase specifically for this location, so this is based on the requirements for the other pit lakes) for Group 2 parameters. For Goose Pit, the monitoring station name change to Goose Pit Lake (ST-20) during late operations (monitored monthly during open water for Group 2); at closure, monitoring frequency of ST-20 drops to bi-annual (Group 2). For Vault Pit (ST-23), the monitoring station name changes to Vault Pit Lake (ST-26) upon closure and will be subject to bi-annual monitoring of Group 2 parameters during open water.

- **Pit Lakes** (Post Closure) – For post-closure, the Type A Water Licence (2AM-MEA1530) identifies Portage-Goose Pit Lake (ST-12) and Vault Pit Lake (ST-13) for annual monitoring of the Full Suite[14] parameters during open water.

The preliminary schedule of Meadowbank closure was most recently presented in the Interim Closure and Reclamation Plan – Update 2019 (SNC, 2020). Meadowbank is currently in the operations and progressive closure phase. Consistent with the objective of progressive reclamation, the transitions from operations to closure are defined on a location-specific basis rather than on the general stage of mine development for the Project. For example, in-pit tailings disposal at Goose Pit was completed in August 2020, while the current plan is to alternate between Pit E and Pit A between January 2021 and June 2026. The post-closure phase will start once water quality is deemed acceptable and the dikes are breached, which will presumably occur at Goose Pit before Portage Pit. This approach ensures that monitoring is tailored to the specific requirements of the pit lake and not to the general status of the mine development. Following this logic, pit lake monitoring would formally move from the Water Quality and Flow Monitoring Plan (Agnico Eagle, 2016) to the CREMP at the transition to the post-closure phase (i.e., when the pit lakes are deemed receiving environment). Thus, CREMP monitoring would target Portage-Goose Pit Lake (ST-12) and Vault Pit Lake (ST-13) after breaching the dikes following the parameter and frequency stipulations in the licence.

Part E (7) of the NWB A Licence presents the expectations of breaching the dikes (NWB, 2020):

> *The Licensee shall not breach dikes until the water quality in the re-flooded area meets CCME Water Quality Guidelines for the Protection of Aquatic Life, baseline concentrations, or appropriate site-specific water quality objectives. Subject to the Board approval, if water quality parameters are above CCME Guidelines, a site-specific risk*

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[14] The “Full Suite” is comprised of the Group 2 water quality parameters (i.e., the same as the CREMP) as well as Total Petroleum Hydrocarbons, and Turbidity (but not the acute lethality tests, which are for discharges only).

> *assessment must be conducted to identify water quality objectives that are protective of the aquatic environment.*

Agnico Eagle is committed to meeting CCME water quality guidelines, baseline concentrations, or appropriate site-specific water quality objectives in each of the fully-flooded pit lakes. Annual monitoring and water quality forecast modelling efforts will support making timely management decisions regarding the need for water treatment to achieve this commitment. If early forecasting predicts that water quality guidelines will not be met, then Agnico Eagle will pursue the use of other approved tools, such as site-specific water quality objectives or site-specific risk assessment, to provide further clarity on water quality acceptability.

4 REFERENCES

AEMP (Aquatic Effects Management Program). 2005. A report prepared by Azimuth Consulting Group, Vancouver for Cumberland Resources Ltd. October, 2005.

Agnico Eagle. 2021a. Meadowbank Complex 2020 Annual Report. 61-000-100-REP-003.

Agnico Eagle. 2021b. Whale Tail Pit Expansion Project – Adaptive Management Plan. Version 1.5. July 28, 2021.

Agnico Eagle. 2020. Pore Water Quality Monitoring Program. Version 2. March 2020.

Agnico Eagle. 2019. CREMP Addendum - Appendix A: Mercury Monitoring Plan for Whale Tail South Area. Prepared by Agnico Eagle Mines Ltd. Meadowbank Division. Version 3. April 2019.

Azimuth. 2021. 2020 Core Receiving Environment Monitoring Program. Meadowbank Complex. Report prepared by Azimuth Consulting Group for Agnico-Eagle Mines Ltd., Meadowbank Division. March 2021.

Azimuth. 2020a. Aquatic Effects Management Program (AEMP). Report prepared by Azimuth Consulting Group for Agnico-Eagle Mines Ltd., Meadowbank Division. March 2020.

Azimuth. 2020b. 2019 Core Receiving Environment Monitoring Program. Meadowbank Mine and Whale Tail Pit Project. Report prepared by Azimuth Consulting Group for Agnico-Eagle Mines Ltd., Meadowbank Division. March 2020.

Azimuth. 2018a. Core Receiving Environment Monitoring Program (CREMP): 2015 Plan Update – Whale Tail Pit Expansion Addendum_NIRB. Report prepared by Azimuth Consulting Group for Agnico-Eagle Mines Ltd., Meadowbank Division. December 2018.

Azimuth. 2018b. Core Receiving Environment Monitoring Program (CREMP) 2017. Meadowbank Mine. Report prepared by Azimuth Consulting Group for Agnico-Eagle Mines Ltd., Meadowbank Division. March 2018.

Azimuth. 2015. Core Receiving Environment Monitoring Program (CREMP): 2015 Plan Update. Report prepared by Azimuth Consulting Group for Agnico-Eagle Mines Ltd., Meadowbank Division. November 2015.

Azimuth. 2012. Core Receiving Environment Monitoring Program (CREMP): Design Document 2012, Meadowbank Mine. Report prepared by Azimuth Consulting Group for Agnico-Eagle Mines Ltd., Meadowbank Division. December 2012.

Azimuth. 2010. Core receiving environment monitoring program (CREMP) 2010 plan update. Report prepared by Azimuth Consulting Group Inc., Vancouver, BC for Agnico-Eagle Mines Ltd., Baker Lake, NU. June 2010.

BAER (Baseline Aquatic Ecosystem Report). 2005. A report prepared by Azimuth Consulting Group, for Cumberland Resources Ltd. October 2005.

CCME. 2016. Guidance Manual For Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment. Volume 4. Analytical Methods. ISBN 978-1-77202-032-8.

Cumberland Resources Ltd. (Cumberland). 2005. Meadowbank Gold Project. Final Environmental Impact Statement. November 2005.

EVS Environment Consultants. 1999. Fisheries evaluation of candidate reference lakes, Meadowbank Gold Project Nunavut, 1998. A report prepared for Cumberland Resources Ltd., Vancouver BC by EVS Environment Consultants, North Vancouver, April 1999.

Golder Associates Ltd. 2019. Mine Site and Downstream Receiving Environment Water Quality Predictions: Whale Tail Pit Expansion Project. May 2019.

Golder Associates Ltd. 2018. Final Environmental Impact Statement Addendum. December 2018.

SNC. 2020. Meadowbank Interim Closure and Reclamation Plan (ICRP - Update 2019. March 27th, 2020.

SNC. 2018. Environmental Impact Study Review – Meadowbank In Pit Tailings Deposition. February 15, 2018.

APPENDIX A

STANDARD OPERATING PROCEDURES

APPENDIX A1

WATER AND PHYTOPLANKTON SAMPLING

CREMP Standard Operating Procedures
Surface Water & Phytoplankton Sampling

Introduction

This standard operating procedure (SOP) outlines the procedure for collecting surface water samples for chemistry and phytoplankton taxonomy as well as limnology measurements for the Core Receiving Environment Monitoring Program (CREMP). The SOP describes the field methods for collecting surface water from a boat but the same method applies to winter water sampling through the ice. Agnico Eagle has internal procedures outlining the health and safety considerations for winter sampling and collect water samples under ice.

Location and Timing for Field Activities

Study areas included in the CREMP water and phytoplankton sampling program are listed below (current to 2021). Lakes/basins may be added to the annual monitoring program in response to expanded mining activities (e.g., Whale Tail Pit Expansion Project) or removed as a routine monitoring station as active mining is scaled back in certain areas (e.g., Tehek Lake). Area-specific timing and frequency of monitoring is included in the recommendations section of the annual CREMP report.

Meadowbank	Baker Lake	Whale Tail
Inuggugayualik Lake (INUG)	Baker Lake – Akilahaarjuk Point (BAP)	Whale Tail Lake South Basin (WTS)
Pipedream Lake (PDL)	Baker Lake – Barge Dock (BBD)	Mammoth Lake (MAM)
Third Portage Lake East Basin (TPE)	Baker Lake – Proposed Jetty (BPJ)	Lake A20
Second Portage Lake (SP)		Lake A76
Wally Lake (WAL)		Lake DS1
Third Portage Lake South Basin (TPS)		Nemo Lake (NEM)
Tehek Lake (TE)		
Tehek Lake – Far-field (TEFF)		

Preplanning for the Water Sampling Program

Consult with the Project Coordinator in February each year to arrange delivery of the necessary supplies for the annual surface water quality and phytoplankton sampling programs. The following equipment and supplies should be inspected early in the calendar year so that any replacement equipment or restock of supplies can be arranged well ahead of planned sampling:

- Pump – check the status of the pump (and back-up pump) to make sure both units are in good working condition. Things to look for include the condition of the wiring and the general cleanliness of the pump.
- Tubing – there should be two boxes of the C-Flex tubing (Cole-Parmer; Item # RK-06424-79). Use a new 3 m length of tubing at the start of the annual sampling program. We recommend replacing the 3 m length after three sampling events or if you suspect the tubing has become contaminated.
- Battery – check the battery to make sure it holds a charge and is in safe working condition
- Bottles, Preservatives, Syringes, Filters, Deionized Water, and Travel Blanks – Azimuth will arrange an order of supplies from ALS in February or March for enough supplies to complete the first three monthly sampling events. A second shipment is typically arranged in July to complete the last two sampling events after taking stock of the supplies on site. One order of vials from Plankton R Us is arranged early in the calendar year to complete sampling for the entire program (Meadowbank, Baker Lake, and Whale Tail Lake).
- Coordinates – Sampling locations at the Meadowbank and Baker Lake are randomly generated using an Excel algorithm from within a defined area in each lake. Locations are selected if the location on the GIS bathymetry map is in water deeper than 5 m. The Whale Tail Pit study lakes are generally shallower than the Meadowbank areas, with a comparatively large proportion of the surface area less than 5 m deep. To avoid the problem of randomly selecting locations in less than 5 m of water, fixed sampling locations were established in each lake in areas where the water depth is greater than 5 m. Two locations are randomly selected from each lake, per event for sampling.

Preparing for Water Chemistry & Phytoplankton Sampling

1. Two (2) target sample locations for each station listed above are sampled for each monthly sampling event. Contact Azimuth for the coordinates and upload the coordinates to a GPS unit (NAD 83). Confirm the correct sample number sequence before going into the field.
2. Prior to leaving camp gather the appropriate type and number of sampling vessels and acid vials for preservation. Prepare appropriate labels for containers, affix them to the appropriate bottle (see below), and wrap label with packing tape.
    - Station abbreviation (e.g. TPE-111, INUG-90, WTS-26, etc.)
    - Date of sample collection
    - Parameters to be measured from individual bottle (TOC, total metals, etc.)
3. Calibrate the multiparameter for pH, specific conductivity, and dissolved oxygen as per the manufacturer's instructions prior to going into the field. Calibration may need to be done daily depending on the instrument (consult the manual for instructions). **Record the calibration information** on one of the field data sheets before heading into the field.
4. Gather field collection materials (use the following checklist to confirm you have all the necessary equipment before going into the field):

In the boat

- Field collection data forms, pencils, waterproof markers & clipboard
- GPS unit, batteries
- Water pump & 12V battery
- Tubing (4 meter length and 1 meter length) & weight (& extra C-clamps and cable ties)
- Syringe and 0.45 µm disc filters (plus spares)
- YSI meter, batteries, and calibration solutions to confirm measurements if need be
- Secchi disk
- Hand held pH meter, batteries
- Depth meter, battery (same battery used to run the pump)
- Rope
- Nitrile sampling gloves
- Field sample bottles & preservatives (per sample) see table below
- Clear plastic tubes (50 mL) for phytoplankton. Preserve with Lugol's back at the laboratory
- Extra sample bottles in case of breakage or loss
- QA/QC field duplicate sampling containers & preservatives (same as above)
- Take one set of Travel Blank bottles into the field and transport and treat as other samples. Note that the Travel Blank bottles are not to be opened and no preservatives added.

In camp

- Hand pump, filters, tweezers, and black tubes for chlorophyll-a
- De-ionized water for rinsing equipment and collected field equipment blank
- Coolers and ice packs for shipping samples
- Address labels for coolers (ALS and Plankton R Us)
- Chain of custody (CoC) forms filled out with the correct sample ID, date, and analyses

Step-by-Step Guide to Collecting Water for Chemistry & Phytoplankton

Water samples are collected from 3 m below the water surface unless specified otherwise.

*** We recognize the Agnico Eagle Environment Department Team is very experienced in collecting samples to the highest standard of quality control. This step-by-step guide is an example of how the data collection and sampling effort *could* proceed; we leave it to the discretion of the field team to decide on a process that works best for them.

1. Before and during sampling fill in the requested information on the field data form; complete one field data form in its entirety for each sampling station and sampling event. Forms are made of waterproof paper; print all information on the form using a lead pencil or a write-in-the-rain pen.
2. Navigate the boat to the sampling station using the UTM coordinates (in NAD 83) provided. Approach the station from downstream of the wind direction. In windy conditions, anchor the

boat upstream of the station and drift back; it is not necessary to anchor the boat in calm conditions providing the boat remains in the same position. Do not allow the anchor to drag through the sampling station. Record the UTM coordinates on the field data form.

3. Measure water depth at the sampling station using the transom-mounted Lowrance or other depth sounding device. Record total lake depth on the field data form. If you are in water that is too shallow (i.e., must have at least 5 meters depth), move to deeper water near the assigned station.
4. Lower the multiparameter probe in the lake and allow it to equilibrate with the ambient surface water conditions. Some instruments, such as the YSI ProPlus take time to stabilize when placed in the lake. Starting the multiparameter probe and putting in the water at the beginning of sampling allows the instrument to stabilize while setting up and collecting the water samples. This may not be necessary for other instruments. We leave this decision to the discretion of the field team.
5. Set up the water pump in the boat; attach the tubing to the pump using the C-clamps and attach the 12-V battery. Attach the 4-meter length of tubing to the intake valve, and the 1-meter length to the output valve. Attach the plastic-coated ball weight to the end of the 4-meter length of tubing. Lower the C-Flex tubing into the water to 3 meters depth and place the 1-meter length of tubing over the edge of the boat. Run the pump for 2 minutes to flush the sampling device.
6. Fill the pre-labeled sampling containers with unfiltered surface water directly from the pump. See the list of unfiltered samples in the table on the following page. The 1 L chlorophyll-a bottle can be reused, but triple rinse this bottle before collecting the sample to take back to the lab for filtering.
7. New in 2018 is the dissolved samples (metals, mercury, and DOC) will now be collected using a syringe and 0.45 µm disc filter provided by ALS.
    I) To collect the dissolved samples, you'll first need to fill a clean wide-mouth container with unfiltered water as described above. Any clean container will do, as long as it has an opening big enough to insert the syringe and take a sample. You can reuse this bottle between stations, just make sure it's triple rinsed like we do with the chlorophyll-a bottles that we bring back to the lab for filtering. Rinse the wide-mouth jar 3 times with lake water pumped from 3 m (same as filling the unfiltered samples).
    II) Draw a sample into the 60 mL syringe, attach as disc filter the syringe, and filter the sample into the dissolved metals container. DO NOT push too hard on the syringe. This can cause the disc filter to rupture and leak unfiltered water into the sample. If the sample is not filtering easily, change the disc filter. Take care to not drop unfiltered water from the syringe into the dissolved sample containers. If you do suspect unfiltered water entered the bottle accidentally, rinse with a small amount of dissolved water (~ 20 mL) twice before continuing with sample collection. Alternatively, you can use a new sample bottle from the spare set taken into the field.
    III) Repeat STEP II for the dissolved mercury and DOC samples at each station. You can use the same disc filter for metals, mercury, and DOC if the sample is filtering easily.
    IV) Arsenic speciation – dissolved samples for arsenic speciation analysis are periodically collected from the Whale Tail Pit study area lakes and reference areas (INUG and PDL). Consult with the Agnico Eagle Environment Coordinator on site or Project Coordinator (Eric Franz) to determine if arsenic speciation samples are required for a given event.

The arsenic speciation sample is collected as a bulk grab sample from the surface of the lake using the syringe. The pump is not used to collect arsenic speciation sample. Instead, collect the sample by placing the syringe below the surface and drawing up a sample. Once the syringe is full, attach the disc filter and prepare to fill the brown narrow-mouth HDPE bottle. Keep in mind that this bottle comes pre-charged with a small amount of EDTA solution; take care not to accidentally dump out the EDTA solution and do not rinse. The sample needs to be filled with no headspace. Fill the bottle approximately half full with dissolved sample, add the HCl acid, and then continue filling the bottle until a meniscus form at the top. Seal the lid tightly and place in the cooler.

8. If this sampling station is selected as the QAQC field duplicate, collect a second set of water samples, fill the pre-labeled sampling containers, including the phytoplankton vial and collect a second filtered chlorophyll-a sample. Record which sampling station the QAQC samples are collected from on the appropriate field data form.
9. Add the specified preservatives to the appropriate sampling containers (according to the information on the labels and the table on the following page [also included on the field data sheet), seal and mix thoroughly by turning upside down and then upright a number of times. Add preservatives in the field to avoid the possibility of dust from the lab entering the sample bottle.

Table 1. Bottle and preservatives for the CREMP water sampling program

Bottle	Parameters	Collected?	Preserved?
500 mL plastic	Conventional parameters		NO
500 mL plastic	TSS (low level), TDS (low level)		NO
125 mL amber	TOC, total P, NH3, TKN		Yes (H2SO4)
125 mL amber	DOC		Yes (H2SO4)
145 mL plastic	Cyanides		Yes (NaOH)
40 mL glass	Total mercury		Yes (HCl)
40 mL glass	Dissolved mercury		Yes (HCl)
60 mL plastic	Total metals *** new for 2019 no field acidification with nitric acid. This is now done by the lab when the samples arrive.		*** NO
60 mL plastic	Dissolved metals*** new for 2019 no field acidification with nitric acid. Filter samples as before, but the lab will do the acidification with nitric acid.		*** NO
1 L plastic	Chlorophyll-a (filter 500 mL at the lab)		NO
1 x 50 mL plastic	Phytoplankton		YES (Lugol's)
60 mL brown HDPE	Arsenic Speciation (bottle is pre-charged with EDTA. DO NOT RINSE. Fill with no headspace with filtered sample.		YES (EDTA and acetic acid)

10. Measure the light attenuation at the sampling station using the Secchi disk. Lower the disk into the water, on the shady side of the boat, so that you can no longer see it. Slowly raise the disk to the point that you can see it and measure this depth using the markings on the disk rope.
11. Measure the temperature (°C), specific conductance (i.e., temperature corrected) (µS/cm) and dissolved oxygen concentration (mg/L) in the water and record on the field data form. Lower the meter to a depth of 1 m and record the field measurements. Allow the concentrations on the meter to stabilize before recording the data. Continue recording the field measurements at 1 m depth intervals until you reach the whole meter mark above the lake bottom (i.e. if the lake depth is 9.3 meters, record field measurements up to a depth of 9 meters).

    It is important to ensure your instruments are calibrated, as mentioned above, but also to check that the readings are 'making sense' while collecting data in the field. If you notice that a reading is *abnormally low* (for DO) *or abnormally high* (for conductivity or temperature) and the meter appears to be working correctly, then you should collect a second water chemistry sample at the anomalous depth (following the steps below). To help guide field crew, the table below shows limnological parameter values (conductivity, DO, temperature) that should be achieved under normal circumstances. Note that these values are a guide for the open-water months only and for near-field stations only (TPE, TPN, SP, and WAL).

    The parameter value should be as indicated under normal circumstances, during each month-parameter combination.

Table 2. Upper limits for conductivity, temperature, and dissolved oxygen at the near-field study areas for the Meadowbank CREMP

Sampling Month	Parameter (units)	TPN	TPE	SP	WAL
July	Conductivity (µS/cm)	< 20	< 22	< 25	< 28
	Temperature (°C)	< 13	< 15	< 18	< 17
	DO (mg/L)	> 8	> 8	> 7	> 6
August	Conductivity (µS/cm)	< 28	< 31	< 38	< 35
	Temperature (°C)	< 12	< 14	< 14	< 16
	DO (mg/L)	> 6	> 7	> 7	> 8
September	Conductivity (µS/cm)	< 31	< 30	< 36	< 35
	Temperature (°C)	< 10	< 11	< 11	< 10
	DO (mg/L)	> 7	> 6	> 6	> 7

As an example, in August at station TPE, conductivity should be less than 31 µS/cm, temperature should be less than 14 °C, and DO should be greater than 7 mg/L. If the profile shows that at 7 meters depth conductivity is 36 µS/cm or that DO is 5 mg/L, for example, then collect a full water chemistry sample at 7 meters (no phytoplankton, no chlorophyll-a) following the steps below.

12. !!! Confirm all samples have been collected and the field data sheet is filled out before packing up the pump leaving the location.
13. Back in the office, to process the chlorophyll-a sample, use the hand-held pump apparatus and filters. Using the tweezers, place an ashless filter paper on the screen in the water filter apparatus, then screw the two sections together and attach the hand-held vacuum pump. Filter 500 mL of

water through the water filter apparatus. After filtering the 500 mL of water, remove the filter and place in the 15 mL black plastic tube provided by ALS. With a sharpie pen, write the appropriate sampling information on a label and stick to the plastic tube. Place the tubes in a Ziploc bag and put into the freezer. Mark on the field collection data sheet the volume of water filtered.

14. Until ready for shipping, the water samples are stored chilled in a refrigerator in camp, if space is available. The filter for chlorophyll-a analysis must be frozen; store this bag in a deep freezer in the camp. Bottles should be put in plastic bubble bags prior to storage on ice to protect the labels from water damage. The phytoplankton samples are stored at room temperature.
15. Fill out a chain-of-custody form for the water samples and filters being sent to ALS Environmental. The COC form must be completed carefully and, in its entirety, to ensure proper analysis. This includes listing all of the specific conventional parameters (see table above), Azimuth and ALS contact names, and checking off all of the specific boxes for requested analyses. The ALS laboratory quote number must be printed on the COC form to ensure proper billing. Note that there are pre-made COCs for ALS water chemistry – separated by Ground shipments, Express shipments and Chlorophyll-a. These have been separated because they will be shipped separately.

    A digital COC form is most commonly used; this form can be filled out in advance to ensure accuracy and efficiency and amended in the field as required. Note that using a digital copy of the COC requires printing 2 copies of the document in the field (one for the laboratory, one for Azimuth). Any questions regarding the COC form should be directed to the Azimuth project coordinator – Eric Franz. Put the completed COC form in a sealed ziploc plastic bag in a cooler with the water samples.
16. Fill out a chain-of-custody form for the phytoplankton samples being sent to Plankton R Us Inc., Winnipeg, MB. Complete all of the required fields and then put the form in a sealed ziploc plastic bag in the cooler with the phytoplankton samples.

QAQC Samples

Four different QAQC samples are required for each monthly sampling event:

1. **Field duplicate**: All parameters measured in the original sample are measured in the field duplicate. The sampling station is selected at random and labeled as station CREMP [month] DUP-1, -2, -3, -4, etc. Prepare the QAQC labels and affix to the sampling containers.
2. **Travel blank**: These are to be carried into the field and treated like the other sampling vessels except that the bottles are not to be opened or anything added to them. Ship back to the lab, each set with different shipment.
3. **Equipment blank and DI blanks**: During the open water sampling event, we recommend collecting the equipment and DI blanks from the boat to avoid the potential for dust or other debris from the lab entering the samples. Blanks can be collected from areas that are easily accessed by truck, such as Wally Lake, Second Portage, or Third Portage to avoid having to pack extra bottles and gear to harder-to-reach stations.

    Equipment Blank – To collect the equipment blank, set up the pump and tubing in the boat as you would to collect a surface water sample.

***IMPORTANT NOTE: The equipment and DI blanks are susceptible to inadvertent cross-contamination. We recommend dedicating a piece of C-Flex tubing just for collecting the equipment blank to avoid introducing dust or debris into the 4L jug of DI water.

I) Place the tubing in the lake and run the pump for a minimum of 2 minutes to flush out any old water. Remove the intake hose and let the pump run dry. Disconnect the pump.

II) Position one of the 4 L jugs of DI water close to the pump and place the tip of the intake and outlet tubing into the jug. Start the pump to recirculate the DI water in the 4 L jug for 2 minutes. DISCARD the DI water in this 4 L jug. Disconnect the pump.

III) Grab a second new 4-L jug of DI-water, connect the pump, and discharge approximately 2 L of DI water directly into the lake. Disconnect the pump.

IV) After discharging the DI water, begin filling the sample bottles for total (undissolved analyses) with the remaining 2 L plus whatever is needed from a third new 4-L jug of DI-water. For the filtered samples, pump some DI water into a clean container (250 mL TOC or other clean lab container) and collect using the syringe. Attach the 0.45 µm disc filter and filter the sample into the pre-labelled containers for dissolved metals, dissolved mercury and DOC. One (1) draw of the syringe will fill the metals bottle (60 mL). Discard any DI-water that is left in the 4-L jugs and recycle the empty jugs. Use the new COC, fill in for every parameter except chlorophyll-a. Label this sample according to the name listed in the Excel sheet for annual sample collection under the tab for whichever month you are in (e.g., May EB-1).

DI (De-ionized water) Blank: Using a second set of sample bottles you will be collecting a DI Blank. To do this, use another brand new 4-L jug of DI (do not use DI water from last year or DI water that you have just had the pump tubing sitting in!). You will simply fill the entire set of sample bottles using the new clean DI-water (you may need more than one 4-L jug) by pouring from the DI jugs into the sample bottles. Preserve as indicated above. You will NOT need to filter anything, as you will not be using the pump to collect these samples. Fill up sample bottles for dissolved parameters anyway. Add this sample to the same COC, fill in for every parameter except chlorophyll-a. Label this sample according to the name listed in the Excel sheet (e.g., May DI-1).

Packaging & Shipping Samples

ALS has reduced the volume of water needed to complete metals analysis, conventional parameters, TSS/TDS, and TOC. As a result, the smaller sample bottles and less volume have resulted in a significant reduction in weight of the shipment to ALS. Starting in 2018, all sample bottles bound for ALS can be shipped by Purolator Express.

1. Ensure all water samples are sealed securely. Pack water sampling containers upright in coolers with ice packs, and packing material, to ensure samples do not break during transport. (Ideal storage and transport temperature is 4°C and the coolers should arrive at ALS with an internal temperature less than 10°C). Chlorophyll-a samples tubes will be sent in their own mini cooler with plenty of ice packs.
2. Ensure the COC form is enclosed and then seal the cooler(s). Label the cooler(s) with the following address:

ALS Environmental
101-8081 Lougheed Hwy.
Burnaby, BC, Canada
V5A 1W9
Tel: 604-253-4188
Attention: Brent Mack

Notify Brent Mack at ALS (Brent.Mack@ALSGlobal.com) and the project coordinator at Azimuth when water samples are being sent to ALS.

3. Ensure phytoplankton samples are sealed securely and pack in a cooler with packing material to ensure samples do not break during transport. It is not necessary to keep samples cool.
4. Ensure the COC form is enclosed and then seal the cooler. Label the cooler with the following address:

   Plankton R Us Inc.
   Dave Findlay
   39 Alburg Drive
   Winnipeg, MB
   R2N 1M1
   Tel: 204-254-7952

5. Ship the phytoplankton samples to Dave Findlay at the end of each month or event.
6. Email electronic copies of the COC forms and field data sheets to the project coordinator at Azimuth at the of each sampling event.

APPENDIX A2

BENTHIC INVERTEBRATE & SEDIMENT SAMPLING

CREMP Standard Operating Procedures
Benthic Invertebrates & Sediment Sampling

Introduction

This standard operating procedure (SOP) outlines the procedure for collecting benthic invertebrates and supporting sediment chemistry parameters for the Core Receiving Environment Monitoring Program (CREMP). This SOP is specific to collecting sediment grabs using a petite ponar. A separate SOP outlines the process for collecting sediment cores.

Location and Timing for Field Activities

Study areas included in the CREMP benthic invertebrate sampling program are listed below (current to 2021). Lakes/basins may be added to the annual monitoring program in response to expanded mining activities (e.g., Whale Tail Pit Expansion Project) or removed as a routine monitoring station as active mining is scaled back in certain areas (e.g., Tehek Lake). Area-specific timing and frequency of monitoring is included in the recommendations section of the annual CREMP report.

Meadowbank	**Baker Lake**	**Whale Tail**
Inuggugayualik Lake (INUG)	Baker Lake – Akilahaarjuk Point (BAP)	Whale Tail Lake South Basin (WTS)
Pipedream Lake (PDL)	Baker Lake – Barge Dock (BBD)	Mammoth Lake (MAM)
Third Portage Lake East Basin (TPE)	Baker Lake – Proposed Jetty (BPJ)	Lake A20
Second Portage Lake (SP)		Lake A76
Wally Lake (WAL)		Lake DS1
Third Portage Lake South Basin (TPS)		Nemo Lake (NEM)
Tehek Lake (TE)		
Tehek Lake – Far-field (TEFF)		

Preplanning for the Benthic Invertebrate Sampling Program

Field activities are scheduled in August. Sampling is completed by staff with Azimuth Consulting Group in August. The sampling areas are well established in areas where the target water depth is 8 meters +/- 1.5 m. The following equipment and supplies should be ordered and shipped early in the calendar year so that any replacement equipment or restock of supplies can be arranged well ahead of planned sampling:

- Petite ponar, extra screens, pins, and rope – Two complete petite ponar should be available in case equipment is lost or damaged. Extra screens and pins are essential. Each Petite Ponar should have at least 12 m of braided fabric rope similar to rock climbing rope that is at ½” to ¾” thick. Nylon rope is not suitable for sampling sediment with a Petite Ponar. Inspect the rope before shipping field equipment and replace the rope if there is evidence of fraying. Some wear-and-tear is normal on the outer covering, but if the inner core of the rope is visible, replace it.

- Sieve bag – ship at least two 500 um sieve bags along with marine goop to repair minor tears or small holes. Inspect the bags before shipping field equipment and replace worn out sieve bags.
- Transom-mounted depth sounder – most of the boats at Meadowbank do not come outfitted with a depth sounder. A portable depth sounder is essential to identify sampling locations at the target water depth of approximately 8 m. The transducer can be mounted using a suction cup or by attaching it to a small stake and using a C-clap to attach the stake to the transom. Depending on the model, the depth sounder may run on power from a 12 V battery marine battery, alkaline batters (D cell), or a lithium-ion battery in the case of newer Garmin models. Familiarize yourself with the power source and ensure you have chargers / extra batteries.
- Sample containers and supplies – 500 mL HDPE jars are the preferred sampling containers for benthic invertebrate samples. Sediment for particle size and total organic carbon analyses can be collected in glass jars provided by the lab or Whirl-Pak® plastic bags. Composite samples for PAHs/LEHPs/HEPHs must be collected in glass jars. Pack at least 2 stainless steel bowls and spoons for scooping sediment from the petite ponar.
- Formalin – Transport Canada allows the free transport of formalin at concentrations less than 25% formaldehyde. Consequently, the formalin transported up to Meadowbank will be diluted in half (18.5% formaldehyde / 50% formalin solution). A 100% formalin solution is equivalent to a solution of 37% formaldehyde. The target formalin concentration in each of the sampling containers is 10%. A neutral buffered formalin solution is achieved by adding a sufficient amount of calcium carbonate powder or pellets to render the solution pH neutral (pH = 7.0). Borax powder may be substituted for calcium carbonate powder if necessary.

  To prepare the neutral buffered formalin, add a small amount of calcium carbonate powder or pellets to the 50% formalin solution, seal the container and shake until mixed. Check the pH of the solution using the pH pen. Continue adding the powder/pellets until the pH of the solution reaches approximately 7.0. Store at room temperature until ready to use. Only prepare the required volume of neutral buffered formalin for that sampling event. Buffered formalin will not store for long periods of time. Follow all safety precautions when preparing the formalin solution. Formalin is a carcinogen and irritant. Wear sampling gloves and safety glasses when mixing the solution and prepare the solution in a well-ventilated area.

  Include a copy of the MSDS sheet in the Action Packer/tote and ensure the Nalgene bottles are clearly labelled with the appropriate hazard warnings. Seal each 1 L Nalgene bottle in a plastic bag and store the bottles upright when shipping.

Preparing for Benthos & Sediment Chemistry Sampling

It is best practice to label the lids of all sampling containers using a permanent waterproof marker before going into the field. After collecting the samples at a given station, check to make sure the following information is recorded on the benthos sampling jars: Azimuth, project (i.e., CREMP), station abbreviation (e.g., TPE-1, INUG-3), date of sample collection, and the number of jars per sample (e.g., 1 of 2 &, 2 of 2). Sediment bags and containers only need to be labelled with the station abbreviation and the number of containers per sample; the date is recorded on the CoC.

Each day before getting ready to drive/fly to the sampling location, consult the boat checklist below to make sure you have all the necessary sampling equipment:

In the boat:

- Field collection data forms, waterproof paper, pencils, waterproof markers & clipboard
- GPS unit, batteries
- Depth sounder, batteries
- Petite ponar and rope
- 500-micron sieve bag
- 2 stainless-steel bowls
- 2 stainless-steel spoons
- Liquinox detergent and dish cleaning brush
- Plastic squirt bottles
- Sampling gloves
- Benthos jars (500 mL HDPE) and sediment chemistry jars/plastic bags
- Formalin (50% of pure Formaldehyde; diluted to 10% final concentration in each sample)
- Ashless filter paper & tweezers for filter swipes

In camp:

- Coolers, action packers (for storing and shipping samples)
- Ice packs (for shipping sediment samples to lab)
- Address labels for coolers
- Chain-of-custody forms
- Large Ziploc bags (for sending chain-of-custody form in coolers)
- Electrical tape (for sealing benthos jars)
- Packing tape (for affixing labels to sediment sample containers & sealing coolers)

Step-by-Step Guide to Collecting Sediment Using A Petite Ponar

The same basic approach to collecting sediment using a petite ponar applies to benthic invertebrate sampling and for collecting sediment chemistry. The sampling sequence at each replicate station starts with benthic invertebrate sampling followed by sediment collection for chemistry.

1. Prepare internal labels for each of the benthos containers. On a small piece of waterproof paper, write, using a lead pencil, the station abbreviation and replicate number (e.g., TPE-1). If no waterproof paper is available, use regular paper. Store the labels in their corresponding sampling container.
2. For QAQC purposes, sediment samples are collected in duplicate from 8 replicate station every sampling event (DUP + Swipe). All parameters measured in the original sample are measured in the field duplicate. The sampling station is selected randomly from the 65 replicate stations, and labeled as station DUP (or Swipe). Prepare the QAQC labels and affix to the sediment jars, as described in step 2. And label one new 125 mL glass jars with the Azimuth company name, date, QAQC filter and total metals for each swipe sample.
3. Before and during the benthos and sediment sampling fill in the requested information on the field data form; complete one field data form in its entirety for each sampling station and sampling event. Forms are made of waterproof paper; print all information on the form using a pencil or write-in-the-rain pen.
4. With the aid of a GPS unit, navigate the boat to the sampling station using the UTM coordinates (in NAD 83) provided. Approach the station from downstream of the wind direction. In windy conditions, anchor the boat upstream of the station and drift back; it is not necessary to anchor the boat in calm conditions providing the boat remains within a 50 meter radius of the position. Do not allow the anchor to drag through the sampling station. Record the UTM coordinates on the field data form.
5. Measure the water depth at the sampling station. It is recommended to use a transom mounted sonar to first “view” each rep location looking for a smooth, relatively flat lake bottom. Record the depth information on the field data form. Ensure sample depth is within the target (8 meters +/- 1.5 m).
6. Begin collecting the benthos samples. Collecting the sediment first would disturb the benthic community.
7. Ensure the rope is securely attached to the Ponar. Rinse the Ponar grab, 3 stainless steel bowls and a spoon with lake water. Wash each of these items with Liquinox soap by scrubbing with the dish cleaning brush and then thoroughly rinse with lake water. Put aside two stainless steel bowls and spoon until later (step 18) and ready the largest stainless bowl for the Ponar.
8. Lower the Ponar to within 1 meter of the bottom of the lake. Lower the Ponar very slowly over the last meter and allow the rope to go slack. Raise the Ponar to the edge of the boat and check the grab for acceptability. The grab is acceptable if the sample:
   - does not contain large foreign objects;
   - has adequate penetration depth (i.e., 10-15 centimeters though in some locations if the substrate is particularly hard it may be necessary to accept smaller grabs);
   - is not overfilled (sediment surface must not be touching the top of the Ponar, though in reality there will be occasions when the Ponar is full, careful judgment is required to determine if the grab is too full);
   - did not leak (there is overlying water present in Ponar); and
   - is undisturbed (sediment surface relatively flat).

If the grab is deemed acceptable, open the Ponar jaws and drop the sample into the large stainless-steel bowl. Rinse the ponar with squirt bottles to make sure all of the material is in the bowl. Gently pour the contents of the bowl into the 500-micron sieve bag.

9. Sieve the sample in the lake water until only the benthic organisms and coarse materials remain. Care must be taken to ensure the benthic organisms are not damaged or crushed. Do not disturb the sample to the point that it is splashing out of the sieve. Do not forcibly push materials through the sieve; gently massage apart any small clay balls. Rinse off any pieces of larger plant material or rocks in the sample and discard.
10. Flush the remaining sample in the bottom of the sieve into the pre-labeled plastic sampling container (i.e., station-1 jar). A plastic squirt bottle filled with lake water is useful for this purpose.
11. Repeat steps 10-12, flushing the sample into the same pre-labeled plastic sampling container (i.e., station-1 jar). Ensure the sample is collected in an area not previously disturbed by the Ponar. The two independent grabs (per replicate) are composited to increase the surface area sampled.
12. Rinse the sieve bag to clear out any debris in the screen. To rinse, hold the sieve upside down and raise and lower the sieve into the water.
13. Refer to step 18. At this point while you are still at the first rep you can also collect the Ponar grabs for the sediment chemistry composite.
14. Repeat steps 10-14 four more times; there must be a separation of *20 meters* or more from other replicate stations. Prior to collecting the next REP, clean ponar and both bowls with Liquinox and scrub brush, rinse with lake water. Record the depth and GPS coordinates of each replicate station on the field data form. Put the samples from each replicate in pre-labeled station replicate jars 2 through 5. In total, 10 Ponar grabs will be collected for benthos collection, two grabs per replicate.
15. Ensure internal labels are in each sample container. Shake the formalin to ensure all of the calcium carbonate powder is in solution. Add a sufficient volume of formalin to each sampling container to make a corresponding formalin solution of approximately 10%. Volumes of formalin are added by ‘eye’ (for a 10% solution, a ratio of 4 parts water and 1 part 50% formalin solution). Overall, there must be enough liquid in the jar to cover the entire sample. Seal the sample container securely and gently roll the container to mix the sample and formalin solution. Do not shake the sample container; this will crush the benthic organisms inside.
16. Begin collecting the sediment samples. Lower the Ponar to within 1 meter of the bottom of the lake, in an area not previously disturbed by the Ponar. Lower the Ponar very slowly over the last meter and allow the rope to go slack. Raise the Ponar to the edge of the boat and check the grab for acceptability (see step 10 for criteria).
17. Once the grab is deemed acceptable, open the top of the Ponar and remove any overlying water. Using the pre-cleaned stainless-steel spoon, scoop out the top 3-5 centimeters of sediment and place in the pre-cleaned stainless-steel bowl. Empty the remainder of the grab sample into a bucket in the boat, not directly into the lake, to ensure the area is not disturbed.
18. Repeat steps 16 and 17 one more time, placing the sediment into the bowl with the other sediment sample(s).

19. Homogenize the sediment samples in the stainless-steel bowl (by stirring with the spoon) until the sediment is thoroughly mixed. Scoop the sediment into pre-labeled sediment sampling containers. Fill the jars to the top and seal securely.
20. Add one level-scoop of sediment from the sediment chemistry bowl to the last, clean, stainless bowl. This process is completed at each rep until there are 5 good scoops (one from each rep) in the “composite” bowl. Homogenize thoroughly and fill 1 x 125 mL jar for analysis (LEPHs & HEPHs, MOG, and PAHS). Be sure label ID includes “COMP” (e.g., TPE-COMP).
21. If this station is selected as the QAQC field duplicate, using the tweezers and a set of clean sampling gloves, swipe the stainless-steel bowl and spoon with one piece of ashless filter paper (or a “ghost wipe”) and store in the pre-labeled 125 mL glass jar. Collect the duplicate sediment sample from the same sediment collected in steps 18-20. Fill the sampling containers labeled as station DUP. Record that the QAQC samples were collected from this sampling station on the field data form.
22. Complete the field data form, including a description of the sediment (grain size, consistency, colour, presence of biota, sheen, unusual appearance) and the sampling effort (equipment failure, control of vertical descent of sampler) required to collect the benthos and sediment samples.
23. Rinse out the Ponar, stainless steel bowl and spoon with lake water. Dump the sediment and water from the plastic bin into the lake.
24. Until ready for shipping, store the sediment samples and QAQC filter paper chilled (on ice) in a cooler or in a refrigerator in camp, if space is available. The sediment sampling containers may be put in plastic bags prior to storage on ice to further protect the labels from water damage. Benthos samples are stored in a cooler or action packer at room temperature.
25. Fill out a chain-of-custody form for the sediment samples being sent to ALS Environmental. The COC form must be completed carefully and, in its entirety, to ensure proper analysis. This includes listing all of the specific parameters to be analyzed (see step 2), Azimuth and ALS contact names, and checking off all of the specific boxes for requested analyses. The ALS laboratory quote number must be printed on the COC form to ensure proper billing.
26. A digital COC form is most used; this form can be filled out in advance to ensure accuracy and efficiency and amended in the field as required. However, using a digital copy of the COC requires printing 2 copies of the document in the field (one for the laboratory, one for Azimuth). Any questions regarding the COC form should be directed to the Azimuth project coordinator – Marianna DiMauro. Put the completed COC form in a sealed Ziploc plastic bag in the cooler with the samples.
27. Fill out a chain-of-custody form for the benthos samples being sent to Zaranko Environmental Assessment Services (ZEAS). Complete all the required fields and then put the form in a sealed Ziploc plastic bag in the cooler with the benthos samples.

Packaging & Shipping Samples

1. Ensure all sediment samples are sealed securely. Pack sediment sampling containers upright in a cooler with ice packs, and packing material, to ensure containers do not break during transport. (Ideal storage and transport temperature is 4°C).

2. Ensure the COC form is enclosed and then seal the cooler(s). Label the cooler(s) with the following address:
   ALS Environmental
   101-8081 Lougheed Hwy.
   Burnaby, BC, Canada
   V5A 1W9
   Tel: 604-253-4188
   Attention: Brent Mack
3. Ensure benthos samples are sealed securely. Wrap electrical tape around the edge of the lids to ensure a tight seal. Pack benthos sampling containers upright in a cooler or action packer; ensure the cooler/action packer is well packed so the jars are not able to move around.
4. Ensure the COC form is enclosed and then seal the cooler(s). Label the cooler(s) with the following address:
   Zaranko Environmental Assessment Services (ZEAS)
   36 McCutcheon Avenue
   P.O. Box 1045
   Nobleton, ON
   L0G 1N0
   Tel: 905-859-7976
5. Ship the sediment samples to ALS Environmental as quickly as possible. Ship the benthos samples to ZEAS when convenient. Coordinate shipping with the camp manager.
6. Email electronic copies of the COC forms and field data sheets to the project coordinator at Azimuth at the of each sampling event.

Table 1. Laboratory data quality objectives (from ALS) for sediment chemistry analyses.

Parameter	Target D.L.	Units	Accuracy [1] DQO	Matrix Spike [2] DQO	Precision [3] (RPD) DQO	Hold Times	Bottle Required	Volume Required	Method Reference
Soil - Physical Tests									
Moisture	0.25	%	90-110%	n/a	20%	14 days	Glass	125 ml	ASTM D2974-00 Method A
pH (1:2 soil:water)	0.10	pH	± 0.3 pH units	n/a	± 0.3 pH units	1 year	Glass	125 ml	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL
Soil - Particle Size									
% Gravel (>2mm)	0.10	%	LTM ± 5% [5,6]	n/a	Diff < 5% [6]	6 months	Glass	125 ml	SSIR-51 METHOD 3.2.1
% Sand (2.0mm - 0.063mm)	0.10	%	LTM ± 5% [5,6]	n/a	Diff < 5% [6]	6 months	Glass	125 ml	SSIR-51 METHOD 3.2.1
% Silt (0.063mm - 4um)	0.10	%	LTM ± 5% [5,6]	n/a	Diff < 5% [6]	6 months	Glass	125 ml	SSIR-51 METHOD 3.2.1
% Clay (<4um)	0.10	%	LTM ± 5% [5,6]	n/a	Diff < 5% [6]	6 months	Glass	125 ml	SSIR-51 METHOD 3.2.1
Soil - Organic / Inorganic Carbon									
Total Organic Carbon	0.10	%	80-120%	70-130%	30%	28 days	Glass	125 ml	SSSA (1996) p. 973
Soil - Metals									
Aluminum (Al)	50	mg/kg	70-130% [4]	n/a	40%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Antimony (Sb)	0.10	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Arsenic (As)	0.100	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Barium (Ba)	0.50	mg/kg	70-130% [4]	n/a	40%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Beryllium (Be)	0.10	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Bismuth (Bi)	0.20	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Boron (B)	5.0	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Cadmium (Cd)	0.020	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Calcium (Ca)	50	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Chromium (Cr)	0.50	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Cobalt (Co)	0.10	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Copper (Cu)	0.50	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Iron (Fe)	50	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Lead (Pb)	0.50	mg/kg	70-130% [4]	n/a	40%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Lithium (Li)	2.0	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Magnesium (Mg)	20	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Manganese (Mn)	1.0	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Mercury (Hg)	0.0050	mg/kg	70-130% [4]	n/a	40%	28 days	Glass	125 ml	EPA 200.2/1631E (mod)
Molybdenum (Mo)	0.10	mg/kg	70-130% [4]	n/a	40%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Nickel (Ni)	0.50	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Phosphorus (P)	50	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Potassium (K)	100	mg/kg	70-130% [4]	n/a	40%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Selenium (Se)	0.20	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Silver (Ag)	0.10	mg/kg	70-130% [4]	n/a	40%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Sodium (Na)	50	mg/kg	70-130% [4]	n/a	40%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Strontium (Sr)	0.50	mg/kg	70-130% [4]	n/a	40%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Thallium (Tl)	0.050	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Tin (Sn)	2.0	mg/kg	70-130% [4]	n/a	40%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Titanium (Ti)	1.0	mg/kg	70-130% [4]	n/a	40%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Uranium (U)	0.050	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Vanadium (V)	0.20	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Zinc (Zn)	2.0	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)
Zirconium (Zr)	1.0	mg/kg	70-130% [4]	n/a	30%	6 months	Glass	125 ml	EPA 200.2/6020A (mod)

Table 1 con't. Laboratory data quality objectives (from ALS) for sediment chemistry analyses.

Parameter	Target D.L.	Units	Accuracy[1] DQO	Matrix Spike[2] DQO	Precision[3] (RPD) DQO	Hold Times	Bottle Required	Volume Required	Method Reference
Soil - Aggregate Organics									
Mineral Oil and Grease	500	mg/kg	70-130%	60-140%	40%	28 days	Glass	125 ml	CCME PETROLEUM HYDROCARBONS-GRAVIMETRIC
Soil - Hydrocarbons									
EPH10-19	200	mg/kg	70-130%	60-140%	40%	14 days	Glass	125 ml	BC MOE EPH GCFID
EPH19-32	200	mg/kg	70-130%	60-140%	40%	14 days	Glass	125 ml	BC MOE EPH GCFID
LEPH	200	mg/kg	70-130%	60-140%	40%	14 days	Glass	125 ml	BC MOE LABORATORY MANUAL (2005)
HEPH	200	mg/kg	70-130%	60-140%	40%	14 days	Glass	125 ml	BC MOE LABORATORY MANUAL (2005)
Soil - Polycyclic Aromatic Hydrocarbons									
Acenaphthene	0.0050	mg/kg	60-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270
Acenaphthylene	0.0050	mg/kg	60-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270
Anthracene	0.0040	mg/kg	60-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270
Benz(a)anthracene	0.010	mg/kg	60-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270
Benzo(a)pyrene	0.010	mg/kg	60-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270
Benzo(b)fluoranthene	0.010	mg/kg	60-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270
Benzo(b+j+k)fluoranthene	0.015	mg/kg	60-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270
Benzo(g,h,i)perylene	0.010	mg/kg	60-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270
Benzo(k)fluoranthene	0.010	mg/kg	60-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270
Chrysene	0.010	mg/kg	60-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270
Dibenz(a,h)anthracene	0.0050	mg/kg	60-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270
Fluoranthene	0.010	mg/kg	60-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270
Fluorene	0.010	mg/kg	60-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270
Indeno(1,2,3-c,d)pyrene	0.010	mg/kg	60-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270
2-Methylnaphthalene	0.010	mg/kg	60-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270
Naphthalene	0.010	mg/kg	50-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270
Phenanthrene	0.010	mg/kg	60-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270
Pyrene	0.010	mg/kg	60-130%	50-140%	50%	14 days	Glass	125 ml	EPA 3570/8270

Notes: All jars should be kept cool from sampling to lab receiving.

[1] Accuracy is measured as Percent Difference from True Value or Certified Target for Reference Materials and/or Method Analyte Spikes and Surrogates where applicable. For Matrix Spikes, accuracy is measured as the measured amount minus the sample background amount divided by the spiked amount. For low level results the accuracy objective is for the measured result to lie within +/- 1 times the LOR from the target.

[2] Matrix Spike (MS) recovery, expressed as a percentage is defined as:
100 * {[(Measured Concentration) - (Background Analyte Concentration in Sample)] ÷ (Spike Concentration)}
High analyte background may prevent accurate determination of MS recovery. MS recoveries are not calculated or evaluated when the spiked amount is less than the background analyte concentration in the sample.

[3] Precision is measured as the absolute value of Relative Percent Difference (RPD) for Laboratory Duplicate Samples. RPD = |(Result2 - Result1) / Mean| * 100. For low level results, the precision objective is for the difference of the two results to be less than 2 times the LOR.

[4] Accuracy targets for metals in soils are expressed relative to the ALS long term mean for each method where certified method-specific reference material targets are unavailable. Full recovery of matrix-bound elements is not expected or intended for environmental acid digestion methods.

[5] Long Term Mean (LTM) ± 5% sand, silt, clay.

[6] The recovery is calculated from the absolute difference (DIFF).

APPENDIX A3

SEDIMENT CORE SAMPLING

CREMP Standard Operating Procedures
Sediment Core Sampling

Introduction

This standard operating procedure (SOP) outlines the procedure for collecting sediment core samples for chemistry for the Core Receiving Environment Monitoring Program (CREMP). The SOP describes the field methods for collecting sediment core samples from a boat.

Location and Timing for Field Activities

Study areas included in the CREMP sediment coring program are listed below (current to 2021). Lakes/basins may be added to the annual monitoring program in response to expanded mining activities (e.g., Whale Tail Pit Expansion Project) or removed as a routine monitoring station as active mining is scaled back in certain areas (e.g., Tehek Lake). Area-specific timing and frequency of monitoring is included in the recommendations section of the annual CREMP report.

Meadowbank	Baker Lake	Whale Tail
Inuggugayualik Lake (INUG)	Baker Lake – Akilahaarjuk Point (BAP)	Whale Tail Lake South Basin (WTS)
Pipedream Lake (PDL)	Baker Lake – Barge Dock (BBD)	Mammoth Lake (MAM)
Third Portage Lake East Basin (TPE)	Baker Lake – Proposed Jetty (BPJ)	Lake A20
Second Portage Lake (SP)		Lake A76
Wally Lake (WAL)		Lake DS1
Third Portage Lake South Basin (TPS)		Nemo Lake (NEM)
Tehek Lake (TE)		
Tehek Lake – Far-field (TEFF)		

Field activities are scheduled for every three years, coinciding with the EEM program. The sampling areas are located in the same basins as the benthos stations. Sampling occurs in mid/late August. The target water depth at each sampling station is approximately 8 meters +/- 1.5 m.

Sediment Coring Program

An average top 1.5 cm of sediment chemistry at all CREMP stations will be characterized using sediment cores. Note that this complements, rather than replaces, the grab samples (top 3 to 5 cm) collected synoptically with benthic community samples in late August. This is in addition to the traditional composite sample using the petite Ponar grab. Ten (10) independent cores are to be collected from each of the stations. Cores will be collected within a 250 m radius around the center of each sampling area.

The intent is to collect cores over a wide area, targeting depths of 6.5-9.5 m to match benthos sampling within the basin being sampled. The protocol for collecting sediment cores is as follows:

1. Core sampling is conducted prior to benthic sampling and will most often be paired with benthic sampling reps. Consideration can be given to identifying core sample locations prior to field collections.
2. If conditions are windy, anchor the boat. If calm, anchoring is not necessary. Survey the area to be sampled with the sonar to determine bottom type.
3. Deploy the corer from the boat and try to ensure that the core barrel is perpendicular with the surface before penetration. Depending on results, the corer can free-fall from 1 m above the surface. Avoid sampling over steep gradient slopes or over coarse grain substrate.
4. When the boat is anchored, deploy the corer from the boat and lower it when the boat has reached its furthest point in its swing to the right. This will be an odd numbered core. For the second core wait until the boat swings to the left, check the GPS to make sure this is around 5 m from the first core. This core will be an even numbered core. Cores can be taken from new locations each time and do not need to be at the exact same location as the other benthos work.
5. Raise the core to just below the water surface and cap prior to bringing above the water to ensure sediment is not lost out the bottom.
6. Check to make sure that the surface of the core is intact and is not mixed or disturbed and that the overlying water is clear. Record water depth and UTM location (NAD 83) of all successful core samples.
7. Process the core on the boat. Decant overlying water and collect only the top 1.5 cm of sediment.
8. Place the entire 1.5 cm slice into a 125 mL glass jar. Discard the remaining core sample. Replicate stations with loose sediment (high moisture content) may require compositing 2x1.5 cm core samples to provide enough sediment to complete all the analyses.
9. Label the jars as per CREMP protocol (e.g., TPN-x) but with a suffix indicating a core sample (e.g., TPN-SC-01 to TPN-SC-10).
10. Fill in the data sheet and record any observations about the core sample such as presence of varves, distinct changes in color, grain size, or any other unusual features.
11. Repeat the procedure above until all 5 or 10 core samples (depending on the needs outlined in the planning phase) have been collected, randomly covering the general area depicted on the map.
12. Ten cores are collected at the near-field and reference areas. Sampling at mid- and far-field locations is not required unless there are statistically significant changes detected in the near-field benthic invertebrate community.
13. Randomly from one of the 10 coring locations, take a duplicate core (independent deployment of corer) for QAQC purposes.
14. Even number core samples will be archived for those sites where ten samples are collected.
15. All core samples are to be analysed for total metals, pH and total organic carbon. Fill in CoCs as necessary.
16. Hold on ice or in the refrigerator until shipping to ALS, Vancouver.

17. Fill out a chain-of-custody form for the sediment samples being sent to ALS Environmental. The COC form must be completed carefully and in its entirety to ensure proper analysis. This includes listing all of the specific parameters to be analyzed (see step 2), Azimuth and ALS contact names, and checking off all of the specific boxes for requested analyses. The ALS laboratory quote number must be printed on the COC form to ensure proper billing.
18. A digital COC form is most commonly used; this form can be filled out in advance to ensure accuracy and efficiency and amended in the field as required. However, using a digital copy of the COC requires printing 2 copies of the document in the field (one for the laboratory, one for Azimuth). Any questions regarding the COC form should be directed to the Azimuth project coordinator – Marianna DiMauro. Put the completed COC form in a sealed Ziploc plastic bag in the cooler with the samples.

Packaging & Shipping Samples

1. Ensure all sediment samples are sealed securely. Pack sediment sampling containers upright in a cooler with ice packs, and packing material, to ensure containers do not break during transport. (Ideal storage and transport temperature is 4°C).
2. Ensure the COC form is enclosed and then seal the cooler(s). Label the cooler(s) with the following address:
   ALS Environmental
   101-8081 Lougheed Hwy.
   Burnaby, BC, Canada
   V5A 1W9
   Tel: 604-253-4188
   Attention: Brent Mack
3. Email electronic copies of the COC forms and field data sheets to the project coordinator at Azimuth at the of each sampling event.

APPENDIX B
WATER QUALITY TRIGGERS – 2019 UPDATE

Report Version

Date	Document
December 2012	Appendix A – Statistical Analyses for Water Chemistry. In: *Core Receiving Environment Monitoring Program (CREMP): Design Document 2012* -> First iteration of the water chemistry triggers for Meadowbank and Baker Lake study areas
March 2014	Appendix A – Updated Threshold and Trigger Development for CREMP Water Parameters. In *CREMP 2013 Annual Report*. -> Triggers developed specifically for Wally Lake -> Minor updates to the triggers
March 2015	Appendix A – Updated Threshold and Trigger Development for CREMP Water Parameters. In *CREMP 2014 Annual Report*. -> Minor updates to include more recent water chemistry data -> New thresholds added from other jurisdictions for parameters not covered by the CCME freshwater aquatic life guidelines
November 2015	Appendix D – Updated threshold and trigger development for CREMP water parameters. In: *Core Receiving Environment Monitoring Program (CREMP): 2015 Plan Update* -> No change from previous version. Re-packed for the updated CREMP Design Document
March 2020	Appendix I – Water Quality Triggers – 2019 Update. In *CREMP 2019 Annual Report* -> New triggers for the Whale Tail Pit study area lakes -> Revised triggers for Meadowbank, Wally, and Baker Lake study areas based on updated thresholds published since 2015.

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1 INTRODUCTION

This version of the Water Quality Triggers for the Core Receiving Environment Monitoring Program (CREMP) was originally prepared as an appendix in the 2019 CREMP (Appendix I; Azimuth, 2020). Updates to the water quality triggers and thresholds were completed in 2019, coinciding with the first year of before-after / control-impact (BACI) data analysis for the Whale Tail Pit Project. With the exception of a revised threshold for strontium (1.7 mg/L to 2.5 mg/L), and corresponding update to the trigger value, the 2019 version of the water quality triggers still applies.

Future Revisions to the Water Quality Triggers

Environment and Climate Change Canada (ECCC) has been developing Federal Environmental Quality Guidelines (FEQGs) as part of the Chemicals Management Plan to support federal environmental quality monitoring, risk assessment, and risk management activities on substances for which there are no Canadian Council of Ministers of the Environment (CCME) guidelines or in cases where the guidelines are unlikely to be updated. The FEQGs for strontium, as well as cobalt, and vanadium were adopted in the 2019 update to the water quality triggers. Since 2019, FEQGs have been finalized for copper (biotic ligand model) and lead, with draft FEQGs out for public comment for iron (under revision), aluminum, and selenium (public comment period ending in August 2021). The next iteration of the water quality triggers will assess whether new FEQGs or guidelines from other jurisdictions should replace existing and outdated CCME water quality guidelines.

2 THRESHOLDS AND TRIGGERS

2.1 Data

The data used to develop triggers were the standard control (“baseline”) samples – duplicates and depth replicates were excluded as they are pseudo-replicates of standard samples. All baseline samples through September 2019 were used. The number of baseline samples collected for each system was 351 for Meadowbank study area lakes/basins, 34 for Wally Lake, 64 for Baker Lake, and 306 for the Whale Tail study area lakes. The development of triggers was based on baseline data specific to each system (Meadowbank, Wally, Baker Lake, and Whale Tail). The control/impact status of all CREMP sampling areas since the beginning of monitoring is outlined in **Table 1** (current to the end of 2019).

2.2 Methods

There are three basic methods of trigger development as follows:

1. When a threshold (e.g., CCME guideline) was established, the trigger was set as the maximum of the value halfway between the baseline median and the threshold (*Method A*), or the 95th percentile of the baseline data (*Method B*).
2. When a threshold was not established, the trigger was set equal to the maximum of either the 95th percentile of the baseline data (*Method B*) or two times the current detection limit (*Method C*).

Medians and 95th percentiles were chosen as metrics rather than means, standard deviations, or maximums, because the former are generally robust to skewed distributions and potential outliers. When required, robust methods were used to estimate medians and 95th percentiles to account for values below detection limits (i.e., censored data; Helsel, 2011). The analytical procedures for a given variable were as follows. First, all data reported detection limits greater than the maximum observed value were removed (such values contain no information regarding summary statistics of the data distribution; Helsel, 2011). Next, classical estimates of medians and 95th percentiles were computed if possible (i.e., when there was the required number of observations exceeding detection limits). When there was insufficient data to compute a classical estimate, the median and/or 95th percentile were estimated using the robust "Regression on Order Statistics" (ROS) method as recommended by Helsel (2011) and implemented in the function "cenros" in the R package NADA. However, Helsel (2011) suggests that estimates of summary statistics such as the median are typically unreliable when more than 80% of the observations are censored (below detection limits). Thus, ROS estimates were only used when at least 20% of the observations were above detection limits. When a threshold was established but there was no viable estimate of the median, the current detection limit was used in *Method A* above. When a threshold was not established and there was no viable estimate of the 95th percentile, *Method C* was used.

There were special considerations for several variables, specifically t-Al, t-Cd, t-Mn, t-Zn, d-Al, ammonia-N, t-P, pH and TSS. These cases are explained in detail below.

2.3 Results

Thresholds for the 2019 trigger update are summarized in **Table 2**. For comparative purposes, the previous threshold values from the 2014 update are included in the table, along with updated references for those parameters with threshold values that have changed. In most cases, the threshold was equal to a given guideline, but there were exceptions for a few variables as discussed below. Note that in cases where a water quality guideline exists but Method B was used for trigger development (i.e., cases where baseline data already exceed the guideline for > 5% of cases), it is possible for the trigger to equal or exceed the guideline (e.g., this occurs for total phosphorus, several lower pH triggers, and the Baker triggers for chloride and total/dissolved strontium). In such cases, the guideline is reported as the threshold but is not used as a criterion for action; rather, the trigger is the only criterion for action as is the case for variables lacking water quality guidelines.

There are three variables (t-Cu, t-Pb, t-Ni) for which the water quality guidelines are specific to water hardness ranges below 82, 60, and 60 mg/L $CaCO_3$, respectively. Hardness levels for baseline samples were consistently below 60 mg/L $CaCO_3$ in all four systems. For example, the 95th percentiles for hardness were 9.5, 16.7, 64.7, and 17.4 mg/L $CaCO_3$ for Meadowbank (**Table 3**), Wally (**Table 6**), Whale Tail (**Table 9**), and Baker (**Table 12**), respectively. Thus, for these three variables, the guidelines associated with low hardness ranges were used as thresholds.

There were several variables that warranted special consideration in the development of thresholds and/or triggers. These are discussed in the following sections.

Ammonia (as N)

The CCME guideline for total ammonia in freshwater is pH and temperature dependent, with more stringent guidelines applying at higher pH and higher temperature (CCME, 2010). The proposed threshold for Ammonia-N (all systems) was conservatively derived using two discrete CCME guidelines corresponding to specific pH and temperature values. Note that the maximum pH among baseline data for Meadowbank/Wally/Baker/Whale Tail is 8.85, while maximum temperatures in the lakes are around 16 to 18 degrees. The two CCME guidelines that span these maximum (i.e., worst-case) conditions are as follows: (1) total ammonia = 0.239 mg/L for pH = 8.5 and temperature = 15 degrees; and (2) total ammonia = 0.067 mg/L for pH = 9.0 and temperature = 20 degrees. The mid-point of these two values is 0.153 mg/L, which when converted from total ammonia to total ammonia as N is 0.126 mg/L.

Thus, the proposed threshold for ammonia-N is 0.126 mg/L. Application of this threshold provided trigger values of 0.065, 0.067, 0.066, and 0.065 mg/L respectively for Meadowbank (**Table 3**), Wally (**Table 6**), Whale Tail (**Table 9**), and Baker (**Table 12**). Only at extreme pH and temperature would this trigger potentially exceed the CCME guideline. Whenever the trigger is exceeded, the concentrations of ammonia-N should be compared to the CCME guideline based on the specific pH and field temperature of each sample.

Total Phosphorus

The CCME does not specify a particular guideline for total phosphorus, but instead establishes a guidance framework for site-specific application (CCME, 2004). Under that framework, the specification for ultra-oligotrophic lakes is for total-P of <0.004 mg/L. The framework notes that up to a 50% increase in total-P over baseline is generally considered acceptable. Regardless, the 95th percentiles for Total-P exceeded 0.004 mg/L for Meadowbank (**Table 3**), Wally (**Table 6**), Whale Tail (**Table 9**), and Baker (**Table 12**) study areas. Consequently, the proposed lake-specific triggers were set equal to these 95th percentiles (Method B).

pH

The CCME guideline for pH in freshwater is a range from 6.5 to 9.0. Thus, for pH, there is both an upper threshold (9.0) and a lower threshold (6.5), with associated upper and lower triggers. In all cases except for laboratory pH at Wally Lake, the lower trigger was based on Method B because the 5th percentiles of the baseline data were close to or less than the lower threshold of 6.5. The upper and lower pH trigger values are provided in: Meadowbank (**Table 3**), Wally (**Table 6**), Whale Tail (**Table 9**), and Baker (**Table 12**).

Total Suspended Solids

For water bodies with low natural TSS, the CCME guideline is a maximum increase of 25 mg/L over background for short periods (e.g., 24h) and a maximum increase of 5 mg/L over background for longer periods (e.g., 24h to 30 days) (CCME, 2002). If we conservatively assume a background TSS of 0 mg/L, then thresholds of 25 mg/L and 5 mg/L would apply for short-term and long-term exposures, respectively. However, because sampling occurs at most once per month, it will be unknown whether a given TSS measure is a short-term (< 24 h) or longer term (> 24 h) phenomenon. We therefore propose a TSS trigger based on the lower threshold of 5 mg/L, which thereby addresses both short and long durations. The resulting triggers, based on Method A, were 3.0 mg/L for all four systems: Meadowbank (**Table 3**), Wally (**Table 6**), Whale Tail (**Table 9**), and Baker (**Table 12**)..

Total Aluminum[1]

The CCME guideline for t-Al in water is 0.005 mg/L when pH < 6.5, and 0.1 mg/L when pH ≥ 6.5 (CCME,). Across baseline samples for Meadowbank/Wally/Baker/Whale Tail (n = 648), there were 29 cases of pH < 6.5, and 19 of these occurred during the months of July, August, and September in 2014 (at stations INUG, PDL, TPS, and TEFF). Since September 2014, there was only one baseline sample with pH < 6.5 (pH = 6.41 at station A20 in April 2016, with t-Al = 0.0033 mg/L).

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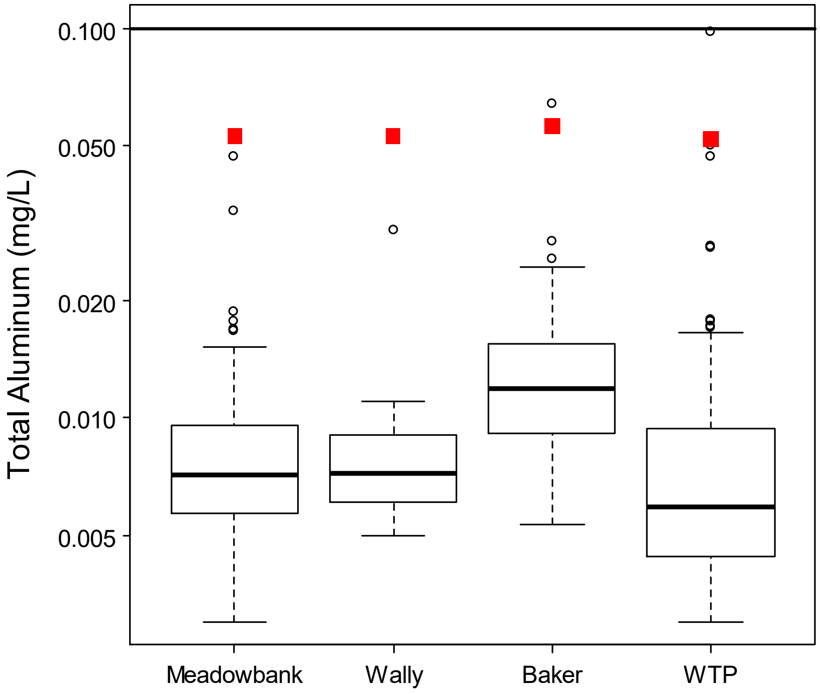
[1] Environment and Climate Change Canada published a draft Federal Environmental Quality Guideline (FEQG) for total aluminum in June 2021. The FEQG is site-specific, varies with DOC, hardness, and pH. The next revision of the Water Trigger appendix will include a review of the FEQG for aluminum and its suitability for establishing a new trigger value for the CREMP study areas.

Given the strong tendency for pH to equal or exceed 6.5 across baseline samples, the CCME guideline of 0.1 mg/L was adopted as the threshold for t-Al, and triggers were computed for each system based on Method A: Meadowbank (**Table 4**), Wally (**Table 7**), Whale Tail (**Table 10**), and Baker (**Table 13**). For example, across the 351 Meadowbank samples, the median t-Al was 0.006 mg/L and the 95th percentile was 0.013 mg/L (**Table 4**). Based on Method A, the value halfway between the median t-Al and the threshold is 0.053 mg/L (i.e., [0.1 – 0.006]/2 = 0.053), which is larger than the 95% percentile (Method B), and thus the proposed trigger for Meadowbank t-Al is 0.053 mg/L. Similar trigger values were computed for Wally, Whale Tail and Baker. As an example, **Figure 1** shows box-plots of t-Al values (> DL; in log scale) for each system, as well as the guideline (solid line) and triggers (solid red squares).

Figure 1. Trigger values for total aluminum (mg/L) for each study area.

Notes: Black line = CCME freshwater aquatic life guideline; red squares = trigger values for each study area.



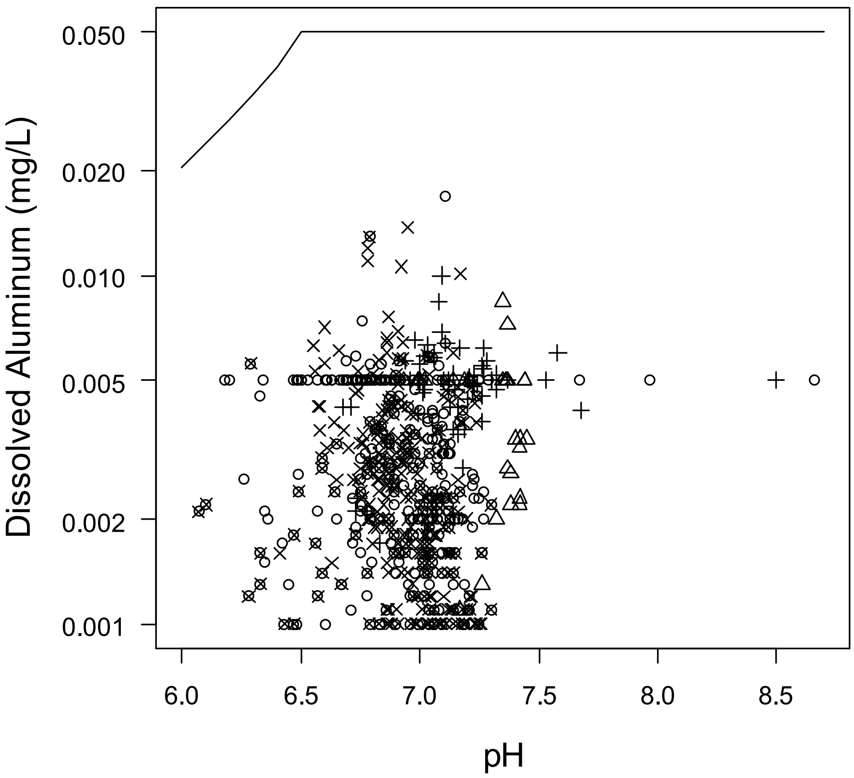
Dissolved Aluminum

There is no CCME guideline for d-Al in water. However, a pH-dependent water quality guideline for d-Al (mg/L) has been developed by BC MOE for protection of freshwater aquatic life (BC MOE, 2001a). For pH < 6.5, the guideline is as follows: d-Al = $e^{(1.6-3.327*pH + 0.402*K)}$ where K = pH^2. For pH ≥ 6.5, the guideline is 0.05 mg/L. This relationship is illustrated in **Figure 2** below (solid curve) across the range of baseline observations of pH for Meadowbank (circles), Wally (triangles), Baker ("+"), and Whale Tail ("x"). The BC MOE guideline greatly exceeds all observed values of d-Al.

Again, we propose a single d-Al trigger for each system. Based on the median lab pH observed for Meadowbank (6.90), Wally (7.35), Baker (7.14), and Whale Tail (6.94), the corresponding BC MOE guideline for d-Al is 0.05 mg/L in each case. The proposed triggers for d-Al (based on Method A and ROS estimates for median d-Al) are 0.026 mg/L for Meadowbank (**Table 5**), 0.026 mg/L for Wally (**Table 8**), 0.026 mg/L for Whale Tail (**Table 11**), and 0.027 mg/L for Baker (**Table 14**).

Figure 2. Dissolved aluminum concentrations in baseline water samples relative to the BC MOE water quality guideline.

Notes: Solid line = BC MOE guideline for dissolved aluminum (pH dependent).
Meadowbank (circles), Wally (triangles), Baker ("+"), and Whale Tail ("x")



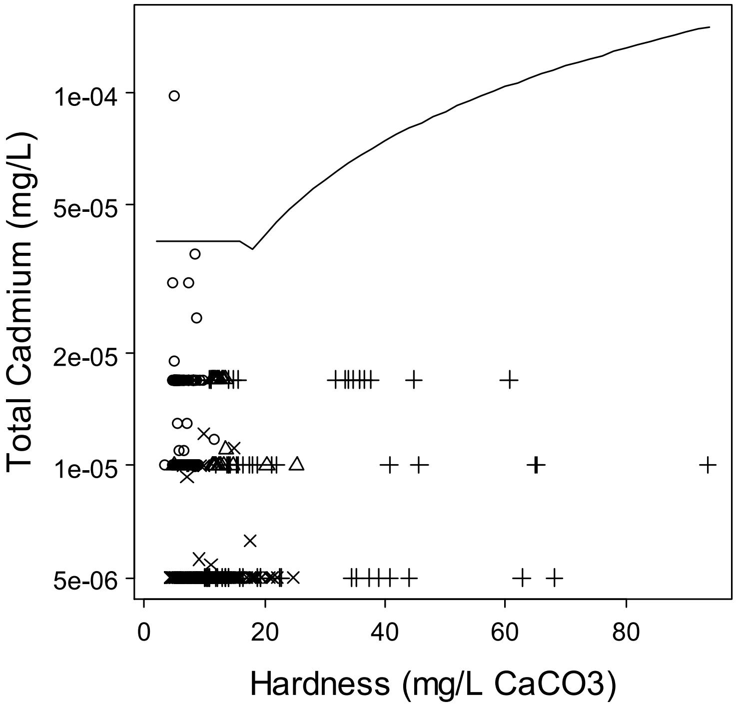
Total Cadmium

The hardness-dependent CCME guideline for t-Cd (mg/L) is 0.00004 when water hardness (mg/L $CaCO_3$) is less than 17.0, and equal to 0.001*100.83*log10(H)-2.46 (where H = hardness) when water hardness is ≥ 17.0 and ≤ 280 (CCME, 2014). The relationship is illustrated in **Figure 3** below (solid curve) across the range of baseline observations of hardness for Meadowbank (circles), Wally (triangles), Baker ("+"), and Whale Tail ("x"). Note that measurements of t-Cd exceeded detection limits for 20 of 648 baseline samples, and just one measure exceeded the CCME guideline (station TPE, hardness = 5.05, t-Cd = 0.000098 mg/L).

The median sample values of hardness for Meadowbank (6.19), Wally (12.20), and Whale Tail (9.10) were all less than 17.0 mg/L $CaCO_3$, and hence, the CCME guideline of 0.00004 mg/L was set as the threshold for each system. For Baker, median hardness (17.65) was slightly above 17.0 mg/L $CaCO_3$; however, the corresponding guideline (0.000038 mg/L; see equation above) is below the intended lower limit of 0.00004 mg/L due to numerical imprecision (e.g., see the slight reduction in the curve below for hardness values slightly above 17.0 mg/L $CaCO_3$). Thus, the CCME lower limit for t-Cd (0.00004 mg/L) applies to Baker as well. Because there were insufficient data to compute medians or 95th percentiles for t-Cd, the trigger was computed via Method A using the current detection limit (i.e., halfway between 0.000005 and 0.00004), providing a trigger value of 0.000023 for all CREMP study areas.

Figure 3. Baseline total cadmium concentrations relative to the CCME water quality guideline.

Notes: Solid line = CCME water quality guideline for total cadmium aluminum (hardness-dependent).
Meadowbank (circles), Wally (triangles), Baker ("+"), and Whale Tail ("x")



Total Manganese[2]

The hardness-dependent BC MOE guideline for t-Mn (mg/L) is 0.0044*H + 0.605, where H = hardness (mg/L $CaCO_3$). The BC MOE guideline (2001b) is based on numerous studies for fish, invertebrates and

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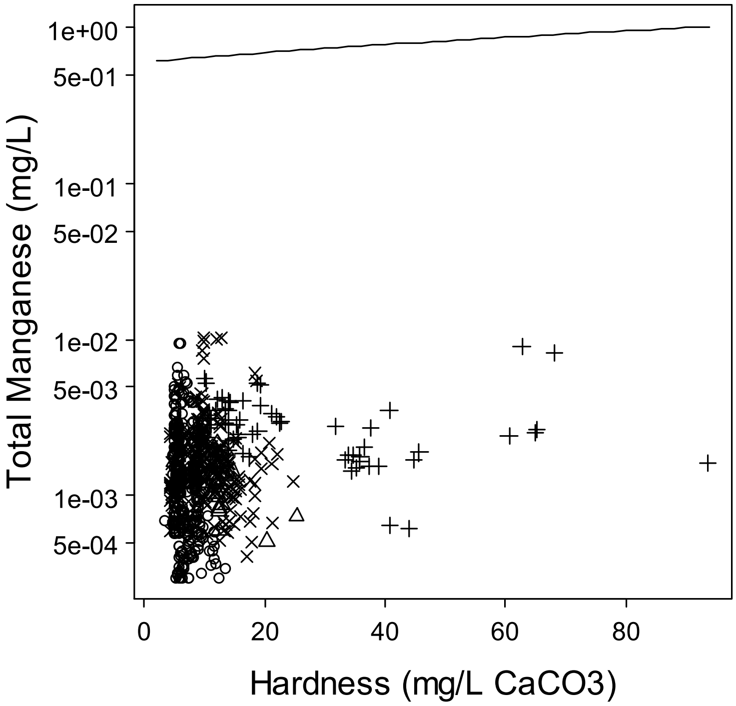
[2] CCME derived short- and long-term freshwater aquatic life water quality guidelines for dissolved manganese in 2019 (CCME, 2019). The update to the triggers were completed prior to the release of the CCME WQGs. The threshold for total manganese published by BC MOE was adopted as the threshold for total and dissolve manganese.

plants. The relationship is illustrated in **Figure 4** below (solid curve) across the range of baseline observations of hardness for Meadowbank (circles), Wally (triangles), Baker Lake ("+"), and Whale Tail ("x"). The guideline greatly exceeds observed t-Mn values for all samples.

For simplicity, a single t-Mn trigger is proposed for each system. To compute the t-Mn trigger, we first computed the guidelines corresponding to the median values of hardness observed for Meadowbank (median hardness = 6.19 mg/L, t-Mn guideline = 0.63 mg/L), Wally (median hardness = 12.2 mg/L $CaCO_3$, t-Mn guideline = 0.66 mg/L), Baker Lake (median hardness = 17.65 mg/L $CaCO_3$, t-Mn guideline = 0.68 mg/L), and Whale Tail (median hardness = 9.10 mg/L $CaCO_3$, t-Mn guideline = 0.65 mg/L). The corresponding lake-specific triggers for t-Mn (using Method A) are 0.32 mg/L for Meadowbank, 0.33 mg/L for Wally, 0.032 mg/L for Whale Tail, and 0.34 mg/L for Bake Lake.

Figure 4. **Baseline total manganese concentrations relative to the BC MOE water quality guideline.**

Notes: Solid line = BC MOE water quality guideline. Meadowbank (circles), Wally (triangles), Baker ("+"), and Whale Tail ("x")



Total Zinc

As discussed below, a long-term freshwater aquatic life WQG was recently developed for dissolved zinc (d-Zn). However, the triggers developed for d-Zn were lower than the current DL for total zinc (t-Zn; 0.003 mg/L) for all systems except Baker. Given this problem, and because d-Zn best represents the bioavailable fraction, we did not develop a trigger for t-Zn for any of the four systems. Instead, monitoring and trigger evaluations for zinc will focus on d-Zn.

Dissolved Zinc

The new 2018 long-term freshwater aquatic life WQG for dissolved zinc (d-Zn; mg/L) is calculated as:

$$\text{Zinc WQG} = 0.001 \times e^{0.947*\ln(H) - 0.815*pH + 0.398*\ln(DOC) + 4.625}$$

where H = hardness (mg/L $CaCO_3$), pH is in standard units, and DOC = dissolved organic carbon (mg/L). As for t-Mn, we propose a single d-Zn trigger for each system. To compute the d-Zn trigger, we first computed the d-Zn guideline corresponding to the median values of hardness, pH, and DOC observed for baseline samples within each system, as summarized in the table below. Triggers were then computed using Method A with the current DL = 0.001 mg/L for d-Zn (i.e., too few d-Zn values were above detection limits to estimate a median d-Zn value for any system), as reported in the table below and in **Table 5** (Meadowbank), **Table 8** (Wally), **Table 11** (Whale Tail), and **Table 14** (Baker Lake).

Metric	Meadowbank	Wally	Whale Tail	Baker
Median hardness (mg/L)	6.19	12.20	9.10	17.65
Median pH (lab)	6.90	7.35	6.94	7.14
Median DOC (mg/L)	1.67	2.20	1.79	3.23
Computed CWQG	0.00254	0.00375	0.00365	0.00732
Current d-Zn DL (mg/L)	0.001	0.001	0.001	0.001
Trigger d-Zn (mg/L) (Method A)	0.0018	0.0024	0.0023	0.0042

It is important to note that these triggers for d-Zn are uncertain and perhaps overly conservative because they occur at hardness levels that are often much lower than the data range used to develop the long-term water quality guideline for d-Zn (i.e., hardness between 23.4 and 399 mg/L $CaCO_3$; CCME 2018). CCME (2018) states: *Where users want a more stringent WQG for waters below the DOC and hardness limits or above the pH limit, they should extrapolate with caution and contact their local authority for advice*. **Figure 5** depicts the extrapolated water quality guideline for d-Zn as a function of hardness (with pH set to 7.0 and DOC set to 2 mg/L), and illustrates the extent to which the system-specific median hardness values fall below the lower limit for hardness (23.4 mg/L). In this figure, the solid-line portion of the curve is within the hardness range of data used to derive the CWQC (≥ 23.4 mg/L), the dashed line extrapolates below the lower hardness limit (23.4 mg/L; grey vertical line), and red symbols denote the water quality guideline computed for each system based on the median values for hardness, pH, and DOC across baseline samples (circle = Meadowbank; triangle = Wally; "+" = Baker; "x" = Whale Tail). It is clear that the median-based water quality guidelinesfor d-Zn reported in the table above are largely determined by differences in hardness – when a symbol is off the dashed curve, it is due to slight differences in median pH or DOC values (table above) relative to the specified values (pH = 7.0; DOC = 2.0 mg/L) used to compute the curve.

Figure 5. Extrapolation of the CCME freshwater aquatic life water guideline for dissolved zinc at hardness concentrations below 23.4 mg/L.

Notes: Red symbols denote the CCME FWAL water quality guideline computed for each system based on the median values for hardness, pH, and DOC across baseline samples (circle = Meadowbank; triangle = Wally; "+" = Baker; "x" = Whale Tail).

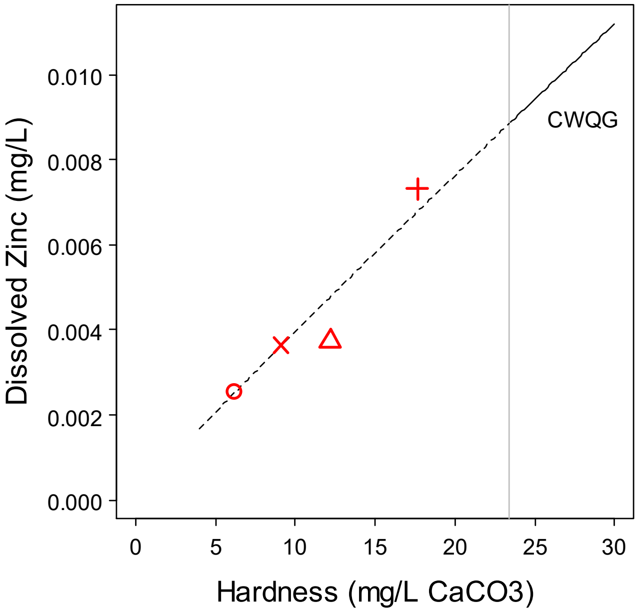
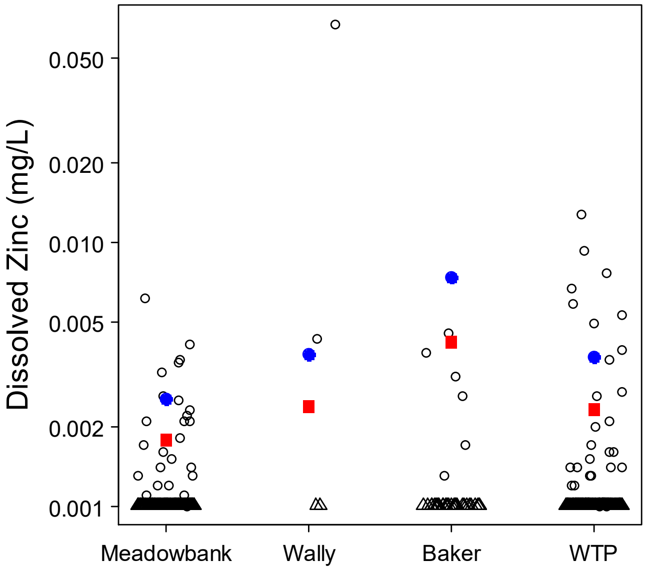


Figure 6 (next page) shows the baseline measurements of d-Zn for each system that were either above (open circles) or at the current detection limit (0.001 mg/L; open triangles). Data are jittered along the x-axis to aid visualization. The median-based CWQGs (blue solid circles) and triggers (red solid squares) are shown for each system. Across baseline measurements examined for Meadowbank (n=172), Wally (13), Baker (46), and Whale Tail (199), there were few exceedances of the CWQG (6, 2, 0, and 8, respectively) and proposed triggers (13, 2, 1, and 11, respectively).

Figure 6. Dissolved zinc concentrations in baseline water samples relative to the CCME freshwater aquatic life water guideline.

Notes: Blue symbols = CCME freshwater aquatic life water quality guideline; red symbols indicate the trigger for each study area.



3 REFERENCES

* References to the current water quality guidelines used as thresholds are provided in **Table 2**.

Azimuth Consulting Group Inc. 2021. Core Receiving Environment Monitoring Program (CREMP) 2020, Meadowbank Complex. Report prepared by Azimuth Consulting Group, Vancouver, BC for Agnico-Eagle Mines Ltd., Baker Lake, NU. March, 2021.

BC MOE (British Columbia Ministry of Environment). 2001a. Ambient Water Quality Guidelines for Aluminum. Water Protection and Sustainability Branch. Environmental Sustainability and Strategic Policy Division. Victoria, BC. August 2001.

BC MOE. 2001b. Ambient Water Quality Guidelines for Manganese. Water Protection and Sustainability Branch. Environmental Sustainability and Strategic Policy Division. Victoria, BC. January 2001. ISBN 0-7726-4444-6.

CCME (Canadian Council of Ministers of the Environment). 2019. Canadian water quality guidelines for the protection of aquatic life: manganese. In: Canadian environmental quality guidelines, 1999. Canadian Council of Ministers of the Environment, Winnipeg, MB.

CCME. 2014. Canadian water quality guidelines for the protection of aquatic life: Cadmium. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CCME. 2010. Canadian water quality guidelines for the protection of aquatic life: Ammonia. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

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.

CCME. 2002. Canadian water quality guidelines for the protection of aquatic life: Total particulate matter. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Helsel, D.R., 2011. Statistics for censored environmental data using Minitab and R (Vol. 77). John Wiley & Sons.

TABLES

Table 1 Status of all CREMP sampling areas since the beginning of monitoring.

Area	**Meadowbank Areas**									**Baker Lake Areas**				**Whale Tail Pit Areas**					
Designation	**REF**	**REF**	**NF**	**NF**	**NF**	**NF**	**MF**	**MF**	**FF**	**REF**	**REF**	**NF**	**NF**	**NF**	**NF**	**NF**	**MF**	**MF**	**FF**
Station	**INUG**	**PDL**	**TPN**	**SP**	**TPE**	**WAL**	**TPS**	**TE**	**TEFF**	**BAP**	**BES**	**BBD**	**BPJ**	**WTS**	**MAM**	**NEM**	**A20**	**A76**	**DS1**
2006	C		C	C	C	C	C	C											
2007	C		C	C	C	C	C	C											
2008	C		C	I (Aug)	C	C	C	I (Aug)		C		I	I						
2009	C	C	I (Mar)	I	I (Aug)	C	C	I	C	C		I	I						
2010	C	C	I	I	I	C	C	I	C	C		I	I						
2011	C	C	I	I	I	C	C	I	C	C	C	I	I						
2012	C	C	I	I	I	C	C	I	C	C	C	I	I						
2013	C	C	I	I	I	I (Jul)	C	I	C	C	C	I	I						
2014	C	C	I	I	I	I	C	I	C	C	C	I	I	C	C	C			
2015	C	C	I	I	I	I	C	I	C	C	C	I	I	C	C	C			
2016	C	C	I	I	I	I	C	I	C	C	C	I	I	C	C	C	C	C	C
2017	C	C	I	I	I	I	C	I	C	C	C	I	I	C	C	C	C	C	C
2018	C	C	I	I	I	I	C	I	C	C	C	I	I	I (Aug)	I (Nov)	C	C	C	C
2019	C	C	I	I	I	I	C	I	C	C	C	I	I	I	I	I (Aug)	I	I	I

Notes:

Area designations:

C=Control; I=Impact; REF=reference (in grey shading); NF=near-field (in blue shading); MF=mid-field (in pink shading); FF=far-field (in teal shading)

Blank cells indicate the area was not part of the monitoring program that year.

Area IDs:

Meadowbank and Whale Tail Pit Reference areas: INUG = Inuggugayualik Lake; PDL = Pipedream Lake

Meadowbank areas: TPN, TPE, TPS = Third Portage Lake - North, East, South basins; SP = Second Portage Lake; WAL = Wally Lake; TE,TEFF = Tehek Lake (Mid-field and Far-field)

Baker Lake areas: BAP, BES, BBD, BPJ=Baker Lake - Akilahaarjuk Point, East Shore, Barge Dock, Proposed Jetty.

Whale Tail Pit areas: WTS = Whale Tail Lake South Basin; MAM = Mammoth Lake; NEM = Nemo Lake; A20 = Lake A20; A76 = Lake A76; DS1 = Lake DS1

Table 2 Thresholds for the Core Receiving Environment Monitoring Program.

Analyte	Threshold (2014)				Current Threshold				
	Value	Source	Year	Comments	Value	Direction	Source	Year	Comments
Anions & Nutrients (mg/L)									
Ammonia	0.126	CCME	2001	The proposed threshold for Ammonia-N (Meadowbank and Baker) was conservatively derived using two discrete CCME guidelines corresponding to specific pH and temperature values. Note that the maximum pH among baseline data for Meadowbank/Wally/Baker is 8.66, while maximum temperatures in the lakes are around 16 to 18 degrees. The two CCME guidelines that span these maximum (i.e., worst-case) conditions are as follows: (1) total ammonia = 0.239 mg/L for pH = 8.5 and temperature = 15 degrees; and (2) total ammonia = 0.067 mg/L for pH = 9.0 and temperature = 20 degrees. The mid-point of these two values is 0.153 mg/L, which when converted from total ammonia to total ammonia as N is 0.126 mg/L.	0.126	No change	CCME	2001	
pH	6.5-9	CCME	1987	Upper and lower thresholds	6.5-9	No change	CCME	1987	
TSS	5	CCME	1999		5	No change	CCME	1999	
Chloride	120	CCME	2011		120	No change	CCME	2011	
Fluoride	0.120	CCME	2002		0.120	No change	CCME	2002	
Nitrate (as N)	3.0	CCME	2012		3.0	No change	CCME	2012	
Nitrite	0.06	CCME	1987		0.06	No change	CCME	1987	
Total Phosphate (as P)	*<50% above baseline*	CCME	2004	CCME describes using trigger value, if not exceeded then need to assess if >50% increase above baseline or not.	*<50% above baseline*	No change	CCME	2004	
Sulphate (SO_4)	128	BC MOE	2013	From BC MOE, approved WQG, 2013; for very soft water (hardness=0-30 mg/L); 218 mg/L for soft to moderate (hardness=31-75 mg/L); 309 mg/L for moderate to hard (hardness=76-180).	128	No change	BC MOE	2013	
Total Metals (mg/L)									
Aluminum (T)	0.1	CCME	1987	The CCME guideline for t-Al in water is 0.005 mg/L when pH < 6.5, and 0.1 mg/L when pH ≥ 6.5. See text for details.	0.1	No change	CCME	1987	CCME WQG has been withdrawn *** Draft FEQG is out for comment until August 11, 2021
Antimony (T)	0.020	BC MOE	2017	From BC MOE, working WQ guidelines, BC adopted from Ontario.	0.009	Lower	BC MOE	2017	Working WQG; Reference to ANZECC (2000b); for Sb(III)
Arsenic (T)	0.005	CCME	1997		0.025	Higher	Golder	2019	Site-specific number derived for the Whale Tail Pit Study areas (Addendum Volume 6, Appendix 6-I, Figure 6-I-2)
					0.005	No change	CCME	1997	Applies to Meadowbank, Wally, and Baker Lake study areas.
Barium (T)	1	BC MOE	2017	Working guideline (30-d average aka LT); Working WQG; Reference to Haywood and Drinnin (1983)	1	No change	BC MOE	2017	

Analyte	Threshold (2014)				Current Threshold				
	Value	Source	Year	Comments	Value	Direction	Source	Year	Comments
Beryllium (T)	0.0053	BC MOE	2000	Working guideline (short-term guideline)	0.00013	Lower	BC MOE	2000	Working WQG; Reference to ANZECC (2000a); Correction made to threshold (changed from short-term to long-term)
Boron (T)	1.5	CCME	2009		1.5	No change	CCME	2009	
Cadmium (T)	0.00004	CCME	2014	The hardness-dependent CCME guideline for t-Cd (mg/L) is 0.00004 mg/L when hardness > 0 to < 17 mg/L $CaCO_3$ and is 0.001*100.83*log(H)-2.46 where H = hardness (mg/L $CaCO_3$) when hardness is >= 17 to <= 280 mg/L $CaCO_3$. For hardness > 280 mg/L $CaCO_3$, the guideline is 0.00037 mg/L.	0.00004	No change	CCME	2014	
Chromium (T)	0.001	CCME	1997	The CCME guideline for hexavalent chromium (the most common form in surface waters) is 0.001 mg/L.	0.005	Higher	FEQG	2018	FEQG for Cr(VI)
Cobalt (T)	NA				0.00077	Lower	FEQG	2017	Hardness-dependent guideline: WQG=exp{(0.414[ln(hardness)] – 1.887} Value shown for hardness of 50 mg/L
Copper (T)	0.002	CCME	1987	The CCME guideline for t-Cu is 0.002 mg/L for hardness < 82 mg/L CaCO3.	0.002	No change	CCME	1987	*** New FEQG as of April 2021 Guideline based on the biotic ligand model. As an example, the site-specific copper guideline of 0.41 µg/L is for a water temperature of 20 °C, pH of 7.5, DOC of 0.5 mg/L and hardness of 50 mg/L $CaCO_3$.
Iron (T)	0.3	CCME	1987	The CCME guideline for t-Fe is 0.3 mg/L.	0.3	No change	CCME	1987	*** Draft FEQG; public comment period ended July 2019 (under revision) FEQG = 0.604 mg/L
Lead (T)	0.001	CCME	1987	The CCME guideline for t-Pb is 0.001 mg/L for hardness < 60 mg/L $CaCO_3$.	0.001	No change	CCME	1987	*** New FEQG as of July 2020 FEQG = exp(0.684[ln(DOC)] + 0.924[pH] – 7.323)
Lithium (T)	0.096	BC MOE	2013	From BC MOE, working WQ guidelines, final chronic value, used in Michigan. Updated to 0.44 in 2013.	None	-	None	None	No CCME, BC MOE, or other applicable WQG for lithium; Previous BC MOE Working WQG is no longer listed
Manganese (T)	See text	BC MOE	2001	There is no CCME guideline for t-Mn in water. The hardness-dependent BC MOE guideline for t-Mn in mg/L is 0.0044*H + 0.605, where H = hardness (mg/L $CaCO_3$). See text for details.	See text	No change	BC MOE	2001	
Mercury (T)	0.000026	CCME	2003		0.000026	No change	CCME	2003	
Molybdenum (T)	0.073	CCME	1999		0.073	No change	CCME	1999	

Analyte	Threshold (2014)				Current Threshold				
	Value	Source	Year	Comments	Value	Direction	Source	Year	Comments
Nickel (T)	0.025	CCME	1987	The CCME guideline for t-Ni is 0.025 mg/L for hardness < 60 mg/L $CaCO_3$.	0.025	No change	CCME	1987	
Selenium (T)	0.001	CCME	1987		0.001	No change	CCME	1987	*** Draft FEQG is out for comment until August 11, 2021
Silver (T)	0.0001	CCME	1987		0.00025	Higher	CCME	2015	
Strontium (T)	0.049	Birge et al. 1979	2018	From the species sensitivity distribution in this De Beers report (Birge et al. 1979);	2.5	Higher	FEQG	2020	The strontium guideline was revised from 1.7 mg/L in the draft (2019) to 2.5 mg/L for the final.
Thallium (T)	0.0008	CCME	1999		0.0008	No change	CCME	1999	
Titanium (T)	2	BC MOE	2013	Working WQGs, median threshold level: *Scenedesmus.*	None	-	None	None	No CCME, BC MOE, or other applicable WQG for titanium; Previous BC MOE Working WQG is no longer listed
Uranium (T)	0.015	CCME	2011		0.015	No change	CCME	2011	
Vanadium (T)	0.006	BC MOE	2013	From BC MOE, working WQ guidelines, BC adopted from Ontario.	0.12	Higher	FEQG	2016	
Zinc (T)	See text	CCME Ekati	2018	The CCME water quality guideline for t-Zn is 0.030 mg/L. However, this guideline does not take into account hardness, and zinc toxicity is known to be hardness-dependent. An assessment for Ekati by EVS (2004) compiled data on species applicable to oligotrophic systems with low hardness, and developed a chronic benchmark for t-Zn that was hardness dependent. See text for details.	Apply the dissolved guideline as recommended by CCME	Variable/lower	CCME	2018	See comment for dissolved zinc below
Dissolved Metals (mg/L)									
Aluminum	0.05	BC MOE	2001	A pH-dependent water quality guideline for d-Al (mg/L) has been developed by BC MOE for protection of freshwater aquatic life when pH <6.5 as follows: d-Al = e(1.6-3.327*pH + 0.402*K) where K = pH2. For pH >= 6.5 the guideline is 0.05 mg/L See text for details.	0.05	No change	BC MOE	2001	Same approach as outlined in the trigger appendix document
Antimony	0.020		See above		0.009	Lower	See above	See above	Same as total
Arsenic	0.005		See above		0.025	Higher	See above	See above	Same as total
Barium	1		See above		1	No change	See above	See above	Same as total
Beryllium	0.0053		See above		0.00013	Lower	See above	See above	Same as total
Boron	1.5		See above		1.5	No change	See above	See above	Same as total
Cadmium	0.00004		See above		0.00004	No change	See above	See above	Same as total
Chromium	0.001		See above		0.005	Higher	See above	See above	Same as total
Cobalt	0.004		See above		0.00077	Lower	See above	See above	Same as total

Analyte	Threshold (2014)				Current Threshold				
	Value	Source	Year	Comments	Value	Direction	Source	Year	Comments
Copper	0.002		See above		0.002	No change	See above	See above	Same as total
Iron	0.3		See above		0.3	No change	See above	See above	Same as total
Lead	0.001		See above		0.001	No change	See above	See above	Same as total
Lithium	0.096		See above		None	-	See above	See above	No threshsold for dissolved lithium as of 2019
Manganese	same as Total		See above		See text	No change	See above	See above	** New CCME long-term WQG for dissolved manganese was published in 2019. The existing guideline from BC was carried forward for the 2019 update.
Mercury	0.000026		See above		0.000026	No change	See above	See above	Same as total
Molybdenum	0.073		See above		0.073	No change	See above	See above	Same as total
Nickel	0.025		See above		0.025	No change	See above	See above	Same as total
Selenium	0.001		See above		0.001	No change	See above	See above	Same as total
Silver	0.0001		See above		0.00025	Higher	See above	See above	Same as total
Strontium	0.049		See above		2.5	Higher	See above	See above	Same as total
Thallium	0.0008		See above		0.0008	No change	See above	See above	Same as total
Titanium	2		See above		None	-	See above	See above	No threshold for dissolved titanium as of 2019
Uranium	0.015		See above		0.015	No change	See above	See above	Same as total
Vanadium	0.006		See above		0.12	Higher	See above	See above	Same as total
Zinc	same as Total		2018		0.004	Lower (0.004 vs 0.011) *** quick comparison assuming hardness of 10 under the old formula	CCME	2018	The long-term CWQG is for dissolved zinc and is calculated using the following equation: CWQG = exp(0.947[ln(hardness mg·L-1)] - 0.815[pH] + 0.398[ln(DOC mg·L-1)] + 4.625). *** WQG of 0.004 mg/L at hardness = 10, pH = 7, and DOC = 2

Table 3 Meadowbank Water Quality Triggers – Nutrients and Conventional Parameters

Variable	Threshold	DL	Meadowbank Study Areas					
			N	>DL	Median	95th %ile	Trigger	Method
Ammonia-N	0.126	0.005	351	125	0.004	0.046	0.065	A
TKN	NA	0.05	323	295	0.101	0.172	0.17	B
Nitrate-N	3	0.005	351	48	NA	0.046	1.5	A
Nitrite-N	0.06	0.001	351	10	NA	NA	0.031	A
Ortho-phosphate	NA	0.001	339	24	NA	0.0011	0.002	C
T. phosphorous	0.004	0.002	339	128	0.0015	0.0051	0.0051	B
TOC	NA	0.5	351	351	1.73	2.6	2.6	B
DOC	NA	0.5	351	351	1.67	2.46	2.46	B
Reactive silica	NA	0.5	332	56	0.25	0.44	1	C
Bicarb. alkalinity	NA	1	311	311	5.8	8.7	8.7	B
Chloride	120	0.1	351	288	0.61	0.97	60.3	A
Fluoride	0.12	0.02	323	323	0.055	0.079	0.088	A
Carb. alkalinity	NA	1	339	0	NA	NA	2	C
Conductivity	NA	2	351	351	17.7	27.4	27.4	B
Hardness	NA	0.5	351	351	6.2	9.5	9.5	B
Calcium	NA	0.05	351	351	1.42	2.39	2.39	B
Potassium	NA	0.05	351	226	0.38	0.58	0.58	B
Magnesium	NA	0.005	351	351	0.71	0.93	0.93	B
Sodium	NA	0.05	351	226	0.56	1.16	1.16	B
Sulphate	128	0.3	351	351	1.44	4.83	64.7	A
pH Field (Upper)	9	0.1	321	321	7.12	8.15	8.15	B
pH Field (Lower)	6.5	0.1	321	321	7.12	6.40[a]	6.4	B
pH Lab (Upper)	9	0.1	351	351	6.9	7.25	7.95	A
pH Lab (Lower)	6.5	0.1	351	351	6.9	6.47[a]	6.47	B
Total Alkalinity	NA	1	311	311	5.8	8.7	8.7	B
TDS	NA	3	323	253	12.6	19	19	B
TSS	5	1	351	24	NA	NA	3	A

Notes: For each variable, thresholds (guidelines) are shown if applicable (see text for discussion); DL = current detection limit; N = sample measurements; >DL = number of measurements above DL; 95th %ile = 95th percentile if estimable; Method = method used to determine the trigger, where A = halfway from median (or DL if median not estimable) to threshold, B = 95th percentile, and C = 2-times the DL, NA = not applicable (thresholds) or not measured (summary statistics)

Table 4 Meadowbank Water Quality Triggers – Total Metals

Variable	Threshold	DL	**Meadowbank Study Areas**					
			N	>DL	Median	95th %ile	Trigger	Method
Aluminum (T)	0.1	0.003	351	283	0.006	0.013	0.053	A
Antimony (T)	0.009	0.0001	350	1	NA	NA	0.0046	A
Arsenic (T)	0.005	0.0001	351	125	0.00013	0.00021	0.00257	A
Barium (T)	1	0.0001	351	226	0.002	0.0033	0.5	A
Beryllium (T)	0.00013	0.0001	351	0	NA	NA	0.000115	A
Boron (T)	1.5	0.01	351	1	NA	NA	0.76	A
Cadmium (T)	0.00004	0.000005	351	13	NA	NA	0.000023	A
Chromium (T)	0.005	0.0001	350	50	0.00006	0.00017	0.0025	A
Copper (T)	0.002	0.0005	351	83	0.00044	0.00064	0.0012	A
Iron (T)	0.3	0.01	351	78	0.0086	0.022	0.15	A
Lead (T)	0.001	0.00005	351	13	NA	NA	0.00053	A
Lithium (T)	NA	0.001	351	10	NA	NA	0.002	C
Manganese (T)	See text	0.0001	351	345	0.0013	0.0042	0.32	A
Mercury (T)	0.000026	0.000005	351	2	NA	NA	0.000016	A
Molybdenum (T)	0.073	0.00005	351	51	0.00003	0.00019	0.037	A
Nickel (T)	0.025	0.0005	351	71	0.0004	0.0008	0.013	A
Selenium (T)	0.001	0.00005	351	2	NA	NA	0.00053	A
Silicon (T)	NA	0.1	232	224	0.15	0.2	0.2	B
Silver (T)	0.00025	0.00001	351	5	NA	NA	0.00013	A
Strontium (T)	2.5	0.0002	339	335	0.0075	0.0108	1.25	A
Thallium (T)	0.0008	0.00001	351	1	NA	NA	0.00041	A
Tin (T)	NA	0.0001	351	3	NA	NA	0.0002	C
Titanium (T)	NA	0.0003	351	19	NA	NA	0.0006	C
Uranium (T)	0.015	0.00001	351	167	0.000039	0.000053	0.0075	A
Vanadium (T)	0.12	0.0005	351	0	NA	NA	0.06	A
Zinc (T)	See text	0.003	351	6	NA	NA	NA	NA

Notes: For each variable, thresholds (guidelines) are shown if applicable (see text for discussion); DL = current detection limit; N = sample measurements; >DL = number of measurements above DL; 95th %ile = 95th percentile if estimable; Method = method used to determine the trigger, where A = halfway from median (or DL if median not estimable) to threshold, B = 95th percentile, and C = 2-times the DL, NA = not applicable (thresholds) or not measured (summary statistics)

Table 5 Meadowbank Water Quality Triggers – Dissolved Metals

Variable	Threshold	DL	Meadowbank Study Areas					
			N	>DL	Median	95th %ile	Trigger	Method
Aluminum (D)	0.05	0.001	311	205	0.002	0.005	0.026	A
Antimony (D)	0.009	0.0001	311	0	NA	NA	0.0046	A
Arsenic (D)	0.005	0.0001	311	89	0.00012	0.00018	0.00256	A
Barium (D)	1	0.0001	311	226	0.002	0.0033	0.5	A
Beryllium (D)	0.00013	0.0001	311	0	NA	NA	0.000115	A
Boron (D)	1.5	0.01	311	0	NA	NA	0.76	A
Cadmium (D)	0.00004	0.000005	311	5	NA	NA	0.000023	A
Chromium (D)	0.005	0.0001	310	9	NA	NA	0.00026	A
Copper (D)	0.002	0.0002	311	222	0.00037	0.00052	0.0012	A
Iron (D)	0.3	0.01	311	3	NA	NA	0.16	A
Lead (D)	0.001	0.00005	311	13	NA	NA	0.00053	A
Lithium (D)	NA	0.001	311	2	NA	NA	0.002	C
Manganese (D)	See text	0.0001	311	254	0.0004	0.0028	0.32	A
Mercury (D)	0.000026	0.000005	299	2	NA	NA	0.000016	A
Molybdenum (D)	0.073	0.00005	311	52	0.00005	0.00018	0.037	A
Nickel (D)	0.025	0.0005	311	42	NA	NA	0.013	A
Selenium (D)	0.001	0.00005	311	1	NA	NA	0.00053	A
Silicon (D)	NA	0.05	232	216	0.12	0.18	0.18	B
Silver (D)	0.00025	0.00001	311	0	NA	NA	0.00013	A
Strontium (D)	2.5	0.0002	311	308	0.0075	0.011	1.25	A
Thallium (D)	0.0008	0.00001	311	0	NA	NA	0.00041	A
Tin (D)	NA	0.0001	311	1	NA	NA	0.0002	C
Titanium (D)	NA	0.0003	311	1	NA	NA	0.0006	C
Uranium (D)	0.015	0.00001	310	166	0.00003	0.00004	0.0075	A
Vanadium (D)	0.12	0.0005	311	0	NA	NA	0.06	A
Zinc (D)	See text	0.001	311	25	NA	NA	0.0018	A

Notes: For each variable, thresholds (guidelines) are shown if applicable (see text for discussion); DL = current detection limit; N = sample measurements; >DL = number of measurements above DL; 95th %ile = 95th percentile if estimable; Method = method used to determine the trigger, where A = halfway from median (or DL if median not estimable) to threshold, B = 95th percentile, and C = 2-times the DL, NA = not applicable (thresholds) or not measured (summary statistics)

Table 6 Wally Lake Water Quality Triggers – Nutrients and Conventional Parameters

Variable	Threshold	DL	Wally Lake					
			N	>DL	Median	95th %ile	Trigger	Method
Ammonia-N	0.126	0.005	34	12	0.007	0.024	0.067	A
TKN	NA	0.05	34	31	0.111	0.163	0.16	B
Nitrate-N	3	0.005	34	2	NA	NA	1.5	A
Nitrite-N	0.06	0.001	34	2	NA	NA	0.031	A
Ortho-phosphate	NA	0.001	34	3	NA	0.001	0.002	C
T. phosphorous	0.004	0.002	34	21	0.0028	0.0067	0.0067	B
TOC	NA	0.5	34	34	2.18	4.11	4.11	B
DOC	NA	0.5	34	34	2.2	3.21	3.21	B
Reactive silica	NA	0.5	32	14	0.74	1.08	1.08	B
Bicarb. alkalinity	NA	1	34	34	10	17.8	17.8	B
Chloride	120	0.1	34	15	0.47	0.64	60.2	A
Fluoride	0.12	0.02	30	30	0.039	0.053	0.08	A
Carb. alkalinity	NA	1	34	0	NA	NA	2	C
Conductivity	NA	2	34	34	28.7	36.6	36.6	B
Hardness	NA	0.5	34	34	12.2	16.7	16.7	B
Calcium	NA	0.05	34	34	3.34	4.88	4.88	B
Potassium	NA	0.05	34	14	0.37	0.59	0.59	B
Magnesium	NA	0.005	34	34	0.96	1.36	1.36	B
Sodium	NA	0.05	34	14	0.48	0.72	0.72	B
Sulphate	128	0.3	34	34	2.34	3.38	65.2	A
pH Field (Upper)	9	0.1	32	32	7.67	8.26	8.34	A
pH Field (Lower)	6.5	0.1	32	32	7.67	6.54[a]	6.54	B
pH Lab (Upper)	9	0.1	34	34	7.35	7.44	8.17	A
pH Lab (Lower)	6.5	0.1	34	34	7.35	7.00[a]	6.92	A
Total Alkalinity	NA	1	34	34	10	17.8	17.8	B
TDS	NA	3	34	34	18	25.3	25.3	B
TSS	5	1	34	1	NA	NA	3	A

Notes: For each variable, thresholds (guidelines) are shown if applicable (see text for discussion); DL = current detection limit; N = sample measurements; >DL = number of measurements above DL; 95th %ile = 95th percentile if estimable; Method = method used to determine the trigger, where A = halfway from median (or DL if median not estimable) to threshold, B = 95th percentile, and C = 2-times the DL, NA = not applicable (thresholds) or not measured (summary statistics)

Table 7 Wally Lake Water Quality Triggers – Total Metals

Variable	Threshold	DL	Wally Lake					
			N	>DL	Median	95th %ile	Trigger	Method
Aluminum (T)	0.1	0.003	34	23	0.006	0.011	0.053	A
Antimony (T)	0.009	0.0001	34	0	NA	NA	0.0046	A
Arsenic (T)	0.005	0.0001	34	14	0.00025	0.00029	0.00263	A
Barium (T)	1	0.0001	34	14	0.0019	0.003	0.5	A
Beryllium (T)	0.00013	0.0001	34	0	NA	NA	0.000115	A
Boron (T)	1.5	0.01	34	0	NA	NA	0.76	A
Cadmium (T)	0.00004	0.000005	34	1	NA	NA	0.000023	A
Chromium (T)	0.005	0.0001	34	0	NA	NA	0.0026	A
Copper (T)	0.002	0.0005	34	16	0.00098	0.00129	0.0015	A
Iron (T)	0.3	0.01	34	6	0.015	0.025	0.16	A
Lead (T)	0.001	0.00005	34	2	NA	0.00015	0.00053	A
Lithium (T)	NA	0.001	34	2	0.00085	NA	0.002	C
Manganese (T)	See text	0.0001	34	34	0.0014	0.002	0.33	A
Mercury (T)	0.000026	0.000005	34	0	NA	NA	0.000016	A
Molybdenum (T)	0.073	0.00005	34	3	0.00013	0.00019	0.037	A
Nickel (T)	0.025	0.0005	34	0	NA	NA	0.013	A
Selenium (T)	0.001	0.00005	34	0	NA	NA	0.00053	A
Silicon (T)	NA	0.1	14	14	0.42	0.65	0.65	B
Silver (T)	0.00025	0.00001	34	0	NA	NA	0.00013	A
Strontium (T)	2.5	0.0002	32	32	0.016	0.022	1.26	A
Thallium (T)	0.0008	0.00001	34	0	NA	NA	0.00041	A
Tin (T)	NA	0.0001	34	0	NA	NA	0.0002	C
Titanium (T)	NA	0.0003	34	3	0.00013	0.00049	0.0006	C
Uranium (T)	0.015	0.00001	34	2	0.000044	NA	0.0075	A
Vanadium (T)	0.12	0.0005	34	0	NA	NA	0.06	A
Zinc (T)	See text	0.003	34	2	NA	NA	NA	NA

Notes: For each variable, thresholds (guidelines) are shown if applicable (see text for discussion); DL = current detection limit; N = sample measurements; >DL = number of measurements above DL; 95th %ile = 95th percentile if estimable; Method = method used to determine the trigger, where A = halfway from median (or DL if median not estimable) to threshold, B = 95th percentile, and C = 2-times the DL, NA = not applicable (thresholds) or not measured (summary statistics)

Table 8 Wally Lake Water Quality Triggers – Dissolved Metals

Variable	Threshold	DL	Wally Lake					
			N	>DL	Median	95th %ile	Trigger	Method
Aluminum (T)	0.05	0.001	27	13	0.003	0.006	0.026	A
Antimony (T)	0.009	0.0001	27	0	NA	NA	0.0046	A
Arsenic (T)	0.005	0.0001	27	13	0.00024	0.00034	0.00262	A
Barium (T)	1	0.0001	27	13	0.0018	0.003	0.5	A
Beryllium (T)	0.00013	0.0001	27	0	NA	NA	0.000115	A
Boron (T)	1.5	0.01	27	0	NA	NA	0.76	A
Cadmium (T)	0.00004	0.000005	27	0	NA	NA	0.000023	A
Chromium (T)	0.005	0.0001	27	0	NA	NA	0.00026	A
Copper (T)	0.002	0.0002	27	15	0.00087	0.00148	0.0015	B
Iron (T)	0.3	0.01	27	0	NA	NA	0.16	A
Lead (T)	0.001	0.00005	27	2	NA	0.00015	0.00053	A
Lithium (T)	NA	0.001	27	2	0.00099	NA	0.002	C
Manganese (T)	See text	0.0001	27	22	0.0004	0.0015	0.33	A
Mercury (T)	0.000026	0.000005	25	0	NA	NA	0.000016	A
Molybdenum (T)	0.073	0.00005	27	8	0.00011	0.00019	0.037	A
Nickel (T)	0.025	0.0005	27	1	NA	NA	0.013	A
Selenium (T)	0.001	0.00005	27	0	NA	NA	0.00053	A
Silicon (T)	NA	0.05	13	13	0.42	0.67	0.67	B
Silver (T)	0.00025	0.00001	27	0	NA	NA	0.00013	A
Strontium (T)	2.5	0.0002	27	27	0.016	0.023	1.26	A
Thallium (T)	0.0008	0.00001	27	0	NA	NA	0.00041	A
Tin (T)	NA	0.0001	27	0	NA	NA	0.0002	C
Titanium (T)	NA	0.0003	27	0	NA	NA	0.0006	C
Uranium (T)	0.015	0.00001	27	2	0.00004	NA	0.0075	A
Vanadium (T)	0.12	0.0005	27	0	NA	NA	0.06	A
Zinc (T)	See text	0.001	27	2	NA	NA	0.0024	A

Notes: For each variable, thresholds (guidelines) are shown if applicable (see text for discussion); DL = current detection limit; N = sample measurements; >DL = number of measurements above DL; 95th %ile = 95th percentile if estimable; Method = method used to determine the trigger, where A = halfway from median (or DL if median not estimable) to threshold, B = 95th percentile, and C = 2-times the DL, NA = not applicable (thresholds) or not measured (summary statistics)

Table 9 Whale Tail Pit Water Quality Triggers – Nutrients and Conventional Parameters

Variable	Threshold	DL	Whale Tail Pit Study Areas					
			N	>DL	Median	95th %ile	Trigger	Method
Ammonia-N	0.126	0.005	306	121	0.004	0.022	0.065	A
TKN	NA	0.05	283	281	0.116	0.171	0.17	B
Nitrate-N	3	0.005	306	29	NA	0.007	1.5	A
Nitrite-N	0.06	0.001	306	2	NA	NA	0.031	A
Ortho-phosphate	NA	0.001	306	54	NA	0.0022	0.0022	B
T. phosphorous	0.004	0.002	306	111	0.0013	0.0045	0.0045	B
TOC	NA	0.5	306	306	1.85	2.42	2.42	B
DOC	NA	0.5	306	306	1.79	2.43	2.43	B
Reactive silica	NA	0.5	306	150	0.5	1.33	1.33	B
Bicarb. alkalinity	NA	1	290	290	6.3	9.6	9.6	B
Chloride	120	0.1	306	306	0.9	7.8	60.4	A
Fluoride	0.12	0.02	306	306	0.034	0.067	0.077	A
Carb. alkalinity	NA	1	306	0	NA	NA	2	C
Conductivity	NA	2	306	306	23.5	48.6	48.6	B
Hardness	NA	0.5	306	306	9.1	17.4	17.4	B
Calcium	NA	0.05	306	306	2.24	4.6	4.6	B
Potassium	NA	0.05	306	306	0.45	0.84	0.84	B
Magnesium	NA	0.005	306	306	0.83	1.41	1.41	B
Sodium	NA	0.05	306	306	0.6	1	1	B
Sulphate	128	0.3	306	306	1.7	4.04	64.8	A
pH Field (Upper)	9	0.1	302	302	6.88	7.59	7.94	A
pH Field (Lower)	6.5	0.1	302	302	6.88	6.34	6.34	B
pH Lab (Upper)	9	0.1	306	306	6.94	7.19	7.97	A
pH Lab (Lower)	6.5	0.1	306	306	6.94	6.57	6.57	B
Total Alkalinity	NA	1	290	290	6.25	9.61	9.61	B
TDS	NA	3	290	290	17.3	38.5	38.5	B
TSS	5	1	306	17	NA	1	3	A

Notes: For each variable, thresholds (guidelines) are shown if applicable (see text for discussion); DL = current detection limit; N = sample measurements; >DL = number of measurements above DL; 95th %ile = 95th percentile if estimable; Method = method used to determine the trigger, where A = halfway from median (or DL if median not estimable) to threshold, B = 95th percentile, and C = 2-times the DL, NA = not applicable (thresholds) or not measured (summary statistics)

Table 10 Whale Tail Pit Water Quality Triggers – Total Metals

Variable	Threshold	DL	**Whale Tail Pit Study Areas**					
			N	>DL	Median	95th %ile	Trigger	Method
Aluminum (T)	0.1	0.003	306	241	0.005	0.015	0.052	A
Antimony (T)	0.009	0.0001	305	4	NA	NA	0.0046	A
Arsenic (T)	0.025	0.0001	306	258	0.00017	0.00041	0.013	A
Barium (T)	1	0.0001	306	306	0.0037	0.0089	0.5	A
Beryllium (T)	0.00013	0.0001	306	0	NA	NA	0.000115	A
Boron (T)	1.5	0.01	306	0	NA	NA	0.76	A
Cadmium (T)	0.00004	0.000005	306	7	NA	NA	0.000023	A
Chromium (T)	0.005	0.0001	303	87	0.00006	0.0002	0.0025	A
Copper (T)	0.002	0.0005	306	38	NA	0.00058	0.0013	A
Iron (T)	0.3	0.01	306	173	0.011	0.037	0.16	A
Lead (T)	0.001	0.00005	302	36	NA	0.00016	0.00053	A
Lithium (T)	NA	0.001	306	28	NA	0.0013	0.002	C
Manganese (T)	See text	0.0001	306	306	0.0015	0.0048	0.32	A
Mercury (T)	0.000026	0.000005	306	2	NA	NA	0.000016	A
Molybdenum (T)	0.073	0.00005	306	43	NA	NA	0.037	A
Nickel (T)	0.025	0.0005	306	181	0.00055	0.00096	0.013	A
Selenium (T)	0.001	0.00005	306	4	NA	NA	0.00053	A
Silicon (T)	NA	0.1	306	306	0.26	0.61	0.61	B
Silver (T)	0.00025	0.00001	306	2	NA	NA	0.00013	A
Strontium (T)	2.5	0.0002	306	306	0.26	0.61	1.26	A
Thallium (T)	0.0008	0.00001	306	2	NA	NA	0.00013	A
Tin (T)	NA	0.0001	306	306	0.01	0.033	0.033	B
Titanium (T)	NA	0.0003	306	1	NA	NA	0.00041	A
Uranium (T)	0.015	0.00001	306	1	NA	NA	0.0002	C
Vanadium (T)	0.12	0.0005	306	9	NA	NA	0.0006	C
Zinc (T)	See text	0.003	306	263	0.000025	0.000048	0.0075	A

Notes: For each variable, thresholds (guidelines) are shown if applicable (see text for discussion); DL = current detection limit; N = sample measurements; >DL = number of measurements above DL; 95th %ile = 95th percentile if estimable; Method = method used to determine the trigger, where A = halfway from median (or DL if median not estimable) to threshold, B = 95th percentile, and C = 2-times the DL, NA = not applicable (thresholds) or not measured (summary statistics)

Table 11 Whale Tail Pit Water Quality Triggers – Dissolved Metals

Variable	Threshold	DL	Whale Tail Pit Study Areas					
			N	>DL	Median	95th %ile	Trigger	Method
Aluminum (D)	0.05	0.001	306	276	0.002	0.006	0.026	A
Antimony (D)	0.009	0.0001	303	3	NA	NA	0.005	A
Arsenic (D)	0.025	0.0001	306	216	0.00014	0.00036	0.013	A
Barium (D)	1	0.0001	306	306	0.0037	0.0088	0.5	A
Beryllium (D)	0.00013	0.0001	306	1	NA	NA	0.000115	A
Boron (D)	1.5	0.01	306	0	NA	NA	0.76	A
Cadmium (D)	0.00004	0.000005	300	2	NA	NA	0.000023	A
Chromium (D)	0.005	0.0001	306	20	NA	0.00011	0.0026	A
Copper (D)	0.002	0.0002	305	286	0.00033	0.00054	0.0012	A
Iron (D)	0.3	0.01	306	23	NA	0.013	0.16	A
Lead (D)	0.001	0.00005	300	37	NA	0.00009	0.00053	A
Lithium (D)	NA	0.001	306	28	NA	0.0012	0.002	C
Manganese (D)	See text	0.0001	306	290	0.0005	0.0032	0.32	A
Mercury (D)	0.000026	0.000005	305	4	NA	NA	0.000016	A
Molybdenum (D)	0.073	0.00005	306	29	NA	0.00006	0.037	A
Nickel (D)	0.025	0.0005	306	145	0.00047	0.0009	0.013	A
Selenium (D)	0.001	0.00005	306	3	NA	NA	0.00053	A
Silicon (D)	NA	0.05	306	306	0.23	0.57	0.57	B
Silver (D)	0.00025	0.00001	306	0	NA	NA	0.00013	A
Strontium (D)	2.5	0.0002	306	306	0.01	0.034	1.26	A
Thallium (D)	0.0008	0.00001	306	0	NA	NA	0.00041	A
Tin (D)	NA	0.0001	306	4	NA	NA	0.0002	C
Titanium (D)	NA	0.0003	306	1	NA	NA	0.0006	C
Uranium (D)	0.015	0.00001	305	259	0.00002	0.000041	0.0075	A
Vanadium (D)	0.12	0.0005	306	0	NA	NA	0.06	A
Zinc (D)	See text	0.001	306	42	NA	0.0021	0.0023	A

Notes: For each variable, thresholds (guidelines) are shown if applicable (see text for discussion); DL = current detection limit; N = sample measurements; >DL = number of measurements above DL; 95th %ile = 95th percentile if estimable; Method = method used to determine the trigger, where A = halfway from median (or DL if median not estimable) to threshold, B = 95th percentile, and C = 2-times the DL, NA = not applicable (thresholds) or not measured (summary statistics)

Table 12 Baker Lake Water Quality Triggers – Nutrients and Conventional Parameters

Variable	Threshold	DL	Baker Lake					
			N	>DL	Median	95th %ile	Trigger	Method
Ammonia-N	0.126	0.005	64	29	0.005	0.056	0.066	A
TKN	NA	0.05	59	55	0.163	0.222	0.22	B
Nitrate-N	3	0.005	64	58	0.018	0.04	1.51	A
Nitrite-N	0.06	0.001	64	3	NA	NA	0.031	A
Ortho-phosphate	NA	0.001	64	9	NA	0.0014	0.002	C
T. phosphorous	0.004	0.002	64	47	0.0035	0.0075	0.0075	B
TOC	NA	0.5	64	64	3.25	4	4	B
DOC	NA	0.5	64	64	3.23	3.89	3.89	B
Reactive silica	NA	0.5	61	12	0.32	0.5	1	C
Bicarb. alkalinity	NA	1	59	59	9.2	10.6	10.6	B
Chloride	120	0.1	64	64	26.2	168.9	168.9	B
Fluoride	0.12	0.02	61	59	0.056	0.073	0.088	A
Carb. alkalinity	NA	1	64	0	NA	NA	2	C
Conductivity	NA	2	64	64	119.5	642.4	642.4	B
Hardness	NA	0.5	64	64	17.7	64.7	64.7	B
Calcium	NA	0.05	64	64	3.04	6.17	6.17	B
Potassium	NA	0.05	64	53	0.95	3.89	3.89	B
Magnesium	NA	0.005	64	64	2.66	12.44	12.44	B
Sodium	NA	0.05	64	64	14.2	88.5	88.5	B
Sulphate	128	0.3	64	64	4.1	24.4	66.1	A
pH Field (Upper)	9	0.1	59	59	7.15	8.15	8.15	B
pH Field (Lower)	6.5	0.1	59	59	7.15	6.55[a]	6.55	B
pH Lab (Upper)	9	0.1	64	64	7.14	7.57	8.07	A
pH Lab (Lower)	6.5	0.1	64	64	7.14	6.75[a]	6.75	B
Total Alkalinity	NA	1	59	59	9.2	10.6	10.6	B
TDS	NA	3	59	59	64.8	245.3	245.3	B
TSS	5	1	64	9	NA	NA	3	A

Notes: For each variable, thresholds (guidelines) are shown if applicable (see text for discussion); DL = current detection limit; N = sample measurements; >DL = number of measurements above DL; 95th %ile = 95th percentile if estimable; Method = method used to determine the trigger, where A = halfway from median (or DL if median not estimable) to threshold, B = 95th percentile, and C = 2-times the DL, NA = not applicable (thresholds) or not measured (summary statistics)

Table 13 Baker Lake Water Quality Triggers – Total Metals

Variable	Threshold	DL	Baker Lake					
			N	>DL	Median	95th %ile	Trigger	Method
Aluminum (T)	0.1	0.003	64	63	0.012	0.024	0.056	A
Antimony (T)	0.009	0.0001	64	0	NA	NA	0.0046	A
Arsenic (T)	0.005	0.0001	64	37	0.00013	0.00017	0.0.00257	A
Barium (T)	1	0.0001	64	47	0.018	0.02	0.51	A
Beryllium (T)	0.00013	0.0001	64	0	NA	NA	0.000115	A
Boron (T)	1.5	0.01	64	21	0.007	0.046	0.75	A
Cadmium (T)	0.00004	0.000005	64	0	NA	NA	0.000023	A
Chromium (T)	0.005	0.0001	64	8	0.00004	0.0002	0.0025	A
Copper (T)	0.002	0.0005	64	12	0.00043	0.00054	0.0012	A
Iron (T)	0.3	0.01	64	40	0.017	0.038	0.16	A
Lead (T)	0.001	0.00005	64	3	NA	NA	0.00053	A
Lithium (T)	NA	0.001	64	25	0.001	0.0033	0.003	B
Manganese (T)	See text	0.0001	64	64	0.0027	0.0053	0.34	A
Mercury (T)	0.000026	0.000005	64	0	NA	NA	0.000016	A
Molybdenum (T)	0.073	0.00005	64	28	0.00007	0.00016	0.037	A
Nickel (T)	0.025	0.0005	64	0	NA	NA	0.013	A
Selenium (T)	0.001	0.00005	64	2	NA	NA	0.00053	A
Silicon (T)	NA	0.1	47	47	0.19	0.28	0.28	B
Silver (T)	0.00025	0.00001	64	0	NA	NA	0.00013	A
Strontium (T)	2.5	0.0002	64	64	0.025	0.083	1.26	B
Thallium (T)	0.0008	0.00001	64	0	NA	NA	0.00041	A
Tin (T)	NA	0.0001	64	0	NA	NA	0.0002	C
Titanium (T)	NA	0.0003	64	6	0.00019	0.00039	0.0006	C
Uranium (T)	0.015	0.00001	64	37	0.000048	0.000065	0.0075	A
Vanadium (T)	0.12	0.0005	64	0	NA	NA	0.06	A
Zinc (T)	See text	0.003	64	1	NA	NA	NA	NA

Notes: For each variable, thresholds (guidelines) are shown if applicable (see text for discussion); DL = current detection limit; N = sample measurements; >DL = number of measurements above DL; 95th %ile = 95th percentile if estimable; Method = method used to determine the trigger, where A = halfway from median (or DL if median not estimable) to threshold, B = 95th percentile, and C = 2-times the DL, NA = not applicable (thresholds) or not measured (summary statistics)

Table 14 Baker Lake Water Quality Triggers – Dissolved Metals

Variable	Threshold	DL	Baker Lake					
			N	>DL	Median	95th %ile	Trigger	Method
Aluminum (D)	0.05	0.001	61	49	0.005	0.006	0.027	A
Antimony (D)	0.009	0.0001	61	0	NA	NA	0.0046	A
Arsenic (D)	0.005	0.0001	61	34	0.00011	0.00014	0.00256	A
Barium (D)	1	0.0001	61	47	0.0178	0.02	0.51	A
Beryllium (D)	0.00013	0.0001	61	0	NA	NA	0.000115	A
Boron (D)	1.5	0.01	61	15	0.007	0.042	0.75	A
Cadmium (D)	0.00004	0.000005	60	0	NA	NA	0.000023	A
Chromium (D)	0.005	0.0001	61	3	NA	0.00013	0.00026	A
Copper (D)	0.002	0.0002	61	45	0.00029	0.00042	0.0011	A
Iron (D)	0.3	0.01	61	4	NA	NA	0.16	A
Lead (D)	0.001	0.00005	61	2	NA	NA	0.00053	A
Lithium (D)	NA	0.001	61	22	0.0011	0.0022	0.0022	B
Manganese (D)	See text	0.0001	61	57	0.0008	0.0036	0.34	A
Mercury (D)	0.000026	0.000005	59	0	NA	NA	0.000016	A
Molybdenum (D)	0.073	0.00005	61	27	0.00006	0.00014	0.037	A
Nickel (D)	0.025	0.0005	61	0	NA	NA	0.013	A
Selenium (D)	0.001	0.00005	61	3	NA	NA	0.00053	A
Silicon (D)	NA	0.05	47	46	0.16	0.25	0.25	B
Silver (D)	0.00025	0.00001	61	0	NA	NA	0.00013	A
Strontium (D)	2.5	0.0002	61	61	0.025	0.078	1.26	B
Thallium (D)	0.0008	0.00001	61	0	NA	NA	0.00041	A
Tin (D)	NA	0.0001	61	0	NA	NA	0.0002	C
Titanium (D)	NA	0.0003	61	0	NA	NA	0.0006	C
Uranium (D)	0.015	0.00001	61	36	0.00004	0.000054	0.0075	A
Vanadium (D)	0.12	0.0005	61	0	NA	NA	0.06	A
Zinc (D)	See text	0.001	61	6	NA	0.003	0.0042	A

Notes: For each variable, thresholds (guidelines) are shown if applicable (see text for discussion); DL = current detection limit; N = sample measurements; >DL = number of measurements above DL; 95th %ile = 95th percentile if estimable; Method = method used to determine the trigger, where A = halfway from median (or DL if median not estimable) to threshold, B = 95th percentile, and C = 2-times the DL, NA = not applicable (thresholds) or not measured (summary statistics)