



WHALE TAIL PIT PROJECT

Groundwater Monitoring Plan

In Accordance with:
Project Certificate No. 008, T&C 15 and 16

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

Version 3_NWB
May 2019

EXECUTIVE SUMMARY

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

The deposit will be mined as an open pit (i.e., Whale Tail Pit), and ore will be hauled by truck to the approved infrastructure at Meadowbank Mine for milling. Approximately 8.3 million tonnes (Mt) of ore will be mined from the open pit and processed over a three to four-year mine life. The Approved Project supports mining ore from one open pit, the Whale Tail Pit, processed over a three to four-year mine life. Ore from Whale Tail Pit will be crushed on site after which it will be transported to Meadowbank Mine for milling. The mill rate will be approximately 9,000 to 12,000 tonnes per day. Agnico Eagle is proposing to expand and extend the Whale Tail Pit operations to include a larger Whale Tail open pit, development of the IVR open pit, and underground operations while continuing to operate and process ore at the Meadowbank Mine

During mining, groundwater will flow into the open pit. This water is naturally high in total dissolved solids and will not be directly discharged out of the active mine site without treatment. Water management during mine operations will involve a variety of activities, described in detail in the Water Management Plan (WMP) developed for the Project (Agnico Eagle 2019).

This Groundwater Management Plan (GWMP) reflects the commitments made with respect to submissions provided during the technical review of the FEIS, to comply with Terms and Conditions No. 15 and 16 included in the Project Certificate.

An update of the hydrogeological model was conducted in May 2019 for the Expansion Project since the submission of the FEIS addendum in December 2018. The updated hydrogeological model is presented in Appendix A. The model was updated based on results of the following items:

1. Sampling results of the multi-level Westbay well system, that were completed in November 2018;
2. Supplemental hydraulic conductivity (packer) testing in December 2018;
3. 2D thermal modelling and 3D block model thermal analyses completed in 2019 ;
4. Groundwater monitoring plan for horizontal and vertical groundwater flow; and,
5. Threshold and adaptive management plan related to the groundwater management.

The updated hydrogeological model was then used to provide revised predictions of groundwater inflow and total dissolved solids (TDS) concentrations during dewatering, mining, pit and underground flooding and long-term post-closure (reflooded) conditions.

The results of these studies indicated that arsenic release from the submerged pit wall (arsenic diffusion) would not affect water quality in the pit lake and mass transfer to water is very low even under the conservative assumptions of the calculations.

Results from these studies further indicate that the seepage into and out of the pit lake are negligible in volume, particularly compared to surface water exchanged annually during post-closure when flows are re-established based on average climate year watershed runoff. The combination of results corroborates to support that the hydrogeological regime around the pit lake is not critical to pit lake water quality.

Agnico Eagle considers that the uncertainty related to the arsenic-related water quality issues emanate from the Water Rock Storage Facility and the fill water in the proposed pit lake created after the excavation of the ore body, are addressed, and the NIRB Project Certificate No. 008 terms and conditions No. 15 and 16 has been fulfilled.

Agnico Eagle would like to clarify that the monitoring requirements related to the Waste Rock Storage Facility (WRSF) are addressed in the approved ARD-ML monitoring plan, Water Quality and Flow Monitoring Plan, Water Management Plan, Waste Management Plan, and the design report for the WRSF (60-day notice) approved by the NWB in December 2018. Any seepage emanating from the WRSF is considered as a surface water management issue. The groundwater monitoring plan focuses on the definition of the groundwater quality and flow reporting to the pit lake created before, during and after the excavation of the ore body.

The GWMP also includes monitoring commitments regarding the horizontal and vertical groundwater flow to validate the prediction of these studies during the operation of the Whale Tail pit. This plan was also updated in support of the Nunavut Impact Review Board (NIRB) review process and for the Expansion Project in support of the Nunavut Water Board (NWB) Type A Water License Amendment Process.

DISTRIBUTION LIST

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DOCUMENT CONTROL

Version	Date (YMD)	Section	Revision
1	2018-05-30	All	To address Project Certificate No. 008. T&C 15 and 16
2	2018/11/8	1.1, 2.4, 2.5	To address ECCC and CIRNAC recommendations issued in October 2018
3_NIRB	2018-11-17	All	Updated for the Expansion Project in support of the Nunavut Impact Review Board review process
3_NWB	2019/05/09	All	Updated as a supporting document submitted to the Nunavut Water Board (NWB) for the Type A Water License amendment process

Prepared by:

Golder Associates & Agnico Eagle Mines Limited - Meadowbank Division

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1. INTRODUCTION

Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle) received Project Certificate No.008 from the Nunavut Impact Review Board (NIRB) for the development of the Whale Tail Pit (the Project), a satellite deposit located on the Amaruq Exploration property. The Amaruq Exploration property is a 408 square kilometre (km²) site located on Inuit Owned Land approximately 150 kilometres (km) north of the hamlet of Baker Lake and approximately 50 km northwest of the Meadowbank Mine in the Kivalliq region of Nunavut (Figure 1). The deposit will be mined as an open pit, and ore will be hauled by truck to the approved infrastructure at Meadowbank Mine for milling.

This document presents Groundwater Monitoring Plan (GWMP) for the Whale Tail Pit. Overall water management for operations, closure, and post-closure is described in the Agnico Eagle Water Management Plan (WMP) (Agnico Eagle 2018a). The WMP provides descriptions of the water control structures and associated design criteria.

1.1 CONCORDANCE

Meadowbank Mine is an approved mining operation and Agnico Eagle is planning to extend the life of the mine by constructing and operating the Project. The Project was subject to an environmental review established by Article 12, Part 5 of the Nunavut Agreement. In June 2016, Agnico Eagle submitted a Final Environmental Impact Statement (FEIS) seeking a reconsideration of the Meadowbank Mine Project Certificate (No. 004/File No. 03MN107) and Type A Water Licence Amendment (No. 2AM-MEA1525) from the NIRB.

On July 2016, the NIRB determined that the proposed Project required a separate screening assessment under the Nunavut Agreement and the *Nunavut Planning and Project Assessment Act* (NuPPAA). A separate Project Certificate (NIRB Project Certificate No. 008) was issued for the Project on March 15, 2018 by the NIRB. This GWMP reflects the commitments made with respect to submissions provided during the technical review of the FEIS, to comply with Terms and Conditions No. 15 and 16 included in the Project Certificate. An update of the hydrogeological model was conducted in May 2019 for the Expansion Project since the submission of the FEIS addendum in December 2018. The updated hydrogeological model is presented in Appendix A. The model was updated based on results of the following items

This version of the plan includes:

1. Sampling results of the multi-level Westbay well system, completed in November 2018;
2. Supplemental hydraulic conductivity (packer) testing in December 2018;
3. 2D thermal modelling and 3D block model thermal analyses completed in 2019;
4. Groundwater monitoring plan for horizontal and vertical groundwater flow; and,
5. Threshold and adaptive management plan related to the groundwater management.

An update of the hydrogeological model was conducted in May 2019 for the Expansion Project since the submission of the FEIS addendum in December 2018 (refer to Appendix A). The model was updated based on sampling results of the multi-level Westbay well system, that were completed in November 2018, supplemental hydraulic conductivity (packer) testing in December 2018, 2D thermal modelling and 3D block model thermal analyses completed in 2019. The updated hydrogeological model was then used to provide revised predictions of groundwater inflow and total dissolved solids (TDS) concentrations during dewatering, mining, pit and underground flooding and long-term post-closure (reflooded) conditions.

The results of these studies indicated that arsenic release from the submerged pit wall (arsenic diffusion) would not affect water quality in the pit lake; and, mass transfer to water is very low even under the conservative assumptions of the calculations. Results from these studies further indicate that the seepage into and out of the pit lake are negligible in volume, particularly compared to surface water exchanged annually during post-closure when flows are re-established based on average climate year watershed runoff. The combination of results corroborates to support that the hydrogeological regime around the pit lake is not critical to pit lake water quality.

Agnico Eagle considers that the uncertainty related to the arsenic-related water quality issues emanate from the Water Rock Storage Facility and the fill water in the proposed pit lake created after the excavation of the ore body, are addressed, and the NIRB Project Certificate No. 008 terms and conditions No. 15 and 16 has been fulfilled. The GWMP was updated to include additional monitoring of the horizontal and vertical groundwater flow to validate the prediction of these studies during the operation of the Whale Tail pit.

Agnico Eagle would like to clarify the monitoring requirements related to the Waste Rock Storage Facility (WRSF) are addressed in the approved ARD-ML monitoring plan, Water Quality and Flow Monitoring Plan, Water Management Plan, Waste Management Plan and the design report for the WRSF, approved by the NWB in December 2018. Any seepage emanating from the WRSF is considered as a surface water management issue. The groundwater monitoring plan focus on the definition of the groundwater quality and flow reporting to the pit lake created before, during and after the excavation of the ore body.

1.2 OBJECTIVES

The objective of the GWMP is to provide consolidated information on groundwater management for the Project. The GWMP is divided into the following components:

- Introductory section (Section 1)
- A brief summary of the physical and hydrogeological setting at the mine site, the mine development plan and FEIS pit inflow predictions and updated predictions in 2019 (Section 2)
- A description of the groundwater monitoring program (Section 3)
- A summary of procedures for quality assurance and quality control (QA/QC) (Section 4)

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LEGEND

- COMMUNITY
- HAUL ROAD
- ALL WEATHER ROAD
- WHALE TAIL PIT
- MEADOWBANK OPERATION AND INFRASTRUCTURE
- WATERCOURSE
- WATERBODY

KEY MAP

0 12 24
1:600,000 KILOMETRES

REFERENCE(S)

1. HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED.
2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
3. INSET MAP DATA OBTAINED FROM ESRI.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

CLIENT

AGNICO EAGLE

PROJECT

WHALE TAIL PIT - EXPANSION PROJECT

TITLE

SITE LOCATION

CONSULTANT	YYYY-MM-DD	2018-11-22
	DESIGNED	JR
	PREPARED	CDB
	REVIEWED	JR
	APPROVED	DF

PROJECT NO.	CONTROL	REV.	FIGURE
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25mm

2. BACKGROUND

2.1 SITE CONDITIONS

The Project is located in Canada's Northern Arctic ecozone. This region includes most of Canada's Arctic Archipelago and northern regions of continental Nunavut and the Northwest Territories. This ecoregion is classified as a polar desert and is characterized by long cold winters and short cool summers. The mean air temperatures in June to September is approximately 7 degrees Celsius (°C) and -20.6 °C in October to May.

Average annual precipitation at Meadowbank Mine is 142.6 mm (1998 to 2004). The annual precipitation at site generally falls as rain between June and September, and snow between October and May. However, snowfall can occur at any time of the year.

Based on data for Baker Lake (120 km to the south), and from experience ice auguring within the Meadowbank Mine lakes in the winter, the mean maximum lake ice thickness over Whale Tail Lake is expected to be 2.25 m. During the winter collection of water quality baseline data in Whale Tail Lake in April 2016, ice thickness was confirmed to be 2 m.

The surficial geology of the Project area shows strong evidence of glacial activity and is dominated by veneers and blankets of till overlying undulating bedrock. Bedrock frequently outcrops in isolated exposures, elevated plateaus and elongated ridges. Lakes and ponds are abundant, occupying approximately 16% of the area.

The local overburden consists of till with a silty sand matrix and clasts that range from granule gravel to large boulders in size. Glaciofluvial deposits in the form of eskers and terraces are found in the northeast section of the satellite deposit and they continue in a southeast direction intersecting the haul road in several locations.

The bedrock geology in the Project area consists of Archean and Proterozoic super crustal sequences and plutonic rocks.

2.2 HYDROGEOLOGY SETTING

2.2.1 Conceptual Model

An updated thermal assessment for the Project was conducted in April 2019 to evaluate the existing permafrost characteristics in the Whale Tail Lake and Project area and to evaluate the existing talik conditions under the Whale Tail Lake adjacent to the Project site. The results of this work are documented in Golder (2019e). The report presents a review and summary of estimated permafrost condition based on available thermistor data to date, as well as the results of a thermal modelling exercise prepared to assess permafrost conditions and the extent of talik formations beneath the Whale Tail Lake.

Results from the thermal modelling were used to develop a 3D representation of the permafrost in the Whale Tail Lake area.

Based on the thermal modelling update and the available thermistor data, the permafrost characteristics in the Project area are summarized below:

- The depth of permafrost outside of the influence of lakes is estimated to be between 452 m and 522 m based on thermal gradients and ground temperatures at the lowest portions of the thermistor strings. The depth of permafrost increases with increasing distance from lakes with talik.
- Considering the 2D thermal modelling and 3D block model, the assessment indicated that:
 - Under the northern portion of the lake below Whale Tail Pit, there is likely a closed talik formation
 - Open talik conditions are probable in the southern portion of the lake where the Whale Tail Lake becomes wider
 - Permafrost depth is between 480 m and 550 m for ground away from the Whale Tail Lake, and between 350 m and 450 m below surface in portions beneath the Whale Tail Lake where a closed talik is present.
 - The cryopeg thickness is likely between 20 m to 30 m.

Review of the 2D thermal analysis and 3D block model indicates that the predicted closed and open talik is consistent with the conceptual hydrogeological conditions adopted in the FEIS Addendum.

The Project is in an area of continuous permafrost. In this region, the layer of permanently frozen subsoil and rock is generally deep and overlain by an active layer that thaws during summer. The depth of the active layer is typically expected to range between one and three metres. Depending on lake size, depth, and thermal storage capacity, the talik (unfrozen ground surrounded by permafrost) beneath lakes may fully penetrate the permafrost layer resulting in an open talik. Circular lakes with a radius greater than 300 m, or elongated lakes with a half-width of at least 150 m, are assumed to be connected to the deep groundwater flow regime through open taliks.

In areas of continuous permafrost, there are two groundwater flow regimes: a deep groundwater flow regime beneath permafrost, and a shallow groundwater flow regime located in the active (seasonally thawed) layer near the ground surface. With the exception of areas of taliks beneath lakes, the two groundwater regimes are isolated from one another by thick permafrost.

The shallow groundwater regime is active only seasonally during the summer months, and the magnitude of the flow in this layer is expected to be several times less than runoff from snowmelt. Groundwater in the active layer primarily flows to local depressions and ponds that drain to larger lakes; therefore, the total travel distance would generally extend only to the nearest pond, lake, or stream. Water in the active layer is stored in ground ice during the cold season and is then released with the ice thaws in late spring or early summer, thus providing flow to surface. During the warm season, groundwater in the active layer is recharged primarily by precipitation.

Permafrost reduces the hydraulic conductivity of the bedrock by several orders of magnitude (Burt and Williams 1976; McCauley et al. 2002). Consequently, the permafrost in the rock would be virtually impermeable to groundwater flow. The shallow groundwater flow regime, therefore, has little to no hydraulic connection with the deep groundwater regime which is overlain by massive and continuous permafrost.

Groundwater flow within the deep groundwater flow regime is limited to the sub-permafrost zone. This deep groundwater flow regime is connected to the ground surface by open taliks underlying larger lakes. Talik exist beneath lakes that have enough depth so that they do not freeze to the bottom over the winter. If the lake is sufficiently large and deep, the talik can extend down to the deep groundwater regime. These taliks are referred to as open talik. If the talik does not extend down to the deep groundwater, it is referred to as a closed or an isolated talik. The width and shape of lakes in the Hydrogeology Baseline Study and FEIS area were reviewed to estimate if open taliks could be present below the lakes (Golder 2019e). Based on 1-D analytical solutions presented in Burn (2002), 2D thermal analysis and a 3D block model, Golder estimated that open taliks could be present for circular lakes with a radius of approximately 300 m and for elongated lakes with a half-width of approximately 150 m. Beneath smaller lakes that do not freeze to the bottom over the winter, a talik bulb may form; however, the talik bulb is not expected to extend to the deep groundwater flow system.

Generally, deep groundwater will flow from higher elevation lakes with open taliks to lower elevation lakes with open taliks. To a lesser degree, groundwater beneath the permafrost is influenced by density differences due to saline water conditions (density driven flow).

Below the active layer, permafrost underlies the land surrounding the lakes, which restricts the lateral or horizontal flow of groundwater and restricts the recharge of the sub-permafrost groundwater flow system by precipitation. Multiple thermistors in the land surrounding Whale Tail Lake, in combination with thermal modelling, indicate the permafrost extends to 452 m to 522 m below ground surface. In particular, thermistor data recorded at AMQ15-294, AMQ15-306, AMQ15-306, AMQ15-349A, AMQ15-421, AMQ15-452, AMQ17-1233, AMQ-1265A, AMQ17-1337 and AMQ17-1277A (Golder 2019c) indicates the presence of permafrost between Whale Tail Lake and Nemo lake, and therefore the absence of horizontal groundwater flow in the upper 452m to 522 m of bedrock.

Groundwater flow is controlled by surface water elevations in lakes with open talik; water moves vertically through the open talik to the underlying sub-permafrost groundwater flow system. The elevations of the lakes with expected talik in the baseline study area indicate that Whale Tail Lake is likely a groundwater discharge zone at the south end of the Lake (upward vertical hydraulic gradient); with flow from Lake A60 to Whale Tail Lake, and a groundwater recharge zone at the north end of the Lake (downward hydraulic gradient), with groundwater flow from Whale Tail Lake to Lake DS1 as presented on the Figure 2 showing the hydrogeology baseline study area.

Whale Tail Pit is located in the north basin and therefore a downward vertical hydraulic gradient is expected (Figure 3). This was verified by hydraulic head monitoring at the Westbay Well system in 2018, which had a measured downward hydraulic gradient of 0.008 m/m, which is equivalent

to what would be expected based on the relative lake elevation of Whale Tail Lake and Lake DS1 (Golder 2019a).

FIGURE 2: HYDROGEOLOGY BASELINE STUDY AREA

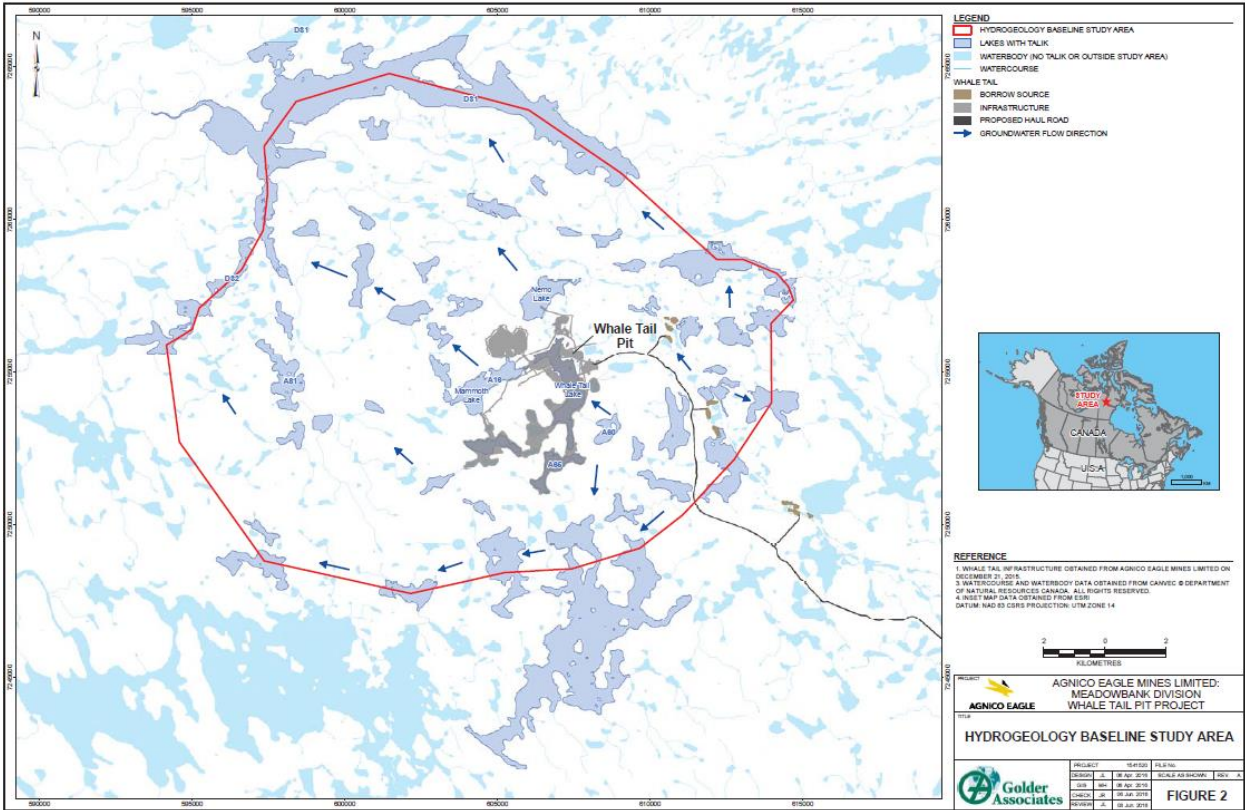
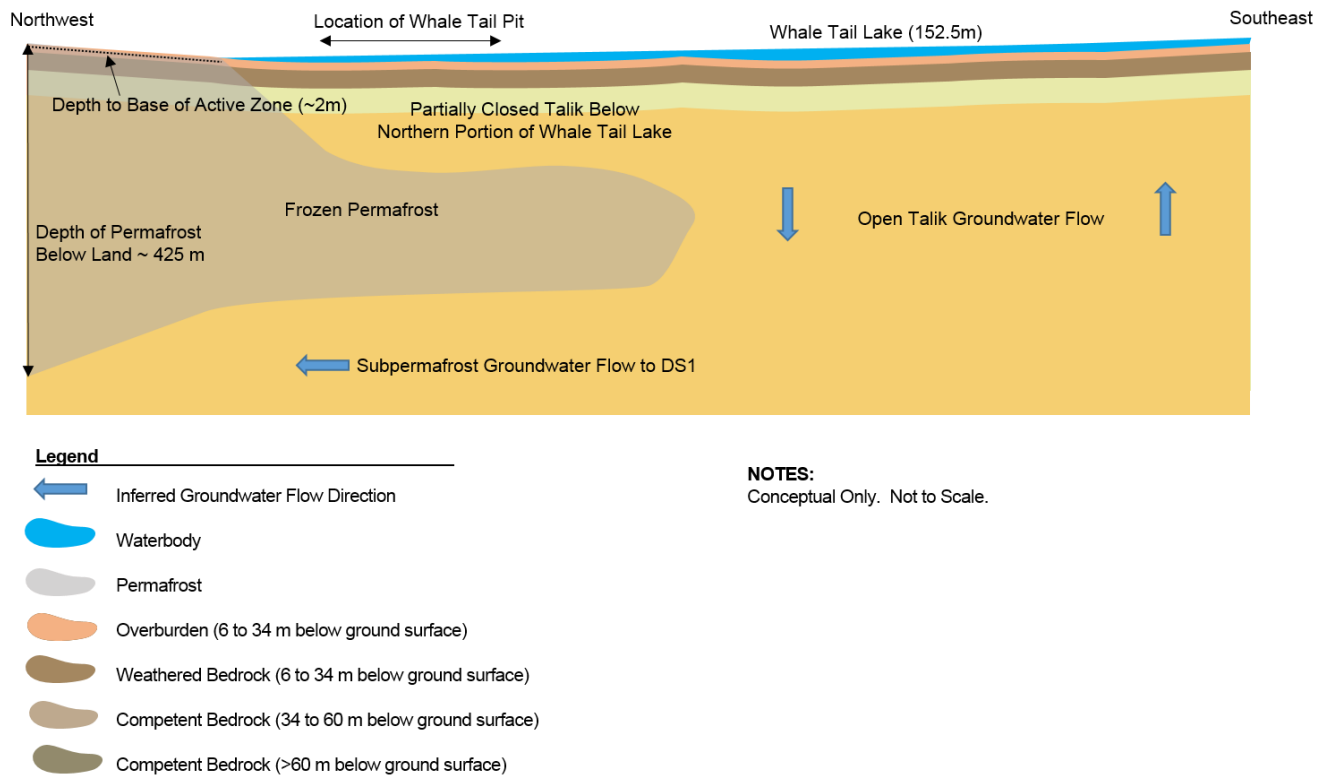
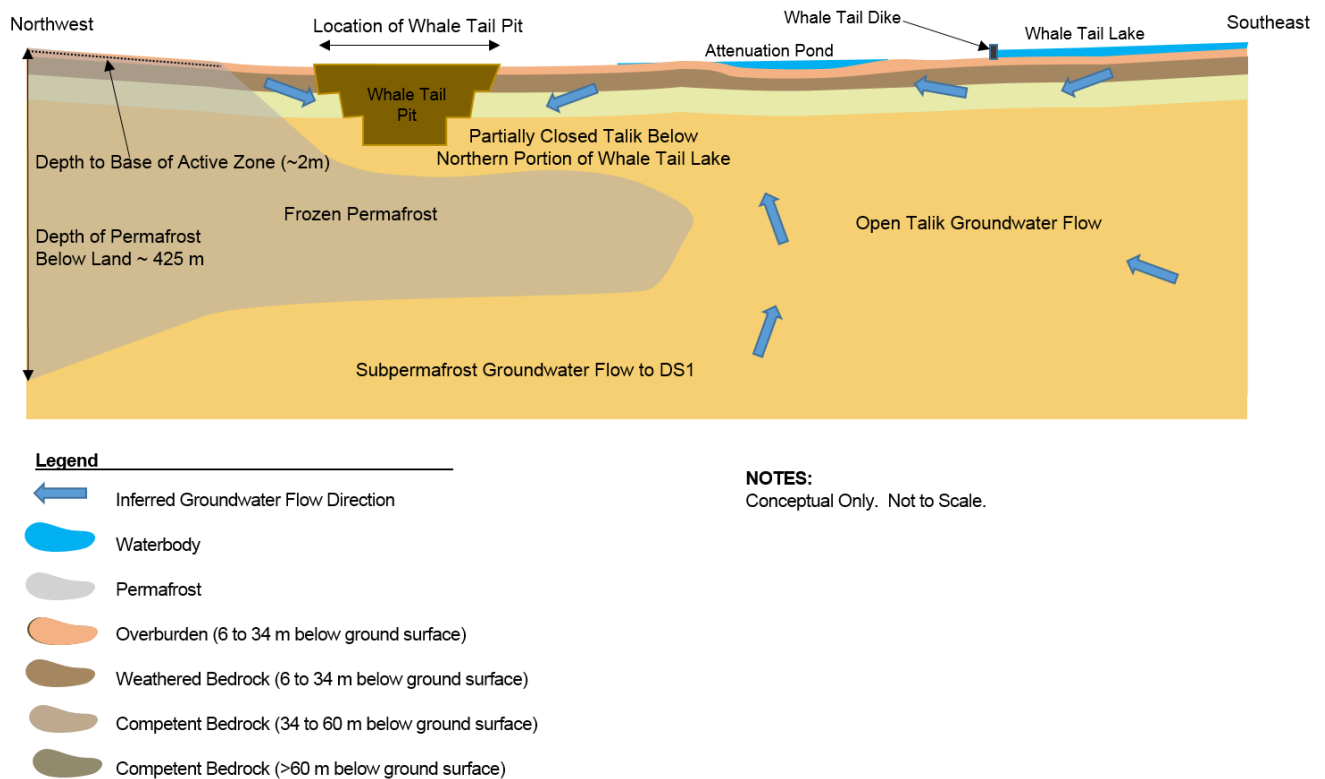


FIGURE 3: CONCEPTUAL MODEL OF PRE-MINING DEEP GROUNDWATER FLOW REGIME - CROSS-SECTION VIEW



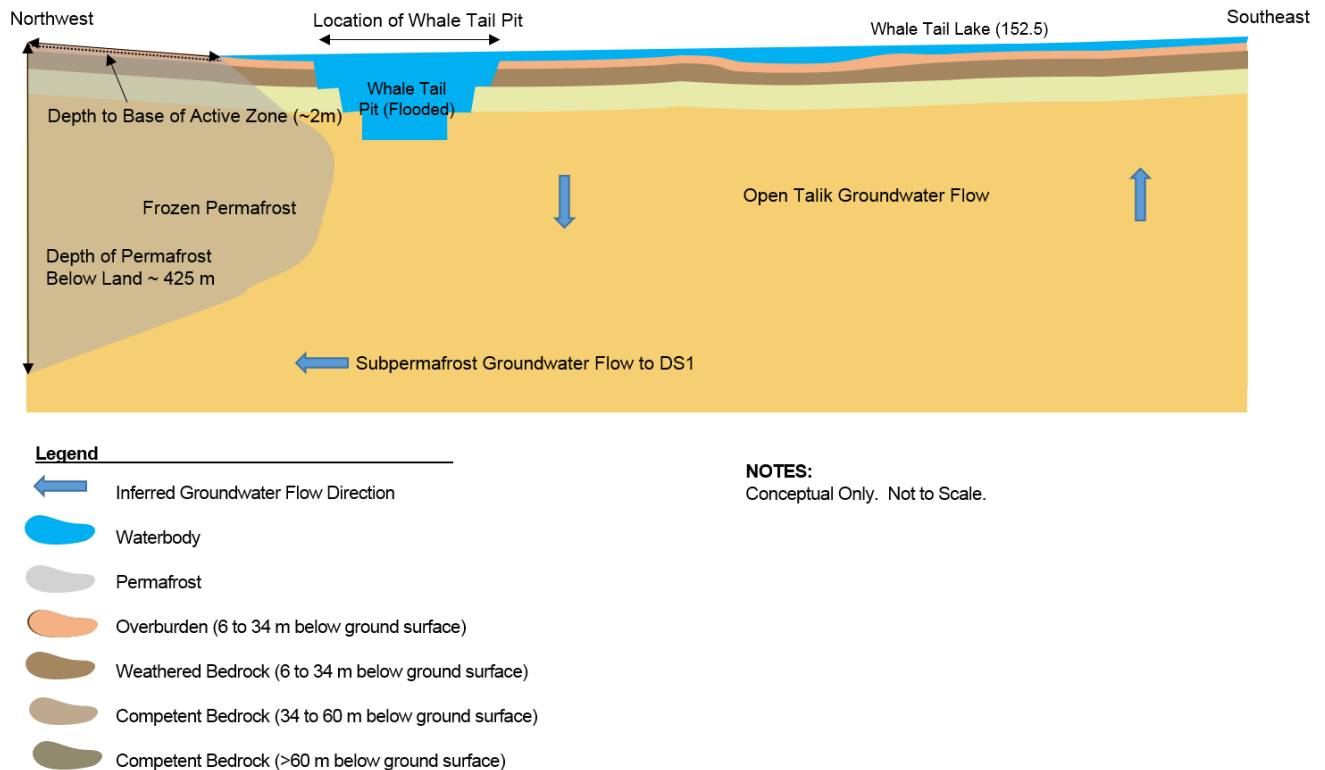
Below Whale Tail Lake, a talik is expected to form a continuous channel that is closed in the northern portion of Whale Tail Lake below the open pit and becomes open towards the south and central portion of the lake. As shown in Figure 4, during mining the open pit will act as a sink for groundwater flow, with seepage faces developing along the pit walls. In response to mining of the open pit, groundwater will be induced to flow through bedrock to the open pit. Mine inflow will primarily originate from Whale Tail Lake, the attenuation pond between the pit and Whale Tail dike, and deep bedrock. The quality of mine inflow will be a result of the mixing from each of these sources.

FIGURE 4: CONCEPTUAL MODEL OF DEEP GROUNDWATER FLOW REGIME DURING MINING - CROSS-SECTION VIEW



During closure (Figure 5), the open pit will be flooded with water from a variety of sources including: water pumped from the flooded South Whale Tail watershed until the original Whale Tail Lake level is reached (152.5 m), the north-east watershed following the breach of the North-East dike, groundwater originating from nearby lakes underlain by open taliks, connate water and water pumped from the attenuation pond. This process will dissipate the large hydraulic head differences established during mine operations in the vicinity of the mine workings. The rate of groundwater inflow will decrease as the water level in the open pit rises. From the start of closure and following the formation of the pit lake in post-closure, permafrost below the pit is expected to thaw slowly. The thermal regime in the vicinity of the pit will be monitored, as outlined in the Thermal Monitoring Plan for the Project (Agnico Eagle 2019).

FIGURE 5: CONCEPTUAL MODEL OF DEEP GROUNDWATER FLOW REGIME IN LONG-TERM POST-CLOSURE - CROSS-SECTION VIEW



2.2.2 Post-Closure Hydrogeological and Thermal Analysis

Hydrogeological analysis was conducted to assess the post-closure groundwater regime in the vicinity of the Whale Tail Pit (Golder 2019e). The intent of the study was to consider post-closure changes in the groundwater regime once the pit lake reaches its ultimate elevation and the influence, if any, that these changes may have on water quality in the flooded pit. As part of the analysis, the predicted changes in the permafrost regime, based on a post-closure thermal assessment, were incorporated in to the hydrogeological model. The results of the hydrogeological assessment provided input into a concurrent study that assessed water quality in the flooded pit (Golder 2019e). Overall, groundwater was found to be a minor component of the flooded pit lake water quality due to the small predicted seepage rates from the pit in relation to typical surface water exchanges.

Results of the post-closure thermal assessment (Golder, 2019e) included:

- During pit flooding, the warm pit lake temperature impacts mostly the upper portion of the permafrost under the pit, and a talik starts to form around the pit wall and floor.

- The permafrost under the pit lake continues to thaw during the long-term post-closure stage, and the open talik expands towards the northern edge of the pit lake (land side). The majority of the permafrost under the pit lake is thawed 300 years after closure.
- The steady-state model indicates the pit lake would thaw the permafrost in the long-term, and eventually somewhat reduce the permafrost depth to the northwest of the pit. A significantly longer time (in the order of 10,000 years) is likely required for the pit lake to reach the steady-state thermal conditions. Permafrost is still predicted to the north of the pit, restricting the horizontal flow of groundwater to towards Nemo Lake where the permafrost is present.

Result of the Post-closure hydrogeological model (Golder, 2018a) included:

- Initially, once the hydraulic heads return to near equilibrium shortly after mine flooding, groundwater inflow into the pit is greater than pit lake discharge into surrounding bedrock. This groundwater discharge to the pit lake decrease gradually over 100 years, at which time it reverses and the pit lake discharge into the bedrock is greater than the groundwater inflow. The relative difference in flow increases with time and as the permafrost layer beneath the pit lake thaws.
- Long-term, the pit lake establishes as a source of groundwater recharge, which is consistent with the current pre-development groundwater flow condition.

As summarized above, with the exception of deep sub-permafrost groundwater flow, groundwater flow during closure will be similar to pre-development conditions and limited to the area of talik below Whale Tail Lake and the developed pit lake during closure. Horizontal flow beneath land will be restricted by the presence of permafrost below the active layer. Thermal analysis indicates that although permafrost degradation below the pit footprint will occur, permafrost will be present below the land outside of the pit lake and other lakes with talik (i.e., including between the pit and Nemo Lake).

Predictions from the hydrogeological modelling were an input into a concurrent study that assesses overall water quality in the flooded pit (Golder, 2018c). Arsenic loading rate from the Whale Tail pit north wall has been determined from the completion of the Arsenic diffusion model (Golder, 2018d) and integrated to the Whale Tail Pit hydrodynamic model (Golder, 2018c). Result of the hydrodynamic model are:

- The concentration of TDS will remain below site specific water quality objectives at all times. TDS will peak at just below 25mg/L in year 2025, and thereafter decrease over time. Concentration of TDS will stabilize at approximately 11mg/L by 2055.
- The concentration of arsenic will remain below site specific water quality objectives at all times. Arsenic will peak at just below 0.025mg/L in year 2025, and thereafter decrease over time. Concentration of arsenic will stabilize at approximately 0.0025mg/L by 2055.
- The concentration of total phosphorous will remain below site specific water quality objectives at all times. Total phosphorus will peak at just above 0.007mg/L in year 2025,

and thereafter decrease over time. Concentration of total phosphorus will stabilize at approximately 0.0025 mg/L by 2055.

The pit lake in the long-term is expected to be a source of groundwater recharge, with a seepage loss rates to groundwater of approximately 1.7 m³/day (620 m³/year), which is negligible relative to the 3,000,000+ m³ of surface water exchanged annually post-closure when surface water flows are re-established, based on average climate year watershed runoff. This groundwater loss rate is representing 0.02% of the total surface water exchanged annually. This indicates that uncertainty in the hydraulic gradient and groundwater flow is not critical to the long-term assessment of pit lake water quality. As presented in Golder (2018) recent monitoring of the hydraulic gradient, and calculated fluxes based on this gradient suggest that the predicted post-closure seepage rates are reasonable based on the measured data.

2.2.3 Groundwater Volumes and Quality

Updated predictions for dewatering of Whale Tail Lake and the mining and reflooding of the pits and underground for the Expansion Project were conducted in May 2019. The model update incorporates a reduction in deep bedrock hydraulic conductivity based on additional packer testing in December 2018, and the results of the thermal modelling, which overall support the permafrost interpretation in the FEIS Addendum. Minor adjustments were made in the permafrost depth along the margins of Whale Tail Lake but overall, changes to the permafrost extent were minor and did not conceptually alter the interpretation of where open and closed talik were present in Whale Tail Lake.

Updated predictions of groundwater inflow (quantity and TDS quality) are provided for the Base Case and EA Scenario. Quantity and TDS quality is consistent with previous modelling in the FEIS Addendum, TDS concentrations do not account for loading from lakes and Whale Tail Attenuation Pond. TDS from these sources accounted for in Site Wide Water Quality analysis. The Base Case Scenario represents the best estimate of groundwater inflow and groundwater TDS based on the measured data. The EA Scenario is designed to be a reasonable, yet more conservative, assessment of potential groundwater inflow quantity and TDS quality than values that might be adopted for mine operation planning. (i.e., Base Case Scenario). Results from the more conservative EA Scenario are used in the Updated Site-Wide Water Balance and Water Quality model (Golder 2019).

A summary of these updated predictions is presented in the section below.

2.2.3.1 Base Case Scenario

Dewatering

Table 1 presents a summary of the predicted discharge to the North Basin of Whale Tail lake during dewatering for the base case. The predicted discharge of 1320 m³/day is within 20 m³/day of the FEIS predictions (1340 m³/day) and no change in TDS concentration was predicted. The minor variation in predicted discharge from the FEIS reflects the small adjustments made to permafrost extent along the margins of Whale Tail Lake.

Table. 1 Predicted Groundwater Discharge to North Basin of Whale Tail Lake during Dewatering – Base Case Scenario

Phase	Base Case Scenario	
	Groundwater Discharge (m3/day)	TDS Concentration (mg/L)
Lake Dewatering (Q1-Q3 2019)	1320	80

Mining

Table 2 presents a summary of the updated predicted groundwater flow rates and groundwater TDS concentrations to the mine development areas for the Base Case Scenario during mining of the open pits and underground. The predictions include: predicted groundwater inflow to Whale Tail Pit, predicted groundwater inflow to the Underground, predicted flow to and from the Whale Tail Attenuation Pond, and predicted discharge to the dewatered North Base of Whale Tail Lake (i.e., the flow of water below the Whale Tail Lake Dike to the dewatered lake bottom). Groundwater inflow to the IVR Pit during mining is not included as the pit is in permafrost (groundwater inflow will be negligible). Some interception of surface water runoff and direct precipitation by the IVR Pit is expected, but this is not a flow component derived from the groundwater modelling. It is addressed in the Updated Site-Wide Water Balance and Water Quality Model (Golder 2019d).

- **Whale Tail Open Pit**

In the last quarter of 2019, following dewatering of the North Basin of Whale Tail Lake, mining is expected to intersect unfrozen rock, and groundwater inflow to the pit is predicted to be 970 m3/day. The groundwater inflow to the open pit was predicted to increase from 970 m3/day in 2019 to 1,340 m3/day in 2022 to 2025. The overall inflow to the pit does not increase significantly as the pit deepens because the flow of water is primary through the permeable shallow (weathered) bedrock and the lower portion of the pit is in permafrost. The predicted quantity of groundwater inflow into the open pit during mining for the Base Case Scenario is close to what was predicted in the FEIS Addendum as no changes were made to the shallow bedrock hydraulic conductivity based on the recent packer test data.

Groundwater inflow predictions during mining conservatively assumes that no freeze-back will occur in the pit walls. This assumption was adopted for Whale Tail Pit to be conservative and because during the first few years of mining, the pit will be both widened and deepened, resulting in the continual exposure of unfrozen bedrock. During the later years of mining; however, the pit development will be entirely within the permafrost and significant freeze back in the pit walls is considered possible and has been observed at Meadowbank. Although not simulated, if freeze back does occur as is the case at Meadowbank, actual groundwater inflow to the pit could be substantively lower than the predicted (i.e., reduce to zero during periods of full freeze back).

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Table. 2 Predicted Groundwater Inflow and Groundwater Quality during Mining – Base Case Scenario – Whale Tail Pit and Underground

Phase	Time Period	Whale Tail Pit		Underground		Whale Tail Attenuation Pond			North Basin of Whale Tail Lake (within the diked area) ³	
		Groundwater Inflow (m³/day)	TDS Concentration ² (mg/L)	Groundwater Inflow (m³/day)	TDS Concentration ² (mg/L)	Groundwater Inflow (m³/day)	Inflow TDS Concentration (mg/L)	Surface Water Outflow (m³/day)	Groundwater Discharge to Surface (m³/day)	Inflow TDS Concentration (mg/L)
Mining	August-December 2019 ¹	970	120	NA	NA	350	110	180	650	70
	2020	1160	50	20	3880	120	170	860	720	30
	2021	1310	20	30	4080	90	150	1040	730	20
	2022	1340	20	110	5630	90	130	1080	720	10
	2023	1340	10	180	6890	90	110	1080	720	10
	2024	1340	10	170	7430	90	80	1080	720	10
	2025	1340	10	130	7760	90	40	1080	720	10

Notes:

IVR Pit is located in permafrost and was therefore not modelled. Interception of runoff / direct precipitation accounted for in Site Wide Water Balance.
Mining prior to Q4 2019 is within permafrost and groundwater inflow will be negligible.
TDS concentrations do not account for loading from lakes and Whale Tail Attenuation Pond. TDS from these sources to be accounted for in Site Wide Water Quality analysis.
NA = not applicable; TDS = total dissolved solids; m3/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

TDS concentration in the groundwater inflow to the pit was predicted to decrease during mining from approximately 120 mg/L (2019) to 10 mg/L (2023 to 2025). These TDS concentrations are identical to the predicted TDS concentrations in the FEIS Addendum. The relatively low TDS concentration and decrease in TDS over time reflects the minimal upwelling of higher salinity waters at depth due to the presence of the permafrost at the base of the pit and the high contribution of lake water from the South Base of Whale Lake and from the Whale Tail Attenuation Pond water. Consistent with the FEIS Addendum, the predicted TDS concentrations in this model only account for TDS loading from groundwater. TDS loading from the Whale Tail Attenuation Pond and South Basin of Whale Tail Lake is accounted for in the water quality model (Golder 2019d).

- **Underground**

For the Underground, groundwater inflow was predicted to increase from 20 m³/day in 2020, which is the first year the Underground development will be within unfrozen bedrock, up to 180 m³/day in 2023, which is when the underground reaches its maximum depth of -505 masl. By the final year of mining, the groundwater inflow decreases to 130 m³/day. This decrease reflects that the underground is no longer being deepened and flow to the underground is likely near steady state conditions (reduced drainage from storage). The predicted flows based on the updated model is approximately 13% lower than the predicted values in the FEIS Addendum at the end of mining (150 m³/day). The reduction in groundwater inflow reflects the small decrease in hydraulic conductivity in the deep sub-permafrost bedrock due to the additional packer testing data.

TDS concentrations in the groundwater inflow to the Underground were predicted to increase from 3,880 mg/L in 2020 to 7,760 mg/L in 2025. The predicted increase in TDS concentration is the result of the interception of higher salinity groundwater as the mine is deepened, and the upwelling of higher TDS water from beneath the Underground. The predicted TDS concentrations are within 30 mg/L of the predicted values in the FEIS Addendum for the Base Case Scenario.

Reflooding Of Pits and Underground

Table 3 and Table 4 respectively presents a summary of the predicted groundwater inflow rates and groundwater TDS concentration to the mine development areas for the Base Case Scenario during reflooding of the pits and underground. The predictions presented in tables 3 and 4 include: predicted groundwater inflow to Whale Tail Pit Lake, predicted groundwater flow to the Underground, predicted flow to and from the Whale Tail Attenuation Pond, and predicted discharge to the dewatered North Base of Whale Tail Lake (i.e., the flow of water below the Whale Tail Lake Dike to the dewatered lake bottom surface). Groundwater inflow to the IVR Pit during refilling was not included as the pit is in permafrost (groundwater inflow will be negligible).

The predictions presented for the reflooding phase utilize a conceptual filling schedule for the Whale Tail Pit and the Underground, based on initial water balance predictions. Fine tuning of the flooding sequence was conducted after the conceptual filling schedule was developed; however, these adjustments will not have a significant impact on the predicted flow rates and salinity for a given elevation range.

For the prediction of pit reflooding, the pit walls were assumed to be frozen at the start of closure / end of mining, which restricted the inflow of groundwater to the pit lake until the pit lake rises and thaws the pit walls. This is considered reasonable as during the later years of mining, the pit development is limited to within the permafrost below Whale Tail Lake. If the pit walls do not remain frozen or melts seasonally, higher inflows than what is predicted could occur resulting in a shorter pit-filling period.

Considering the assumption of freeze-back in the pit walls, groundwater inflow to the Whale Tail Pit was not predicted to occur until 2030, when the pit lake level rises above the top of permafrost elevation near the pit (approximately 40 masl). When the water elevation in the pit lake rises above the permafrost, the freeze back is assumed to dissipate below the lake level and groundwater inflow to the pit was predicted to resume. The groundwater inflow to the pit lake was predicted to increase from 10 m³/day in 2030 to approximately 1,160 m³/day in 2036 as the pit walls progressively become unfrozen and connected to the permeable weathered bedrock. As the pit lake rises further in elevation, the groundwater inflows decrease and eventually the pit lake switches to a groundwater recharge boundary (i.e., the pit lake starts to recharge the sub-permafrost groundwater flow system). These groundwater inflow rates are similar to predictions in the FEIS Addendum and reflect that no changes were made to the shallow bedrock hydraulic conductivity.

The refilling of the Underground is expected to occur over a very short period (i.e. the bottom 500 m will be refilled in the first year). The water level in the Underground is therefore almost immediately higher than the hydraulic heads in bedrock near the Underground, resulting in a small but generally consistent flux of water from the Underground to bedrock. At the end of the reflooding period (2041) the Underground remains a source of groundwater recharge. with a predicted discharge of -10 m³/day. These flow rates are slightly lower (by 0 to 5 m³/day) of the predicted groundwater recharge rates predicted in the FEIS Addendum.

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Table. 3 Predicted Groundwater Inflow and Groundwater Salinity during Reflooding - Base Case Scenario – Whale Tail Pit, Whale Tail Attenuation Pond, North Basin of Whale Tail Lake

Phase	Approximate Time Period	Water Level in Pit (masl)		Whale Tail Pit		Whale Tail Attenuation Pond			Dewatered North Basin of Whale Tail Lake (within the diked area)	
		From	To	Net Groundwater Inflow/Outflow ¹ (m³/day)	TDS Concentration ² (mg/L)	Groundwater Inflow (m³/day)	Inflow TDS Concentration (mg/L) ²	Surface Water Outflow (m³/day)	Net Groundwater Discharge to Surface ¹ (m³/day)	Inflow TDS Concentration ² (mg/L)
Flooding	2026	-130	-76	NA	NA	145	30	<5	340	<10
	2027	-76	-39	NA	NA	170	24	<5	340	<10
	2028	-39	3	NA	NA	180	21	<5	345	<10
	2029	3	26	NA	NA	185	19	<5	345	<10
	2030	26	43	10	24	190	18	<5	345	<10
	2031	43	61	60	24	180	17	10	345	<10
	2032	61	73	90	21	170	17	30	345	<10
	2033	73	87	120	19	160	17	45	340	<10
	2034	87	101	130	17	155	17	50	340	<10
	2035	101	111	700	<10	125	25	505	330	<10
	2036	111	124	1160	<10	85	29	940	300	<10
	2037	124	133	910	<10	90	22	740	300	<10
	2038	133	142	360	<10	115	16	315	315	<10
	2039	142	149	-30	NA	70	22	135	370	<10
	2040	149	153.5	-10	NA	0	NA	5	155	<10
	2041	153.5	153.5	0	NA	0	NA	0	-10	<10

Notes:
IVR Pit is located in permafrost and was therefore not modelled. Interception of runoff / direct precipitation accounted for in Site Wide Water Balance.
Positive values indicate flow to the pit/pond and negative values indicate flow to bedrock.
TDS concentrations do not account for loading from lakes and Whale Tail Attenuation Pond. TDS from these sources to be accounted for in Site Wide Water Quality analysis.
NA = not applicable; TDS = total dissolved solids; m3/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

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Table. 4 Predicted Groundwater Inflow and Groundwater Salinity during Refilling – Base Case Scenario – Underground

Phase	Approximate Time Period	Water Level in Underground (masl)		Underground	
		From	To	Net Groundwater Inflow/Outflow ¹ (m³/day)	TDS Concentration ² (mg/L)
Flooding	2026	-505	-76	-30	NA
	2027	-76	-39	<-5	NA
	2028	-39	3	<-5	NA
	2029	3	26	<-5	NA
	2030	26	43	<-5	NA
	2031	43	61	<-5	NA
	2032	61	73	<-5	NA
	2033	73	87	-5	NA
	2034	87	101	-10	NA
	2035	101	111	-10	NA
	2036	111	124	-10	NA
	2037	124	133	-10	NA
	2038	133	142	-25	NA
	2039	142	149	-15	NA
	2040	149	152.5	-10	NA
	2041	153	152.5	-10	NA

Notes:
Positive values indicate flow to the underground and negative values indicate flow to bedrock.
TDS concentrations do not account for loading from lakes and Whale Tail Attenuation Pond. TDS from these sources to be accounted for in Site Wide Water Quality analysis.
NA = not applicable; TDS = total dissolved solids; m3/day = cubic metres per day; mg/L = milligrams per litre; % = percent

2.2.3.1 EA scenario

The Base Case predictions discussed in the preceding section provides the most likely estimates of groundwater inflow quantity and quality for the Expansion Project based on the available hydraulic conductivity data. Considering the number of tests; however, and in consideration of the sensitivity analysis conducted in the FEIS Addendum, an EA Scenario was developed as part of the FEIS addendum. This scenario provides a reasonable yet conservative estimate of groundwater inflow such that there is a high level of confidence that the potential effects of the Expansion Project on groundwater inflow quantity and salinity have not been underestimated. Results from the EA Scenario are used in the Site-Wide Water Balance and Water Quality Models for the Expansion Project.

Dewatering

Table 5 presents a summary of the predicted discharge to the North Basin of Whale Tail lake during dewatering. The predicted discharge of 1330 m³/day is within 20 m³/day of the FEIS Addendum predictions (1350 m³/day) and no change in TDS concentration was predicted. The minor variation in predicted discharge from the FEIS reflects the small adjustments made to permafrost extent along the margins of Whale Tail Lake.

Table. 5 Predicted Groundwater Discharge to North Basin of Whale Tail Lake during Dewatering – EA Scenario

Phase	EA Scenario	
	Groundwater Discharge (m ³ /day)	TDS Concentration (mg/L)
Lake Dewatering (Q1-Q3 2019)	1330	80

Mining

Table 6 and Table 7 presents a summary of the updated predicted groundwater flow rates and groundwater TDS concentrations to the mine development areas for the EA Scenario during mining of the open pits and underground. The predictions presented include: predicted groundwater inflow to Whale Tail Pit, predicted groundwater inflow to the Underground, predicted flow to and from the Whale Tail Attenuation Pond, and predicted discharge to the dewatered North Base of Whale Tail Lake (i.e., the flow of water below the Whale Tail Lake Dike to the dewatered lake bottom). Groundwater inflow to the IVR Pit during mining is not included as the pit is in permafrost (groundwater inflow will be negligible). Some interception of surface water runoff and direct precipitation by the IVR Pit is expected, but this is not a flow component derived from the groundwater modelling. It is addressed in the Updated Site-Wide Water Balance and Water Quality Model (Golder 2019d).

- **Whale Tail Open Pit**

The predicted quantity and TDS concentration of groundwater inflow into the open pit during mining for the EA Scenario is similar to what was predicted in the Base Case and assumes no freeze-back in the pit walls. For the EA Scenario, the groundwater inflow to the open pit was predicted to increase from 970 m³/day in 2019 to 1,350 m³/day in 2025 and the TDS concentration was predicted to decrease from 120 mg/L in 2019 to 10 mg/L in 2025. Groundwater inflow is controlled by the shallow bedrock hydraulic conductivity, which was not modified between the Base Case and EA Scenario due to the high number of tests in this unit and the conservatism used in the Base Case Scenario. The shallow bedrock hydraulic conductivity is also unchanged from the FEIS Addendum; therefore, predicted inflows to the open pit are similar to the predictions in the FEIS Addendum.

- **Underground**

For the EA Scenario, the updated groundwater inflow to the Underground was predicted to increase from 60 m³/day in 2020 to a maximum of 420 m³/day in 2023. In the final year of mining, the groundwater inflow decreases slightly to 340 m³/day. These groundwater inflows are approximately 2 to 3 times higher than the Base Case values for the same period of mining. Predicted TDS concentrations for the EA scenario are 30% higher than the Base Case at the end of mining and reflect more upwelling of deeper more saline groundwater beneath the Underground.

The predicted inflows based on the updated model is approximately 20% lower than the predicted values at the end of mining in the FEIS Addendum (430 m³/day). The reduction in groundwater inflow reflects the small decrease in hydraulic conductivity in the deep sub-permafrost bedrock due to the additional packer testing data. The predicted TDS concentrations are approximately 2 to 9 % lower than the predicted values in the FEIS Addendum.

Contributions to the inflow to the Whale Tail Pit and the Underground from the Whale Tail Attenuation Pond and the South Basin of Whale Tail Lake were evaluated for the EA Scenario to support the update to the Site-Wide Water Quality Model. TDS concentrations from these sources are accounted for in the Site-wide Water Quality model through a feedback loop. The quantity contributions predicted by the hydrogeological model are presented in Table 6 and Table 7. In 2020, approximately 64% of groundwater inflow to the pit is originating from the Whale Tail Attenuation Pond. The pond represents the major contributor to groundwater inflow to the pit due to its connection to the pit through the permeable shallow bedrock. The contribution from the pond was predicted to increase to 82% at the end of mining. The contribution from the South Basin of Whale Tail Lake is also predicted to increase from 3% in 2021 to 15% at the end of mining in 2025. In the Underground, the source of groundwater inflow is attributed only to water from the deep bedrock flow system

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Table. 6 Predicted Groundwater Inflow and Groundwater Quality during Mining - EA Scenario – Whale Tail Pit and Underground

Phase	Time Period	Whale Tail Pit				Underground			
		Groundwater Inflow (m ³ /day) ³	Inflow TDS Concentration (mg/L) ²	Portion of Inflow from Attenuation Pond (%)	Portion of Inflow from South Basin of Whale Tail Lake (%)	Net Groundwater Inflow (m ³ /day)	Inflow TDS Concentration (mg/L) ²	Portion of Inflow from Attenuation Pond (%)	Portion of Inflow from South Basin of Whale Tail Lake (%)
Mining	August-December 2019 ¹	970	120	1%	<1%	NA	NA	NA	NA
	2020	1170	50	64%	<1%	60	4120	<1%	<1%
	2021	1320	30	79%	3%	70	4580	<1%	<1%
	2022	1360	20	81%	9%	250	6230	<1%	<1%
	2023	1360	20	82%	12%	420	7850	<1%	<1%
	2024	1350	10	82%	14%	410	9090	<1%	<1%
	2025	1350	10	82%	15%	340	10180	<1%	<1%

Notes:

IVR Pit is located in permafrost and was therefore not modelled. Interception of runoff / direct precipitation accounted for in Site Wide Water Balance.

Mining prior to Q4 2019 is within permafrost and groundwater inflow will be negligible.

TDS concentrations do not account for loading from lakes and Whale Tail Attenuation Pond. TDS from these sources to be accounted for in Site Wide Water Quality analysis. NA = not applicable; TDS = total dissolved solids; m³/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

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Table. 7 Predicted Groundwater Inflow and Groundwater Salinity during Dewatering and Mining - EA Scenario – Whale Tail Attenuation Pond and Whale Tail Lake (North Basin)

Phase	Time Period	Whale Tail Attenuation Pond				North Basin of Whale Tail Lake (within the diked		
		Groundwater Inflow (m ³ /day)	Inflow TDS Concentration (mg/L) ²	Portion of Inflow from South Basin of Whale Tail Lake (%)	Pond Outflow (m ³ /day)	Net Groundwater Inflow (m ³ /day) ³	TDS Concentration (mg/L) ²	Portion of Inflow from South Basin of Whale Tail Lake (%)
Mining	August-December 2019	350	110	<1%	180	650	70	39%
	2020	120	170	<1%	860	720	30	85%
	2021	90	160	5%	1050	730	20	98%
	2022	90	140	23%	1090	720	10	99%
	2023	90	110	49%	1090	720	10	99%
	2024	90	90	74%	1090	720	10	>99%
	2025	90	70	94%	1090	720	10	>99%

Notes:

IVR Pit is located in permafrost and was therefore not modelled. Interception of runoff / direct precipitation accounted for in Site Wide Water Balance.

Predictions of groundwater inflow to North Basin of Whale Tail lake represents the discharge of groundwater to the lake basin during dewatering and mining. This excludes discharges to the pit and Whale Tail Attenuation Pond, which are within the North Basin of Whale Tail Lake.

TDS concentrations do not account for loading from lakes and Whale Tail Attenuation Pond. TDS from these sources are accounted for in the Site Wide Water Quality model.

NA = not applicable; TDS = total dissolved solids; m³/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

Reflooding of Pits and Underground

Table 8 and Table 9 respectively presents a summary of the predicted groundwater inflow rates and groundwater TDS concentration to the mine development areas for the EA Scenario during reflooding of the pits and underground. The predictions presented in Table 8 and Table 9 include: predicted groundwater inflow to Whale Tail Pit Lake, predicted groundwater flow to the Underground, predicted flow to and from the Whale Tail Attenuation Pond, and predicted discharge to the dewatered North Base of Whale Tail Lake (i.e., the flow of water below the Whale Tail Lake Dike to the dewatered lake bottom surface). Again, it should be noted that TDS concentrations do not account for loading from nearby lakes and the Whale Tail Attenuation Pond. TDS from these sources are taken in to account by a feedback loop in the Site Wide Water Quality model. Groundwater inflow to the IVR Pit during refilling was not included as the pit is in permafrost (groundwater inflow will be negligible).

The predictions presented for the reflooding phase utilize a conceptual filling schedule for the Whale Tail Pit and the Underground, based on initial water balance predictions. Fine tuning of the flooding sequence was conducted after the conceptual filing schedule was developed; however, these adjustments will not have a significant impact on the predicted flow rates and salinity for a given elevation range.

Similar to the Base Case, the pit walls were assumed to be frozen at the start of closure / end of mining, which restricted the inflow of groundwater to the pit lake until the pit lake rises and thaws the pit walls. Considering the assumption of freeze-back in the pit walls, groundwater inflow to the Whale Tail Pit was not predicted to occur until 2030, when the pit lake level rises above the top of permafrost elevation near the pit (approximately 40 masl). When the water elevation in the pit lake rises above the permafrost, the freeze back is assumed to dissipate below the lake level and groundwater inflow to the pit was predicted to resume. The groundwater inflow to the pit lake was predicted to increase from 20 m³/day in 2030 to approximately 1,170 m³/day in 2036 as the pit walls progressively become unfrozen and connected to the permeable weathered bedrock. As the pit lake rises further in elevation, the groundwater inflows decrease and eventually the pit lake switches to a groundwater recharge boundary (i.e., the pit lake starts to recharge the sub-permafrost groundwater flow system). These groundwater inflow rates are similar to predictions in the FEIS Addendum and reflect that no changes were made to the shallow bedrock hydraulic conductivity.

At the start of reflooding, a small flux of groundwater inflow is predicted to discharge to the Underground. Over time, as hydraulic gradients near the Underground dissipate, the Underground switches to a groundwater recharge boundary. At the end of the filling period (2041) the Underground remains a source of groundwater recharge to the sub-permafrost groundwater regime. These predicted inflows are similar to or lower than those predicted in the FEIS Addendum, which ranged from 50 m³/day inflow at the start of reflooding to -25 m³/day (positive values indicate flow to the pit/pond; negative values indicate flow to bedrock) discharge at the end of reflooding (0 to 70 % lower than the FEIS values depending on the pit lake elevation).

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Table. 8 Predicted Groundwater Inflow and Groundwater Salinity during Reflooding - EA Scenario – Whale Tail Pit, Whale Tail Attenuation Pond, North Basin of Whale Tail Lake

Phase	Approximate Time Period	Water Level in Pit (masl)		Whale Tail Pit				Whale Tail Attenuation Pond				North Basin of Whale Tail Lake (within the diked area)		
		From	To	Net Groundwater Inflow/Outflow ¹ (m³/day)	Inflow TDS Concentration ² (mg/L)	Portion of Inflow from Attenuation Pond (%)	Portion of Inflow from South Basin of Whale Tail Lake (%)	Groundwater Inflow (m³/day)	Inflow TDS Concentration (mg/L) ²	Portion of Inflow from South Basin of Whale Tail Lake (%)	Pond Outflow (m³/day)	Net Groundwater Inflow/Outflow ¹ (m³/day)	TDS Concentration (mg/L) ²	Portion of Inflow from South Basin of Whale Tail Lake (%)
Flooding	2026	-130	-76	NA	NA	NA	NA	15	35	76%	<5	345	<10	>99%
	2027	-76	-39	NA	NA	NA	NA	17	30	84%	<5	345	<10	>99%
	2028	-39	3	NA	NA	NA	NA	18	25	89%	<5	345	<10	>99%
	2029	3	26	NA	NA	NA	NA	18	25	91%	<5	345	<10	>99%
	2030	26	43	20	24	47%	41%	18	20	93%	<5	345	<10	>99%
	2031	43	61	90	24	47%	41%	17	20	96%	25	345	<10	>99%
	2032	61	73	130	19	44%	50%	16	20	97%	55	340	<10	>99%
	2033	73	87	170	15	46%	53%	15	20	98%	80	340	<10	>99%
	2034	87	101	170	13	50%	50%	14	20	98%	90	335	<10	>99%
	2035	101	111	730	<10	71%	29%	12	25	99%	530	330	<10	>99%
	2036	111	124	1170	<10	81%	19%	85	30	99%	950	300	<10	>99%
	2037	124	133	910	<10	82%	18%	90	20	99%	745	300	<10	>99%
	2038	133	142	360	<10	82%	18%	11	15	99%	315	315	<10	>99%
	2039	142	149	-30	NA	NA	NA	70	20	98%	140	370	<10	>99%
	2040	149	153.5	-10	NA	NA	NA	0	NA	NA	10	155	<10	>99%
	2041	153.5	153.5	0 to -5	NA	NA	NA	0	NA	NA	5	-10	NA	NA

Notes:
IVR Pit is located in permafrost and was therefore not modelled. Interception of runoff / direct precipitation accounted for in Site Wide Water Balance.
Positive values indicate flow to the pit/pond and negative values indicate flow to bedrock.
TDS concentrations do not account for loading from lakes and Whale Tail Attenuation Pond. TDS from these sources to be accounted for in Site Wide Water Quality analysis.
NA = not applicable; TDS = total dissolved solids; m3/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

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Table. 9 Predicted Groundwater Inflow and Groundwater Salinity during Refilling - EA Scenario – Underground

Phase	Time Period	Water Level in Underground (masl)		Underground			
		From	To	Net Groundwater Inflow/Outflow ¹ (m ³ /day)	Inflow TDS Concentration ² (mg/L)	Portion of Inflow from Attenuation Pond (%)	Portion of Inflow from South Basin of Whale Tail Lake (%)
Flooding	2026	-505	-76	10	9800	<1%	<1%
	2027	-76	-39	30	12100	<1%	<1%
	2028	-39	3	20	12700	<1%	<1%
	2029	3	26	10	13200	<1%	<1%
	2030	26	43	10	13600	<1%	<1%
	2031	43	61	5	13800	<1%	<1%
	2032	61	73	5	14000	<1%	<1%
	2033	73	87	-5	NA	<1%	<1%
	2034	87	101	-5	NA	NA	NA
	2035	101	111	-10	NA	NA	NA
	2036	111	124	-15	NA	NA	NA
	2037	124	133	-20	NA	NA	NA
	2038	133	142	-35	NA	NA	NA
	2039	142	149	-25	NA	NA	NA
	2040	149	152.5	-25	NA	NA	NA
	2041	153	152.5	-20	NA	NA	NA

Notes:

IVR Pit is located in permafrost and was therefore not modelled. Interception of runoff / direct precipitation accounted for in Site Wide Water Balance.
Positive values indicate flow to the underground and negative values indicate flow to bedrock.
TDS concentrations do not account for loading from lakes and Whale Tail Attenuation Pond. TDS from these sources to be accounted for in Site Wide Water Quality analysis. NA = not applicable; TDS = total dissolved solids; m3/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

2.2.3.2 Model Predictions - Fully Flooded Open Pits

The following section provides updated groundwater model predictions for the IVR Pit and Whale Tail pit following flooding of the mine development and North Basin of Whale Tail Lake. This data may be used in the future to support updated hydrodynamic modelling of the pit lakes, if required, to evaluate long-term pit lake water quality. Updated predictions are provided for the pit lakes to evaluate if the changes made to the model (estimated hydraulic conductivity of the deep sub-permafrost bedrock) affect previous predictions in the FEIS addendum. The model predictions were provided for the EA Scenario, and utilizes the same model as the dewatering, mining and reflooding phases. As discussed in the modelling report of the FEIS Addendum (Golder 2018), density- dependent transport of solutes was not considered for the assessment of groundwater conditions as the buoyancy effects were considered negligible in relation to the regional hydraulic head gradient.

Although the two pit lakes are connected following filling, the groundwater flow conditions surrounding the pit lakes are initially very different. As presented in the FEIS Addendum, the Whale Tail Pit lake is predicted by thermal analysis to be connected to the deep sub-permafrost groundwater 11 years into filling and for the permafrost below the pit lake to fully degrade over 50 years. The IVR Pit lake is predicted to be within permafrost during mining and flooding and the permafrost below the pit lake to fully degrade over 1000 years.

- **Whale Tail Pit**

Table 10 presents predicted outflow from the Whale Tail Pit lake following full reflooding of the pit. The pit lake was predicted to recharge the regional sub-permafrost groundwater system from the first year after full flooding and over the following 300 years. Over time, as the groundwater flow system near the flooded mine workings re-equilibrates and the shallow bedrock re-saturates and/or re-pressurizes, the amount of recharge to the sub-permafrost flow system decreases from 3.3 m³/day in Year 1 to 1.4 m³/day after 200 years. The long-term predicted pit lake discharge to the sub-permafrost groundwater flow system is predicted to be 1.2 m³/day, which is 20% less than the long-term pit lake discharge in the FEIS Addendum (1.5 m³/day) as a result of the slight reduction in deep bedrock hydraulic conductivity. No significant groundwater inflows to the pit lake were predicted.

Table. 10 Predicted Whale Tail Pit Lake outflow following Flooding of the Mine Development

Time (Years after Reflooding)	Pit Lake Outflow to Groundwater (m ³ /day)
1	3.3
50	2.1
100	1
200	1
300	1

Considering the hydraulic conductivity assigned to the deep bedrock for the FEIS scenario (3×10^{-9} m/s) based on packer testing data, the approximate area of the pit (0.5 km²), and the measured pre-development downward hydraulic gradient at the Westbay Well (0.008 m/m), the calculated steady-state discharge from the pit is 1 m³/day. This value is in good agreement with the predicted value from the model after 300 years (1.2 m³/day).

- **IVR PIT**

The IVR Pit is in an area of regional permafrost; therefore, during mining and flooding, groundwater inflows to the pit were assumed to be negligible. Following flooding and the formation of the IVR Pit lake, the permafrost is expected to melt and connect the IVR Pit lake to the sub-permafrost groundwater flow system.

In consideration of the long timeline associated with the melting of the permafrost, the fully flooded analysis of the IVR Pit was limited to a prediction of the long-term steady-state groundwater flow environment that would develop near the pit lake following the full melting of permafrost below the pit footprint. Model results confirmed the assumption that the IVR Pit lake would act as recharge boundary to the regional groundwater system once the permafrost layer beneath the lake melts. The long-term predicted discharge from the IVR Pit lake to the sub-permafrost groundwater flow system was approximately 0.5 m³/day, which is 30% lower than the predicted discharge in the FEIS Addendum (0.7 m³/day) as result of the slight reduction in the deep bedrock hydraulic conductivity.

Because the IVR Pit Lake and Whale Pit lakes will be maintained at the same elevation and directly connected following reflooding of the pit lakes and the North Basin of Whale Tail Lake, lateral movement between the two pit lakes is expected to be negligible.

2.2.4 Additional Data Collection

Project Certificate Term and Condition No. 15 indicates the need to collect additional site-specific hydraulic data in key areas of the Project during the pre-development, construction and operational phases. Agnico Eagle has commenced with the collection and documentation of this data, and a summary of the results is presented below.

2.2.4.1 Groundwater Quality

At the time of the FEIS, a representative sample of deep groundwater had not been collected and data collected at the Meadowbank Mine was used to infer the TDS profile at the project. A Westbay well system was installed on site between March and April in 2016. The borehole was drilled to a depth of 499 m. The well was installed to monitor hydraulic heads, test hydraulic conductivity, and collect groundwater samples from multiple intervals (Golder 2016c). The groundwater samples collected from the Westbay system at depths from 276 m to 392 m indicate that the TDS content in the groundwater was between 3,198 mg/L and 4,042 mg/L. This range is

slightly higher than the groundwater TDS measured at Meadowbank from shallower depths (less than 200m vertical depth).

Groundwater samples were also collected from the Westbay in November 2018, along with the measurement of vertical hydraulic gradient (Golder 2018). The 2018 program estimated groundwater quality were in the same range as previously estimated. The calculated groundwater TDS were slightly higher in 2018 which was attributed to the higher proportion of residual drilling water in the sample. The concentrations of metals and arsenic were low. Given that the arsenic concentrations are similar to the assumptions adopted in the geochemical models (low arsenic in formation groundwater), groundwater arsenic content is still not likely to have a significant effect on mine surface water quality.

Data collected from the Westbay will be used in future updates to the water quality forecast in support of the Project. At this time, it is expected that the water treatment system planned for the project can handle groundwater with the measured water quality observed in 2016 and 2018.

2.2.4.2 Hydraulic Conductivity Testing

Hydrogeological investigations were undertaken between 2015 and 2017 to characterize the hydraulic conductivity of the bedrock in the vicinity of the Whale Tail Pit. These investigations were documented in reports by Knight Piesold (2016), Golder (2016a, 2017), and SNC (2017). These investigations included the completion of 49 packer tests in unfrozen areas of bedrock (i.e., within the talik or below the regional permafrost).

Data collected from these four investigations indicated the bulk hydraulic conductivity of the bedrock ranges on the order of 1×10^{-5} m/s near surface (i.e., up to depths of 40 m) to approximately 1×10^{-9} m/s at greater depths.

As part of the FEIS, the hydraulic conductivity was estimated to be between 1×10^{-8} and 2×10^{-7} m/s. Evaluation of the refined estimates of hydraulic conductivity from the supplemental testing with respect to groundwater flows indicate that the inflow to the pit could be up to five times higher (up to 1,400 m³/day) during mining due to the groundwater flow rates to the pit being controlled by the shallow bedrock hydraulic conductivity (connection of the pit to the south whale tail basin). This higher flow rate is within the limits of the water treatment system and water management infrastructure and adaptive management of these flows is not required at this time.

A hydrological testing program was conducted between 7 and 9 December 2018 by Golder to collect data near the underground below IVR pit (refer to appendix C). The testing was conducted in deep bedrock in the sub-permafrost zone over a depth interval of about 375 to 626 meters below the ground surface (mbgs). A total of three (3) packer test were performed. Each of the three test conducted within this interval resulted in estimated hydraulic conductivities of less than 1×10^{-10} m/s. With addition of these tests to historical measurements of bedrock hydraulic conductivity, the hydraulic conductivity of the deep bedrock is inferred to be slightly lower than what was assumed in the previous hydrogeologic model and presented in the FEIS Addendum in 2018. With the additional measurements from December 2018, the calculated geometric average

of the test data below 200 mbgs decreased from 1×10^{-9} m/s to 8×10^{-10} m/s. Table 11 presents a tabular summary of the bedrock hydraulic conductivity used in the EA Scenario for the FEIS Addendum compared to the bedrock hydraulic conductivity used in the updated hydrogeological assessment.

Table. 11 Hydraulic Conductivity of the Hydrostratigraphic Units

Hydrostratigraphic Unit	Depth Interval (m)	Hydraulic Conductivity (m/s)		Hydraulic Conductivity (m/s)	
		FEIS Base Case Scenario	2019 Updated Base Case Scenario	FEIS EA Scenario	2019 Updated EA Scenario
Overburden	0 to 6	2×10^{-6}	2×10^{-6}	2×10^{-6}	2×10^{-6}
Weathered bedrock	6 to 40	1×10^{-5}	1×10^{-5}	1×10^{-5}	1×10^{-5}
Competent bedrock	40 to 100	7×10^{-8}	7×10^{-8}	1×10^{-7}	1×10^{-7}
Competent bedrock	100 to 200	9×10^{-9}	9×10^{-9}	3×10^{-8}	3×10^{-8}
Competent bedrock	>200	1×10^{-9}	<u>8×10^{-10}</u>	4×10^{-9}	<u>3×10^{-9}</u>

Note: Parameters which have changed since the FEIS Addendum are shown in bold and underlined.

Except for the refinement of the hydraulic conductivity for the deep sub-permafrost bedrock, field data collected in 2018 is consistent with the conceptual model presented in the FEIS Addendum and no changes were made to the interpreted flow conditions. The conceptual model is presented in Appendix 6-B of the FEIS Addendum (Golder 2018).

Hydraulic head monitoring conducted in November 2018 (Westbay sampling) confirmed the downward direction of the vertical hydraulic gradient predicted by the model below Whale Tail Lake. Review of the 2D thermal analysis and 3D block model indicates that predicted closed and open taliks are consistent with the conceptual hydrogeological conditions adopted in the FEIS Addendum (closed talik in the northern portion of Whale Tail lake and open talik in the southern portion). The 3D block model was compared to the permafrost in the numerical model, and minor adjustments were made in the simulated permafrost depth along the margins of Whale Tail Lake (slightly smaller in extent).

2.2.4.3 Verification of Horizontal and Vertical Groundwater Flow Direction

Thermal data continues to be collected at the Project to verify assumptions in the permafrost conditions. Thermistors have been installed at ten locations, of which four are located to the north of the Whale Tail Pit, between Nemo Lake and Whale Tail Pit (Golder 2018b). These thermistors verify the presence of permafrost below the active layer and that the deep-sub permafrost groundwater flow system will only be connected/recharged by vertical flow through talik present below lakes of sufficient size, such as Whale Tail lake. The four thermistors between Nemo Lake and Whale Tail Pit (AMQ17-1337, AMQ17-1233, AMQ17-1277A and AMQ15-452) each indicate

permafrost below the land and that horizontal flow below the active layer is restricted by permafrost in the upper 425 to 495 m of bedrock.

The vertical movement of groundwater flow through the open talik is being monitored using the Westbay Well system (AMQ16-626) to measure the vertical hydraulic gradient. This monitoring verified the direction of groundwater flow and can be used in combination with the measured bedrock hydraulic conductivity to estimate the groundwater flux near Whale Tail Pit.

The hydraulic head data collected at AMQ16-626 (Golder 2018), in November 2018 (Westbay sampling) confirmed the downward direction of the vertical hydraulic gradient predicted by the model below Whale Tail Lake. Assuming the measured hydraulic head is representative of the midpoint of the measurement interval, the downward gradient is 0.008 m/m. This gradient is consistent with the estimated gradient derived from looking at the relative elevation of Whale Tail Lake and DS1 (0.008 m/m), as reported in Agnico Eagles response to TC15 (Agnico Eagle 2018). DS1 is the predicted receptor from water in the area of Whale Tail Pit and Underground (Golder 2016c).

For the depth interval over which the hydraulic head was measured (326 to 456 mbgs), the estimated hydraulic conductivity of the bedrock for the FEIS for the Whale Tail Pit Project was 1×10^{-8} to 3×10^{-8} m/s (Golder 2016c). As discussed, in support of TC15 and the development of the Project, additional packer testing was conducted subsequent to the FEIS and the data indicate the hydraulic conductivity of bedrock over this depth interval is likely lower (1×10^{-9} m/s based on the geometric average of the test data) (Golder 2018a). Considering the measured gradient (0.008), the historical range of bedrock hydraulic conductivity adopted in the FEIS (1×10^{-8} to 3×10^{-8}) and the now refined hydraulic conductivity (1×10^{-9} m/s) and an assumed effective porosity of 0.001 (Maidment 1992; Stober and Bucher 2007), the estimated downward groundwater flow velocity is between approximately 0.25 m/yr and 8 m/yr. The lower bound of this range is considered more reasonable, as it uses the refined hydraulic conductivity data discussed above, which is based on the geometric mean of all the packer test measurements (pre- and post-FEIS).

Gradients measured during this monitoring program are considered a reasonable interpretation of what long-term gradients could be post-closure following the formation of the pit lake.

Recharge and discharge from the base of Whale Tail Lake or a flooded pit lake will be controlled by the vertical hydraulic gradients and the bedrock hydraulic conductivity near the base of the permafrost. Considering the approximate area of the Whale Tail Pit (0.5 km²), the range in bedrock hydraulic conductivity (1×10^{-9} to 3×10^{-8} m/s), and the measured downward gradient (0.008), the data would indicate long-term groundwater flux would be approximately 0.3 m³/day to 11 m³/day. Similar to the estimated groundwater velocity, the lower bound of this range is considered more reasonable, as it uses the refined estimate of hydraulic conductivity. Overall, the estimated flux is similar to the long-term predicted discharge from the pit lake at post-closure (1.7 m³/day; Golder 2016c) and supports the conclusion in the FEIS that long-term predicted flows from the pit lake to the groundwater flow system will be negligible relative to the surface water exchange into the pit lake (Golder 2018c).

3. GROUNDWATER MONITORING PLAN

Water quantity and quality monitoring data will be used to verify the predicted water quality and quantity trends and to conduct adaptive management should differing trends be observed. Monitoring will be initiated at the start of mining and continue during operations and closure.

The GWMP will be further defined as the open pit is developed and will be conducted in agreement with the WMP for the Project.

3.1 HORIZONTAL AND VERTICAL GROUNDWATER FLOW MONITORING

Thermal monitoring will continue at each of the installed thermistors to monitor the presence of permafrost below the active layer during construction and operations phases. The monitoring will continue until such time as a thermistor is destroyed by active mining.

Two thermistors, AMQ17-1233 and AMQ17-337, are located outside of the pit footprint and will be used to monitor permafrost conditions between Nemo Lake and Whale Tail Pit. The thermistor data will be used to verify the presence of permafrost and the restricted horizontal movement of groundwater below the active layer due to permafrost in the upper 425 to 495 m of bedrock.

Agnico Eagle is planning to install an additional thermistor between Nemo Lake and IVR pit prior to Q4 of 2020.

As part of the Whale Tail Dike Operation Maintenance and Surveillance manual, performance of the Whale Tail dike will be monitored with different instruments (e.g. piezometers) located in the principal horizontal groundwater flow pathway between Whale Tail South Basin and the Whale Tail pit. Piezometer readings and water level in the Whale Tail South Basin and the Attenuation Pond will be available to calibrate the hydrogeological model during operation if deemed necessary.

Vertical groundwater flow conditions in the area of Whale Tail Pit will be monitored by the Westbay Well system. Agnico Eagle will be sampling the Westbay Well system commencing in March 2019 and will continue to sample and report on an annual basis during the Construction and Operations Phases. The monitoring will include the measurement of the vertical hydraulic gradient and the collection of groundwater samples. During operations, this data will be supplemented by the direct measurement of groundwater quality in the seepage inflow to the pit. Water sampling parameters will be consistent with the sump sampling and seepage surface parameters planned for the pit. Data collected during construction and operations phases will be used to develop an appropriate monitoring for closure and will be documented in the Interim Closure and Reclamation Plan.

4. GROUNDWATER QUANTITY AND QUALITY MONITORING

4.1 WATER QUANTITY

Groundwater inflow to the open pit will be collected in sumps prior to being pumped to surface. Water collected in the sumps represents the bulk, or combined inflow to the open pit, and may include other sources of water, such as precipitation. During construction and operations, groundwater inflow to the pit will be evaluated four time per calendar year as per Water Licence 2AM-WTP1826 requirements. Management of the pumped-out water is described in the WMP.

The above flow monitoring will be supplemented by periodic seepage surveys to be conducted twice during the first year of mining and once a year thereafter. In the first year of pit development, one of the seepage surveys will be conducted in early summer, following snow melt and thawing of any ice in the pit walls, and then again in late August. In the following years of mining, one survey will be conducted in August of each year. The objective of the seepage surveys is to identify preferential groundwater flow paths in the walls of the open pit, if present, and to determine their relative contribution to the groundwater inflow to the pit with respect to water quantity and quality.

4.2 WATER QUALITY

During the operations phase, the quality of water from the sumps (either at the sump or at end of pipe at the surface) will be monitored four time per calendar year as per Water Licence 2AM-WTP1826 requirements.

Water samples will also be collected from seeps in the pit walls if there is sufficient water for analysis and if access to the seep is possible.

For each sample, field parameters will be recorded (pH, turbidity, salinity and electrical conductivity). Analytical parameters will include:

Total and Dissolved Metals: aluminium, antimony, arsenic, boron, barium, beryllium, cadmium, copper, chromium, iron, lithium, manganese, mercury, molybdenum, nickel, lead, selenium, tin, strontium, titanium, thallium, uranium, vanadium and zinc.

Nutrients: ammonia-nitrogen, total kjeldahl nitrogen, nitrate nitrogen, nitrite-nitrogen, ortho-phosphate, total phosphorous, total organic carbon, total dissolved organic carbon and reactive silica.

Conventional Parameters: bicarbonate alkalinity, chloride, carbonate alkalinity, conductivity, hardness, calcium, potassium, magnesium, sodium, sulphate, pH, total alkalinity, total dissolved solids, total suspended solids and turbidity.

Total cyanide and free cyanide. If total cyanide is detected above 0.05 mg/L at a monitoring station in receiving environment; further analysis of Weak Acid Dissociable Cyanide will be triggered.

Additional chemical analyses may be required to more completely characterize the chemical loading from the mine water. The additional analyses will be dependent on monitoring results.

5. DATA COMPILATION AND UPDATES TO GROUNDWATER MODEL

Groundwater monitoring data will be compiled into a Project-specific database and evaluated for trends in groundwater data with respect to pit and underground inflow quantity and quality.

Measured groundwater inflow rates will be compared to model predictions on an annual basis. If significant variations from model predictions are observed, the assumptions behind the data will be reviewed and the analysis updated if required. In addition, updates to the groundwater model will be made if operational changes occur as the open pit advances which could significantly alter groundwater inflow or quality.

Variations that would be considered significant and would be triggers for review of the data include:

- Groundwater inflow quantity to the mine, based on rolling monthly average of inflow over six consecutive months, is 20% higher than predicted groundwater inflow. The six-month averaging period of observation is based on observed seasonal variations in inflow quantities in mines situated in continuous permafrost regions, where half the year there is virtually no surface water component of flow to the pit.
- Collected water samples that indicate that the TDS is more than 25% higher than the estimated water quality, based on a 6-month rolling average.
- Temperature profiles observed in the sentinel thermistors (AMQ17-1233 and AMQ17-337) located between Nemo Lake and Whale Tail Lake are showing sign of permafrost degradation below the active layer.
- Observed inflow quantity and quality is lower than expected would not be of concern and/or effect water management plans on-site. Model updates or analysis would therefore not be conducted if predicted inflow quantity and quality is higher than observed conditions.

If the first three variations are triggered, the groundwater and/ or permafrost data would be assessed to evaluate trends, the potential causes of the triggers and the potential for long-term effects associated with the variation. If for example, the greater than predicted inflows were correlated to a short-term effect such as freezing in the pit walls, changes in mining rate, freshet or transient drainage of a high storage feature, then further reassessment of groundwater inflows may not be required, and the adaptive management of these short-term effects would be

evaluated under the Water Management Plan (WMP). However, if the effects of these variations is found to be potentially long term, this may warrant review of the model and/or permafrost calibration and predictions.

Table 12 presents the adaptive management plan with respect to groundwater monitoring. The design of the water management infrastructure includes contingencies in case of unplanned events. The Whale Tail attenuation pond can handle higher groundwater inflows and the Operation Water Treatment Plan (O-WTP) is designed to handle total flow rates 60% higher than planned (including surface and groundwater inflows reporting to the Attenuation Pond). O-WTP has the capacity to treat more than a five times increase in groundwater inflows from the one predicted during operation. Moreover, if the inflows are greater than this then there is the capacity to store water within the pit and adjust the mining plan to deal with extra inflows. In any case, all contact water will be managed within the pit area.

The groundwater management strategies: the ponds, sumps and water conveyance strategies around the pit can be modified to mitigate the effect of additional groundwater volume or salinity prior to treatment and discharge. The water conveyance strategy will be evaluated and optimized during operations and closure to maintain post-closure commitments. Other engineering solutions such as depressurization wells, grouting and thermosiphons may be considered, if warranted.

If one of the thresholds in Table 12 is triggered and it is found to be a potentially long-term effect, then hydrogeological and thermal analyses will be required to define the best solution to address the exceedance. Agnico Eagle considers that adaptive management must be based on well informed decisions and may include re-calibration of the thermal and hydrogeological models, predictions based on these re-calibrations, and revised Site-Wide water balance and Site-Wide water quality forecasts.

Table. 12. Groundwater Adaptive Management Plan

Threshold	Consequence	Likelihood	Adaptive Management
Groundwater inflows to the mine, based on rolling monthly average of inflow over six consecutive months, is 20% higher than predicted groundwater inflow	- Higher water volume to treat during operation - Potential to compromise storage capacity of the attenuation pond - Impact on mining sequence	Low	O-WTP have 60% contingency to manage higher inflow to attenuation pond (forecasted peak operation flow in the water balance is 1,300m³/h during 12h a day vs treatment capacity of 1,800 m³/h during 24h per day); O-WTP have the capacity to treat more than five times increase in groundwater inflows from the one predicted during operation; Attenuation pond has 50% contingency to manage higher groundwater inflow; Assess situation by performing additional inspection, monitoring and field investigation; Review hydrogeological model, Site-wide water balance and Site-wide water quality forecast with updated data; Review water management strategy (e.g. temporary storing water in the pit); Evaluate potential long-term mitigations (e.g., grouting); Review water management strategy.
Collected groundwater samples that indicate that the TDS is more than 25% higher than the estimated groundwater quality, Based on rolling monthly average over 6 consecutive months	- Higher TDS water quality to treat during operation - Compromise storage capacity of the attenuation pond - Potential to reduce water treatment efficiency and management plan if not meeting Metal and Diamond Mining Effluent Regulations - Impact on mining sequence	Low	O-WTP have 60% contingency to manage higher inflow to attenuation (forecasted peak operation flow in the water balance is 1,300m³/h during 12h a day vs treatment capacity of 1,800m³/h during 24h per day); O-WTP have the capacity to treat more than five times increase in groundwater inflows from the one predicted during operation; Flow to the pit is dominated by seepage loss from the Attenuation Pond and seepage from the South Basin of Whale Tail Lake. As the groundwater inflow to the pit is representing a small ratio of the overall water inflows in the attenuation pond, water treatment efficiency should not be impacted significantly by uncertainty in the groundwater TDS; Assess situation by performing additional inspection, monitoring and field investigation; Review hydrogeological model, Site-wide water balance and site-wide water quality forecast with updated data; Evaluate additional treatment and storage

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			capacity required to manage flow in operation (e.g. storing water in the pit); Evaluate potential long term mitigations (e.g. grouting, thermosiphon); Review water management strategy.
Temperature profile observed in the sentinel thermistors (AMQ17-1233 and AMQ17-337) located between Nemo Lake and Whale Tail Lake are showing sign of permafrost degradation below the active layer.	- Horizontal groundwater flow observed between Whale Tail Pit north wall and Nemo Lake. - Potential for groundwater seepage to pit sump/pit lake. - Increased water treatment requirement.	Unlikely	Assess situation by performing additional inspection, monitoring and field investigation; Review thermal model, hydrogeological model, Site-wide water balance and site-wide water quality forecast with updated data; Install new thermistor(s) to evaluate the extent of the permafrost degradation; Evaluate additional treatment and storage capacity required to manage flow in operation (e.g. storing water in the pit); Evaluate potential long-term mitigations as depressurization wells, grouting, thermosiphon Review water management strategy.

6. QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

Quality Assurance (QA) refers to plans or programs that encompass a wide range of internal and external management and technical practices designed to ensure the collection of data of known quality that matches the intended use of the data. Quality Control (QC) is a specific aspect of QA that refers to the internal techniques used to measure and assess data quality. Specific QA and QC procedures that will be followed during sampling performed for the GWMP are described in Section 4.1 and 4.2.

6.1 QUALITY ASSURANCE

Quality assurance protocols will be diligently followed so data are of known, acceptable, and defensible quality. There are three areas of internal and external management, which are outlined in more detail below.

6.1.1 Field Staff Training and Operations

To make certain that field data collected are of known, acceptable, and defensible quality, field staff will be trained to be proficient in standardized field groundwater sampling procedures, data recording, and equipment operations applicable to the GWMP. All field work will be completed according to specified instructions and established technical procedures for standard sample collection, preservation, handling, storage and shipping protocols.

6.1.2 Laboratory

To make sure that high quality data are generated, accredited laboratories that will be selected for sample analysis. Accreditation programs are utilised by the laboratories so that performance evaluation assessments are conducted routinely for laboratory procedures, methods, and internal quality control.

6.1.3 Office Operations

A data management system will be utilized so that an organized consistent system of data control, data analysis, and filing will be applied to the GWMP. Relevant elements will include, but are not limited to the following:

- all required samples are collected;
- chain-of-custody and analytical request forms are completed and correct;
- proper labelling and documentation procedures are followed, and samples will be delivered to the appropriate locations in a timely manner;
- laboratory data will be promptly reviewed once they are received to validate data quality;
- sample data entered into a Mine-specific groundwater quality database will be compared to final laboratory reports to confirm data accuracy; and
- appropriate logic checks will be completed to ensure the accuracy of the calculations.

6.2 QUALITY CONTROL

The QC component will consist of applicable field and sample handling procedures, and the preparation and submission of two types of QC samples to the various laboratories involved in the program. The QC samples include blanks (e.g., travel, field, equipment) and duplicate/split samples.

Sample bottle preparation, field measurement and sampling handling QC procedures include the following:

- Sample bottles will be kept in a clean environment, capped at all times, and stored in clean shipping containers. Samplers will keep their hands clean, wear gloves, and refrain from eating or smoking while sampling.
- Where sampling equipment must be reused at multiple sampling locations, sampling equipment will be cleaned appropriately between locations.
- Temperature, pH, and specific conductivity will be measured in the field using hand held meters (e.g., YSI water quality sondes).
- Samples will be cooled to between 4°C and 10°C as soon as possible after collection. Care will be taken when packaging samples for transport to the laboratory to maintain the appropriate temperature (between 4°C and 10°C) and minimize the possibility of rupture. Where appropriate, samples will be treated with preservatives to minimize physical, chemical, biological processes that may alter the chemistry of the sample between sample collection and analysis.
- Samples will be shipped to the laboratory as soon as reasonably possible to minimize sample hold times. If for any reason, samples do not reach the laboratory within the maximum sample hold time for individual parameters, the results of the specific parameters will be qualified, or the samples will not be analysed for the specific parameters.
- Chain of custody sample submission forms will be completed by field sampling staff and will be submitted with the samples to the laboratory.
- Only staff with the appropriate training in the applicable sampling techniques will conduct water sampling.

Quality control procedures implemented will consist of the preparation and submission of QA/QC samples, such as field blanks, trip blanks, and split/duplicate water samples. These are defined as follows:

- Field Blank: A sample will be prepared in the field using laboratory-provided deionized water to fill a set of sample containers, which will then be submitted to the laboratory for the same analysis as the field water samples. Field blanks will be used to detect potential sample contamination during collection, shipping and analysis.
- Travel Blank: A sample will be prepared and preserved at the analytical laboratory prior to the sampling trip using laboratory-provided deionized water. The sample will remain unopened throughout the duration of the sampling trip. Travel blanks will be used to detect potential sample contamination during transport and storage.
- Duplicate Sample: Two samples will be collected from a sampling location using identical sampling procedures. They will be labelled, preserved individually and submitted for identical

analyses. Duplicate samples will be used to assess variability in water quality at the sampling site. Duplicate will be collected and submitted for analyses at approximately, 10% of sampling locations. For smaller batches of samples (less than 10), at least one duplicate will be collected and submitted for analysis.

Additional QA/QC procedures that will be applied to the seepage survey component of the GWMP will include:

- Location – Universal Transverse Mercator (UTM) coordinates of seepage will be defined through the use of a hand-held Global Positioning System (GPS) unit and will be recorded in the field log book with a photograph of each pit wall.
- Sample Labels – appropriate sample nomenclature will be assigned to the sample labels that will define sample locations, sample type, year, and designation. These labels will distinguish between samples collected from seeps versus samples collected from sumps.

7. REFERENCES

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**APPENDIX A – UPDATED HYDROGEOLOGICAL ASSESSMENT,
WHALE TAIL PIT, EXPANSION PROJECT**

TECHNICAL MEMORANDUM

DATE 6 May 2019

Project No. 18108905-291-TM-Rev0

TO Michel Groleau
Agnico Eagle Mines Limited - Meadowbank Division

CC Jennifer Range

FROM Jennifer Levenick, Don Chorley

EMAIL jlevenick@golder.com

UPDATED HYDROGEOLOGICAL ASSESSMENT, WHALE TAIL PIT, EXPANSION PROJECT

1.0 INTRODUCTION

Agnico Eagle Mines Limited: Meadowbank Division (Agnico Eagle) is proposing to develop the Whale Tail Pit, IVR Pit and Underground operations on the Amaruq property (Expansion Project), in continuation of mine operations and milling of the Meadowbank Mine. The Approved Project supports mining ore from one open pit, the Whale Tail Pit, processed over a three to four-year mine life. The Expansion Project proposes mining additional ore from the expanded Whale Tail Pit, the IVR Pit, and Underground operations.

This report presents the results of updated hydrogeological modelling completed for the Expansion Project since submission of the FEIS addendum in December 2018. The model was updated based on results of monitoring at the Westbay system in November 2018, supplemental packer testing in December 2018, and additional thermal analysis in 2019. The updated hydrogeological model was then used to provide revised predictions of groundwater inflow and total dissolved solids (TDS) concentrations during dewatering, mining, pit and underground flooding, and long-term post-closure (reflooded) conditions.

The technical memorandum is organized as follows:

- Section 2.0 provides a summary of hydrogeological data and thermal modelling results available since last hydrogeological assessment completed for the Expansion Project (Golder 2018).
- Section 3.0 and 4.0 provides a description of the changes made to the conceptual and numerical model based on the additional data collected.
- Section 5.0 provides a summary of the updated groundwater model predictions during dewatering, mining and filling phases of the Expansion Project.
- Section 6.0 provides a summary of the updated groundwater model predictions after the pits are fully flooded.

2.0 DATA REVIEW

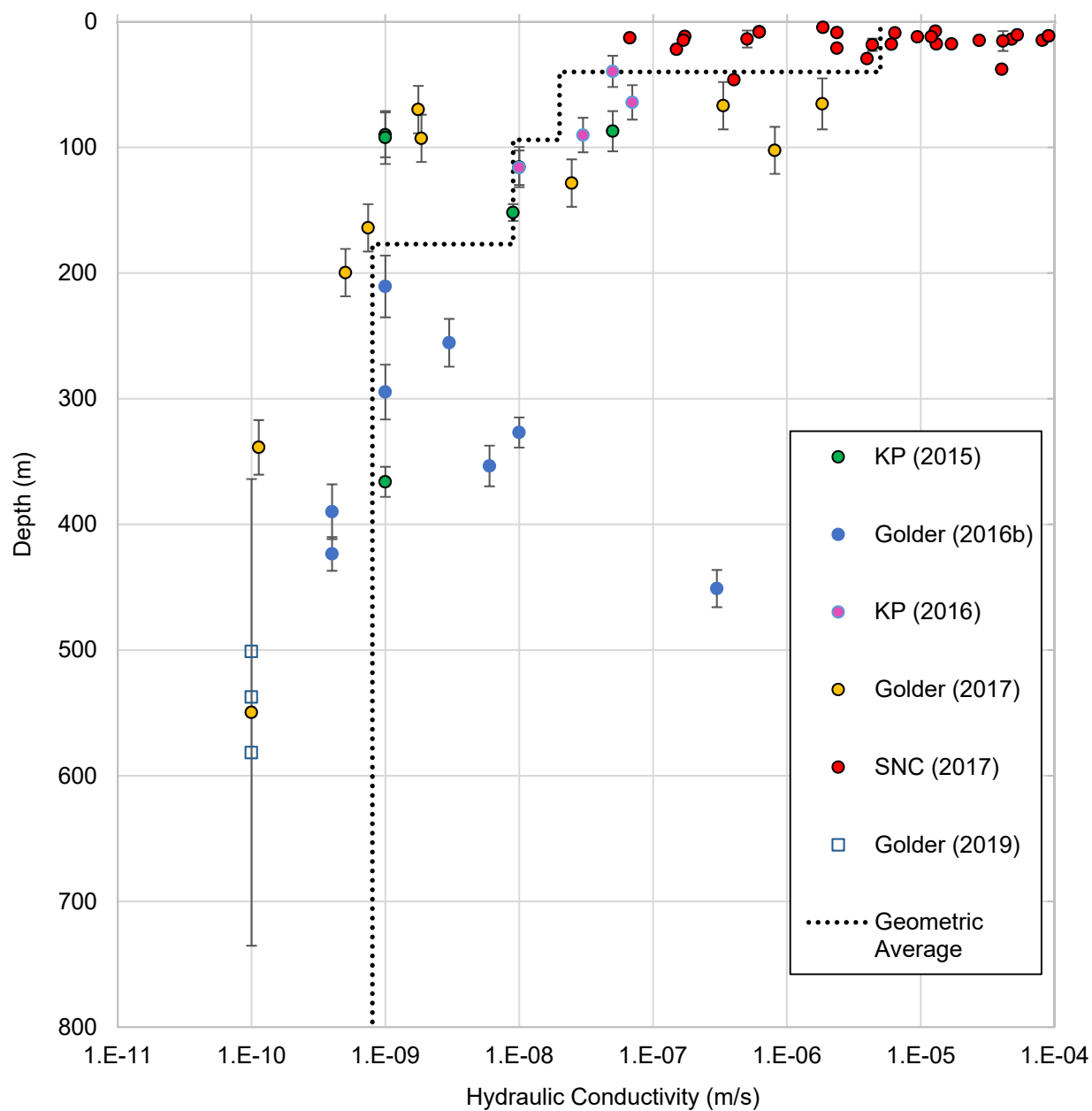
Since the completion of the FEIS hydrogeological assessment for the Expansion Project (Golder 2018), investigations have been carried out to collect additional site-specific data, as requested in the Project Certificate No. 008, Term and Condition No. 15 for the Approved Project. A summary of the results of these investigations is presented below.

2.1 Hydrogeological Testing

A hydrogeological testing program was conducted between 7 and 9 of December 2018 (Golder 2019b) to collect data near the underground below IVR pit. The testing was conducted in deep bedrock in the sub-permafrost zone over a depth interval of about 375 to 626 metres below ground surface (mbgs). Each of the three tests conducted within this interval resulted in estimated hydraulic conductivities of less than 1×10^{-10} m/s (due to limitations of the testing equipment, hydraulic conductivities of less than 1×10^{-10} m/s could not be quantified).

With the addition of these tests to historical measurements of bedrock hydraulic conductivity (Figure 1), the hydraulic conductivity of the deep bedrock is inferred to be slightly lower than what was assumed in the previous hydrogeologic modelling. These packer test data also provide a higher level of confidence that the one high value of hydraulic conductivity over a 30 m zone from a depth of about 436 m to 466 m in deep bedrock that was measured during the drilling of the borehole for the Westbay multi-level well is likely an isolated zone of jointing near the test interval and is not a large-scale enhanced permeability zone.

Figure 1 presents an updated summary of the hydraulic conductivity measurements completed for the area of the two pits and Underground, including the 2018 measurements and historical data. Figure 2 presents the location of the borehole locations tested. With the additional measurements from December 2018, the calculated geometric average of the test data below 200 mbgs decreased from 1×10^{-9} m/s to 8×10^{-10} m/s.



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AMARUQ PROPERTY – EXPANSION PROJECT

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DESIGN JL

REVIEW DC

APPROVED JL

TITLE

SUMMARY OF HYDRAULIC CONDUCTIVITY TEST RESULTS

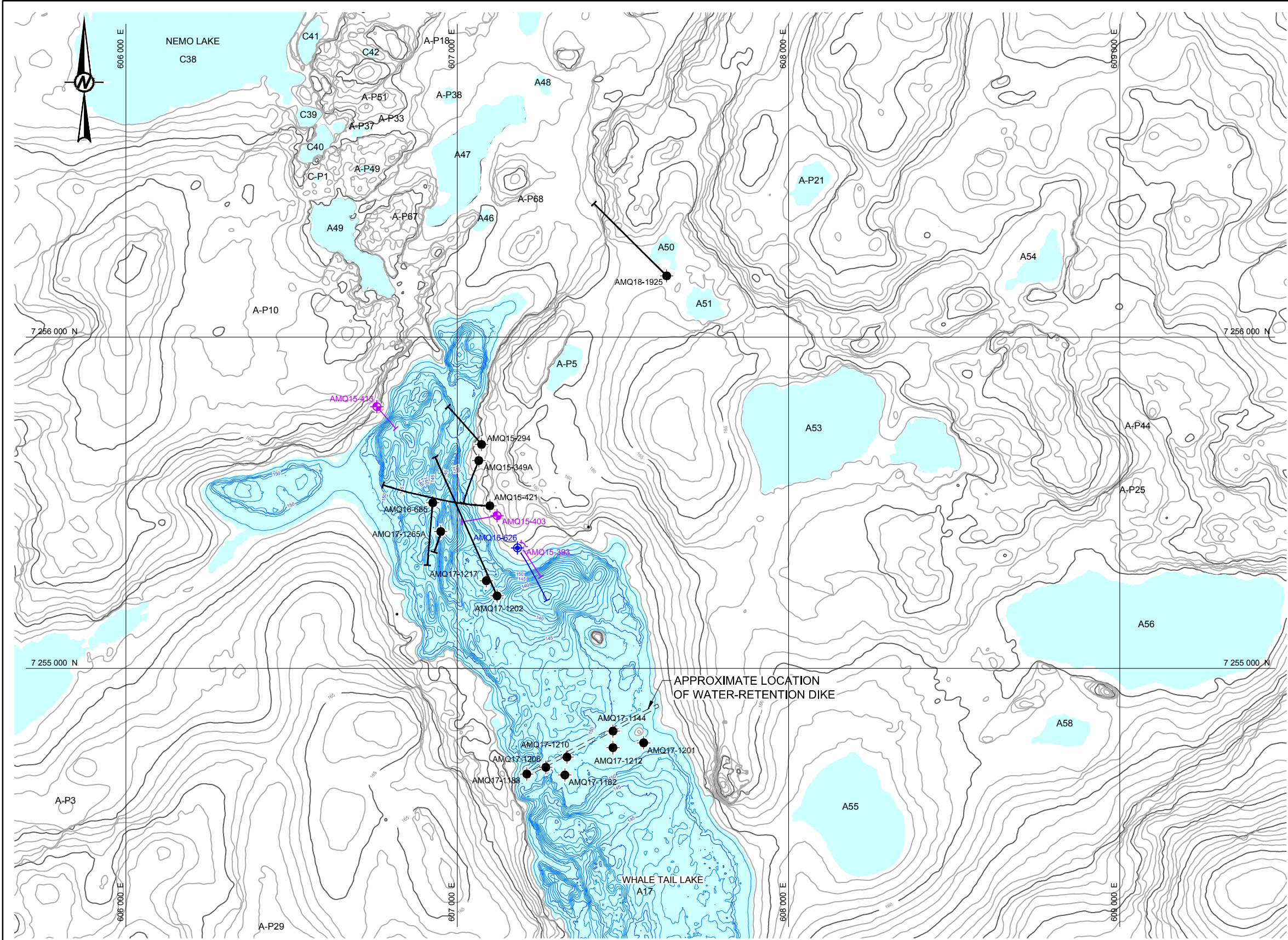
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FIGURE
1



Path: \\golder-gds\gait\Cityawa\TransferData\WhaleTail - File Name: 18108905-001-CH-0002.dwg | Last Edited By: anwong Date: 2019-05-01 Time: 1:57:13 PM | Printed By: ANWong Date: 2019-05-01 Time: 2:03:21 PM



- LEGEND**
- EXISTING GROUND SURVEY
 - EXISTING BATHYMETRY
 - WATER BODY
 - WESTBAY SYSTEM
 - BOREHOLE
 - MONITORING WELL

- NOTE(S)**
- ALL UNITS ARE IN METERS UNLESS NOTED OTHERWISE.
 - CONTOUR INTERVAL 1m MINOR AND 5m MAJOR.

REFERENCE

BASE PLAN AND BATHYMETRY DATA RECEIVED FROM AGNICO EAGLE MINES LTD. DATE RECEIVED NOVEMBER 25, 2016.
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CAD FILE: 1665858-2100B-CM-0002.DWG
CAD FILE: 61-000-142-001_R0BLOC.DWG



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PREPARED MSH/JEM

REVIEWED JL

APPROVED DH

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AMARUQ PROJECT PROPERTY - EXPANSION PROJECT

TITLE

LOCATION OF PACKER TEST BOREHOLES AND INSTALLED MONITORING WELLS

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FIGURE 2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

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2.2 Permafrost Assessment

Golder was recently retained to carry out an updated thermal assessment for the Project to:

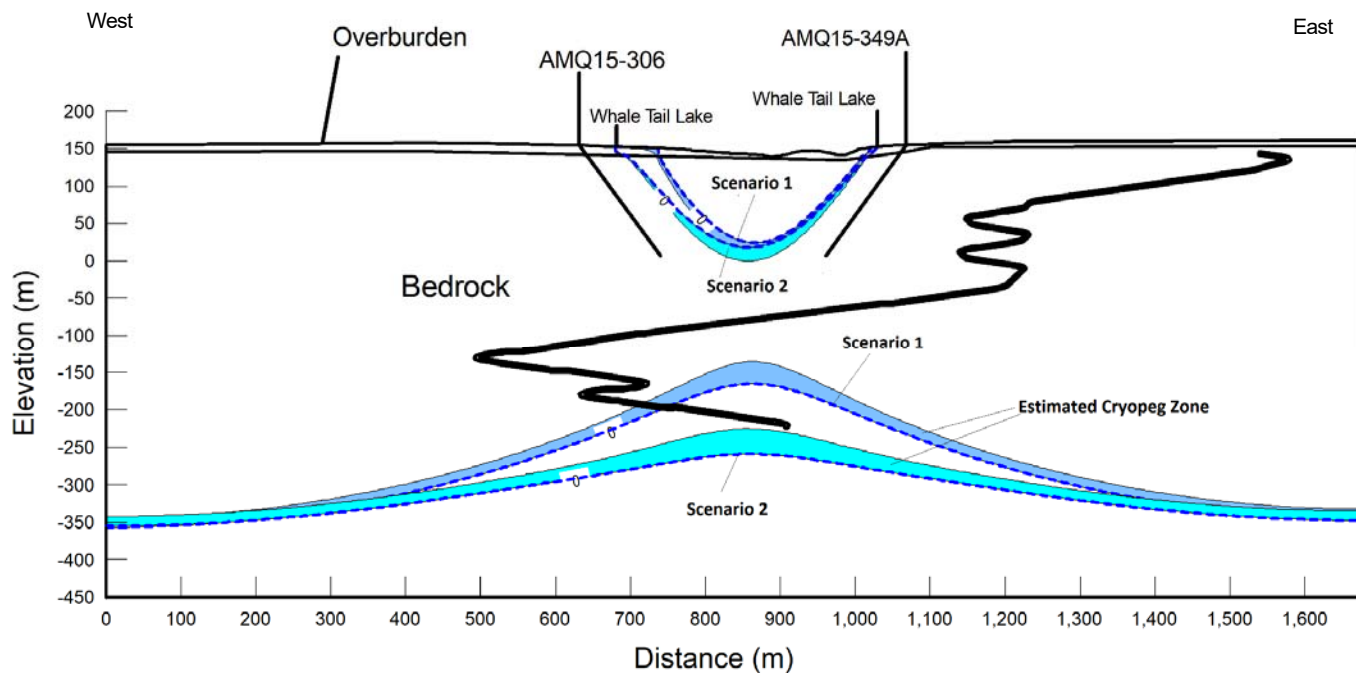
- Evaluate existing permafrost characteristics in the Whale Tail Lake and Project area.
- Evaluate existing talik conditions under the Whale Tail Lake adjacent to the Project site.

The results of this work are documented in Golder (2019c). The report presents a review and summary of estimated permafrost condition based on available thermistor data to date, as well as the results of a thermal modelling exercise prepared to assess permafrost conditions and the extent of talik formations beneath the Whale Tail Lake. Results from the thermal modelling were used to develop a 3D representation of the permafrost in the Whale Tail Lake area.

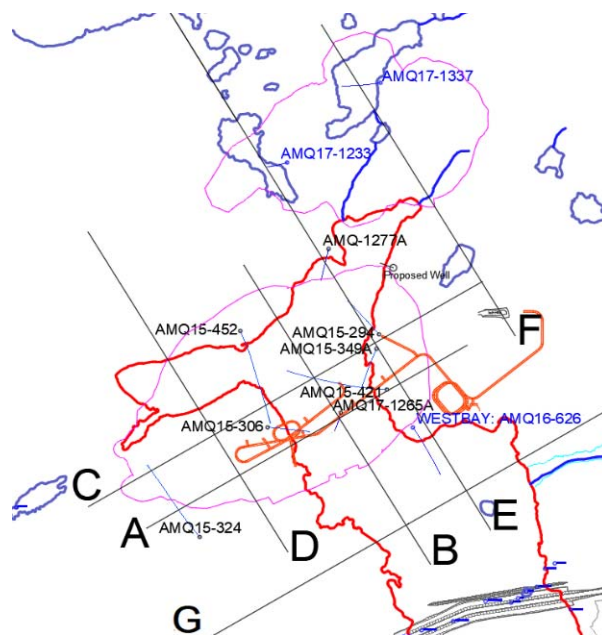
Based on the thermal modelling and the available thermistor data, the permafrost characteristics in the Project area are summarized below:

- The depth of permafrost outside of the influence of lakes is estimated to be between 452 m and 522 m based on thermal gradients and ground temperatures at the lowest portions of the thermistor strings. The depth of permafrost increases with increasing distance from lakes with talik.
- Considering the 2D thermal modelling and 3D block model, the assessment indicated that:
 - Under the northern portion of the lake below Whale Tail Pit, there is likely a closed talik formation (Section C of the thermal modelling report, reproduced on Figure 3 of this report).
 - Open talik conditions are probable in the southern portion of the lake where the Whale Tail Lake becomes wider (Section G of the thermal modelling report, reproduced on Figure 4 of this report).
 - Permafrost depth is between 480 m and 550 m for ground away from the Whale Tail Lake, and between 350 m and 450 m below surface in portions beneath the Whale Tail Lake where a closed talik is present.
 - The cryopeg thickness is likely between 20 m to 30 m.

Review of the 2D thermal analysis and 3D block model indicates that the predicted closed and open talik is consistent with the conceptual hydrogeological conditions adopted in the FEIS Addendum.



----- Zero Temperature Isoline



From Golder 2019.

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TITLE

THERMAL MODEL CALIBRATION RESULTS – SECTION C

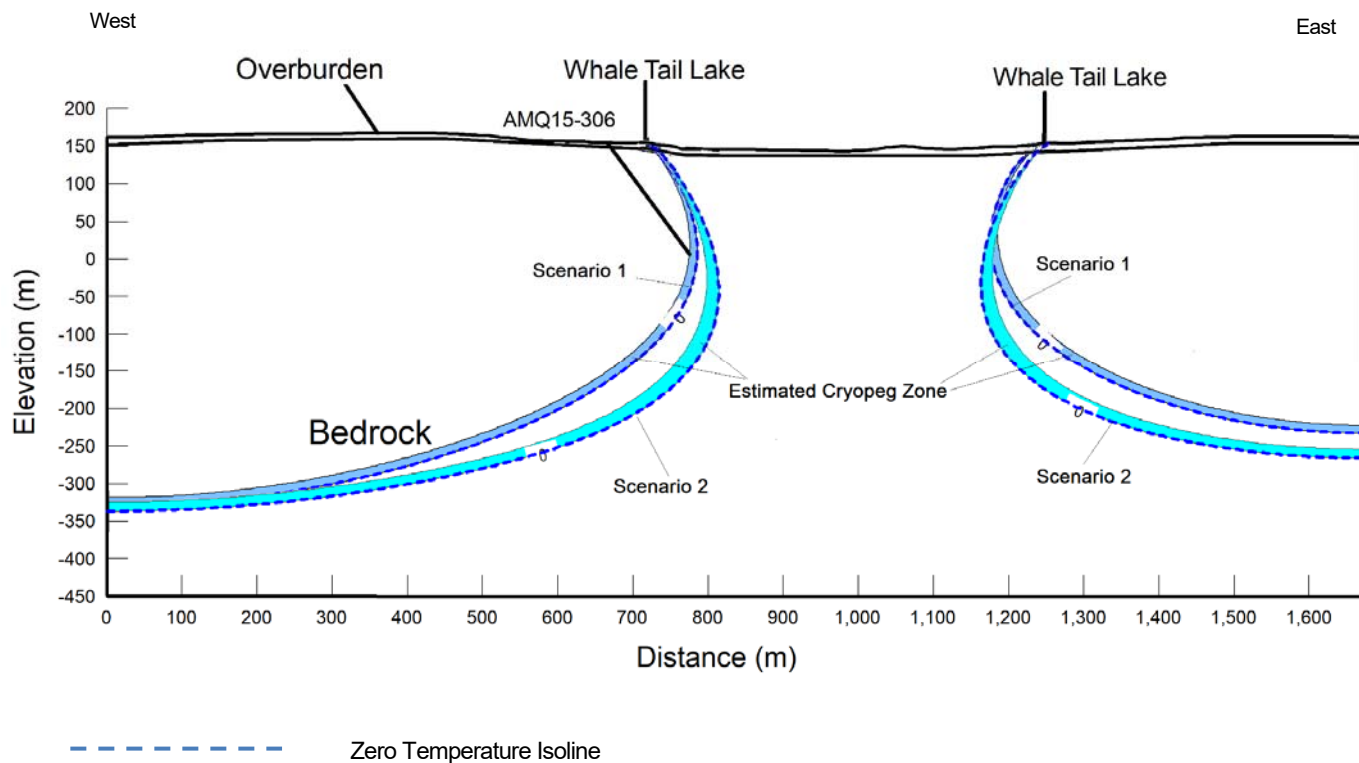
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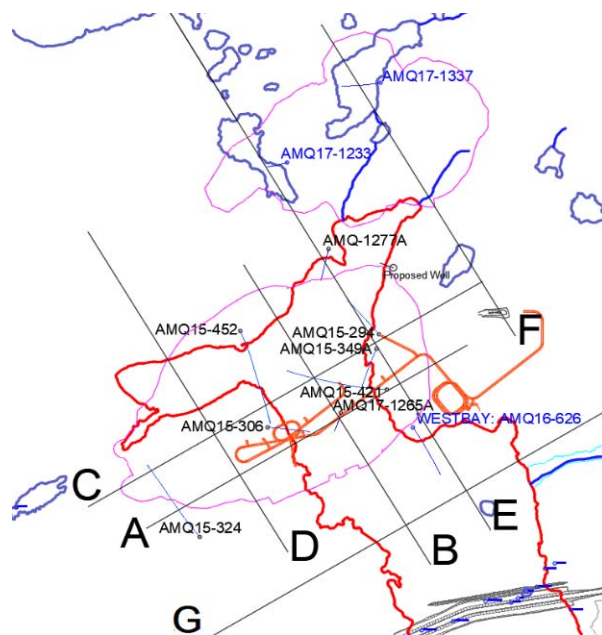
FIGURE
3

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From Golder 2019.



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TITLE

THERMAL MODEL CALIBRATION RESULTS – SECTION G

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FIGURE
4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

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2.3 Westbay Sampling and Hydraulic Head Measurements

Groundwater sampling and hydraulic head measurements of the Westbay multi-level system was undertaken in November 2018 (Golder 2019a) and are described below. The 2018 sampling data supplements previous data collected from the Westbay multi-level system in 2016.

Groundwater samples were collected from ports 2, 3, 4, and 6 of the Westbay multi-level well in November 2018. During drilling and installation of the Westbay, the drilling fluid was tagged with fluorescein. During collection of the water samples, the fluorescein concentration was measured to estimate the proportion of the sample that could be attributed to drilling fluid.

Groundwater quality of each water sample was estimated using a mass balance calculation to remove the proportion of residual drill fluid from the collected samples. The 2018 program estimated groundwater quality at Ports 6, 4, and 3 are in the same range as previously estimated. The calculated groundwater TDS were slightly higher in 2018 relative to 2016. The variation is attributed to the higher proportion of residual drilling water in the sample, which produces greater uncertainty in the TDS of the formation water. Therefore, the 2018 values are not considered to represent an actual increase in groundwater TDS and the assumptions for the FEIS Addendum conceptual model, which are based on the more reliable and applicable 2016 data, are still considered to be appropriate.

The concentrations of metals and arsenic were low. The maximum calculated arsenic concentration remains similar to what was calculated for Port 6 in 2016. Given that the arsenic concentrations are similar to assumptions adopted in the geochemical models for the FEIS (low arsenic in Formation groundwater), groundwater arsenic content is still not likely to have a significant effect on mine surface water quality.

Hydraulic heads measurements were recorded at the sampling ports prior to any sampling or development. The measurements indicate a downward hydraulic gradient was present (magnitude of 0.008 m/m), which is consistent with the conceptual understanding of pre-development groundwater flow directions and predicted conditions post-closure following the formation of the Whale Tail Pit Lake (Golder 2018). Gradients measured pre-development are considered a reasonable interpretation of what long-term gradients could be post-closure following the formation of the pit lake.

Considering the approximate area of Whale Tail Pit (0.5 km^2), the updated geometric average of the deep sub-permafrost bedrock ($8 \times 10^{-10} \text{ m/s}$), and the measured downward gradient (0.008 m/m), the data would indicate long term groundwater flux from the pit lake would be approximately $0.3 \text{ m}^3/\text{day}$. This value is lower than discharge measurements predicted in the FEIS addendum for the Environmental Assessment (EA) Scenario of $1.5 \text{ m}^3/\text{day}$ (Golder 2018).

3.0 CONCEPTUAL MODEL AND REFINEMENT OF BEDROCK HYDRAULIC CONDUCTIVITY

Except for the refinement of the hydraulic conductivity for the deep sub-permafrost bedrock, field data collected in 2018 is consistent with the conceptual model presented in the FEIS Addendum and no changes were made to the interpreted flow conditions. The conceptual model is presented in Appendix 6-B of the FEIS Addendum (Golder 2018).

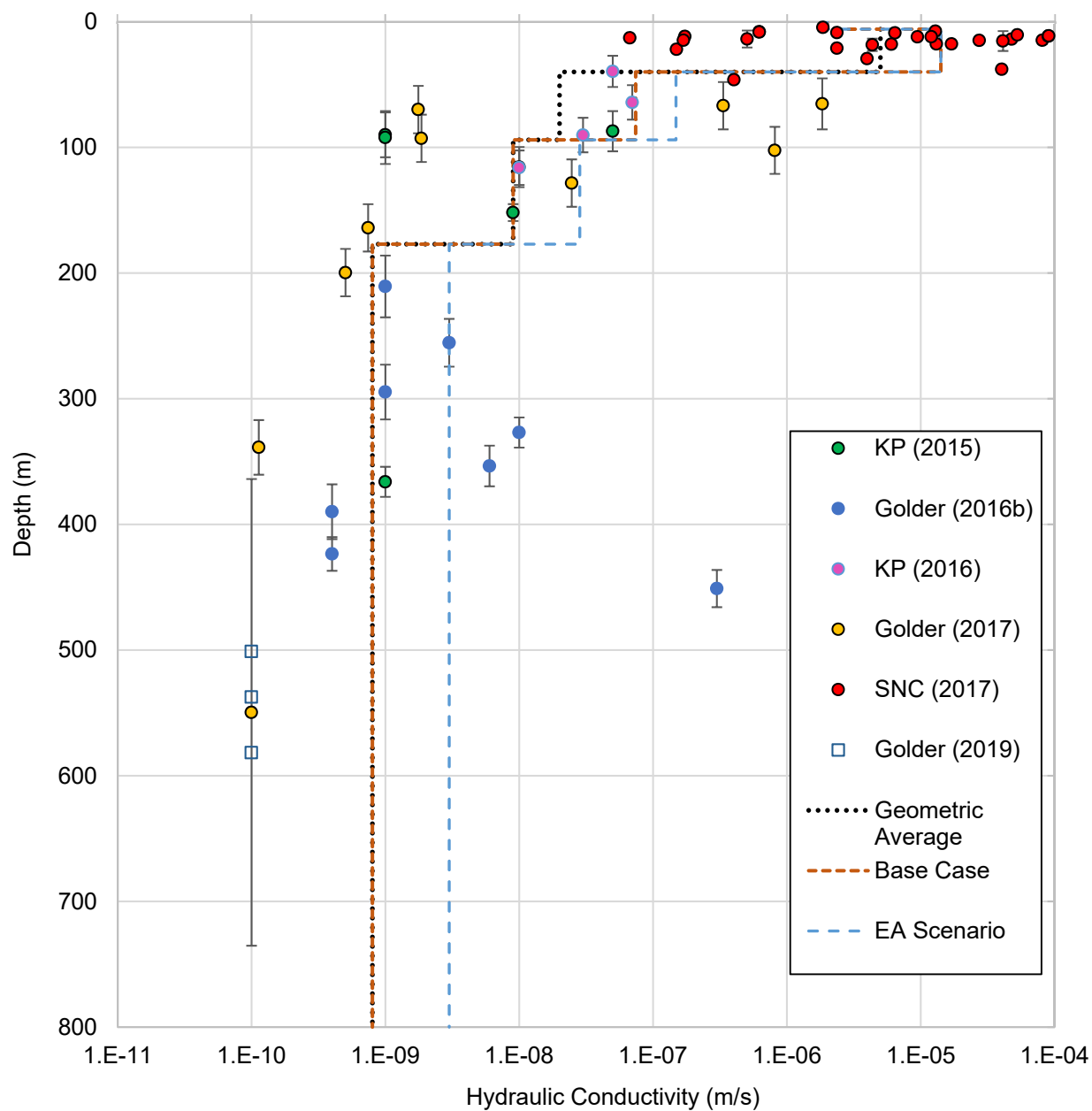
Hydraulic head monitoring conducted in November 2018 confirmed the downward direction of the vertical hydraulic gradient predicted by the model below Whale Tail Lake. Review of the 2D thermal analysis and 3D block model indicates that predicted closed and open taliks are consistent with the conceptual hydrogeological conditions adopted in the FEIS Addendum (closed talik in the northern portion of Whale Tail lake and open talik in the southern portion). The 3D block model was compared to the permafrost in the numerical model, and minor adjustments were made in the simulated permafrost depth along the margins of Whale Tail Lake (slightly smaller in extent).

Considering the packer test results, the hydraulic conductivity of the deep sub-permafrost bedrock was lowered from what was used in the FEIS addendum. For the Base Case, the hydraulic conductivity was decreased from 1×10^{-9} m/s to 8×10^{-10} m/s, which is equivalent to the geometric average of the test values. For the EA Scenario, the hydraulic conductivity was decreased from 4×10^{-9} m/s to 3×10^{-9} m/s, which is approximately 3 times higher than the geometric average of the data values. As described in the FEIS modelling report (Golder 2018), the Base Case Scenario represents reasonable estimates of hydraulic conductivity based on measured data; whereas, the EA Scenario incorporates conservatively higher estimates of hydraulic conductivity. Figure 5 presents the updated hydraulic conductivity profile for the bedrock that was assigned in this assessment of groundwater inflows and quality for the EA and Base Case Scenarios. Table 1 presents a tabular summary of the bedrock hydraulic conductivity used in the EA Scenario for the FEIS Addendum compared to the bedrock hydraulic conductivity used in this updated assessment.

Table 1: Hydraulic Conductivity of the Hydrostratigraphic Units

Hydrostratigraphic Unit	Depth Interval (m)	Hydraulic Conductivity (m/s)		Hydraulic Conductivity (m/s)	
		FEIS Base Case Scenario	2019 Updated Base Case Scenario	FEIS EA Scenario	2019 Updated EA Scenario
Overburden	0 to 6	2×10^{-6}	2×10^{-6}	2×10^{-6}	2×10^{-6}
Weathered bedrock	6 to 40	1×10^{-5}	1×10^{-5}	1×10^{-5}	1×10^{-5}
Competent bedrock	40 to 100	7×10^{-8}	7×10^{-8}	1×10^{-7}	1×10^{-7}
Competent bedrock	100 to 200	9×10^{-9}	9×10^{-9}	3×10^{-8}	3×10^{-8}
Competent bedrock	>200	1×10^{-9}	<u>8×10^{-10}</u>	4×10^{-9}	<u>3×10^{-9}</u>

Note: Parameters which have changed since the FEIS Addendum are shown in bold and underlined.



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TITLE

UPDATED HYDRAULIC CONDUCTIVITY VALUES – BASE CASE AND EA SCENARIO

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FIGURE
5



4.0 3D NUMERICAL HYDROGEOLOGICAL MODEL

To complete the updated hydrogeological assessment for the Expansion Project, the numerical hydrogeological model developed for the Expansion Project in FEFLOW was updated to incorporate the minor changes in hydraulic conductivity at depth and permafrost extent identified in Sections 2.0 and 3.0:

- The 3D block model was compared to the permafrost in the numerical model, and minor adjustments were made in the permafrost depth along the margins of Whale Tail Lake. Overall, changes to the permafrost extent were minor and did not conceptually alter the interpretation of where open and closed talik were present in Whale Tail Lake.
- The hydraulic conductivity of the competent bedrock below a depth of 200 m was decreased based on the updated packer test data collected in December 2018 (Table 1).

Except for the above two changes, no other modifications were made to the numerical model prior to predicting updated groundwater inflow quantity and quality for the Base Case and EA Scenarios. The development and construction of the numerical model is presented in Appendix 6-B of the FEIS Addendum (Golder 2018).

5.0 UPDATED MODEL PREDICTIONS – PRE-DEVELOPMENT, DEWATERING, MINING AND FILLING PHASES

The following section of the report provides updated predictions for dewatering of Whale Tail Lake and the mining and reflooding of the pits and underground for the Expansion Project. As discussed in Section 4.0, this model incorporates a reduction in deep bedrock hydraulic conductivity based on additional packer testing in December 2018, and the results of the thermal modelling, which overall support the permafrost interpretation in the FEIS Addendum. Minor adjustments were made in the permafrost depth along the margins of Whale Tail Lake but overall, changes to the permafrost extent were minor and did not conceptually alter the interpretation of where open and closed talik were present in Whale Tail Lake.

Updated predictions of groundwater inflow (quantity and TDS quality¹) are provided for the Base Case and EA Scenario. The Base Case Scenario represents the best estimate of groundwater inflow and groundwater TDS based on the measured data. The EA Scenario is designed to be a reasonable, yet more conservative, assessment of potential groundwater inflow quantity and TDS quality than values that might be adopted for mine operation planning (i.e., Base Case Scenario). Results from the more conservative EA Scenario are used in the Updated Site-Wide Water Balance and Water Quality model.

¹ Consistent with previous modelling in the FEIS Addendum, TDS concentrations do not account for loading from lakes and Whale Tail Attenuation Pond. TDS from these sources accounted for in Site Wide Water Quality analysis.

5.1 Base Case Scenario

5.1.1 Dewatering

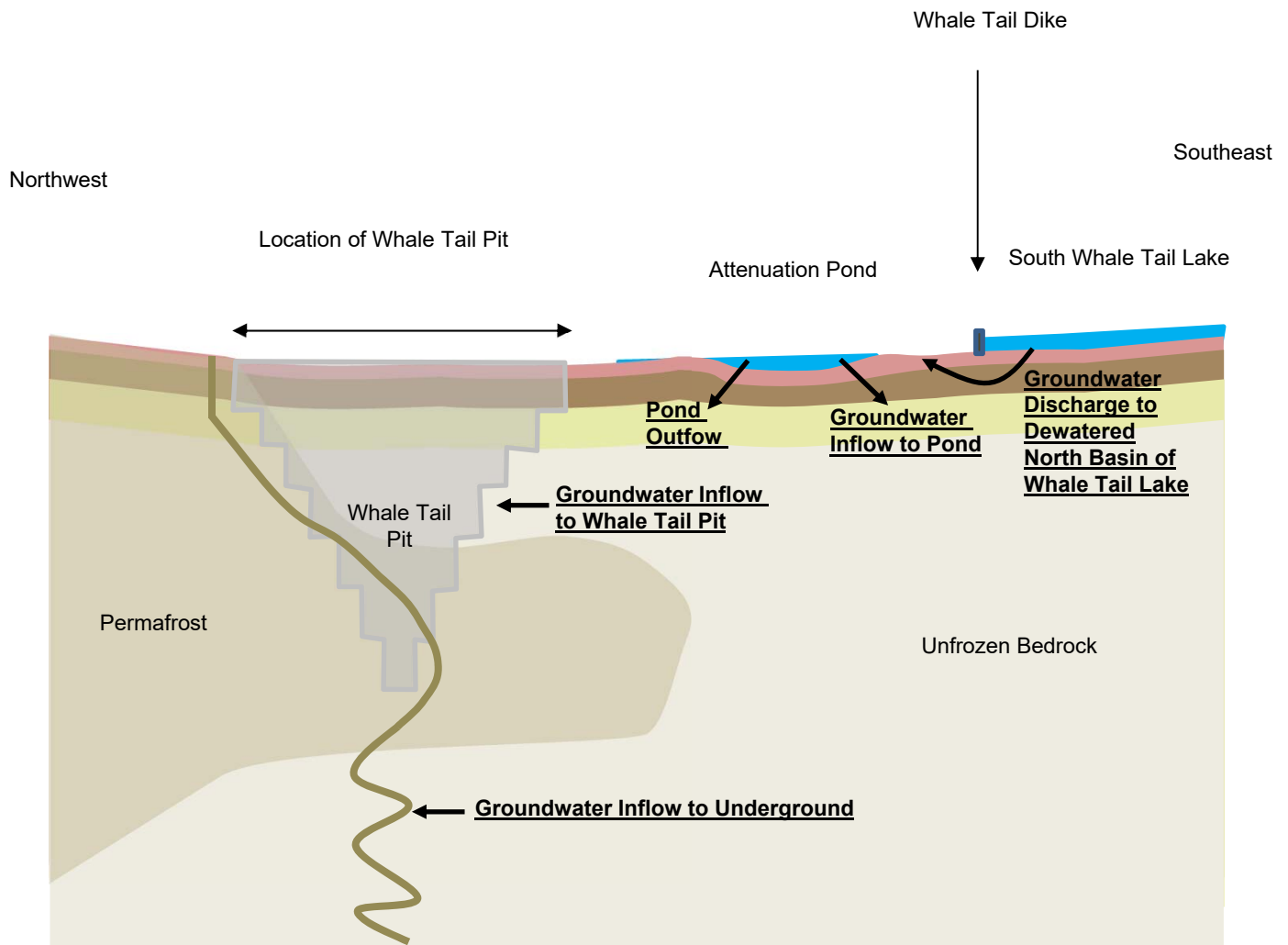
Table 2 presents a summary of the predicted discharge to the North Basin of Whale Tail lake during dewatering. The predicted discharge of 1320 m³/day is within 20 m³/day of the FEIS predictions (1340 m³/day) and no change in TDS concentration was predicted. The minor variation in predicted discharge from the FEIS reflects the small adjustments made to permafrost extent along the margins of Whale Tail Lake.

Table 2: Predicted Groundwater Discharge to North Basin of Whale Tail Lake during Dewatering – Base Case Scenario

Phase	Base Case Scenario	
	Groundwater Discharge (m ³ /day)	TDS Concentration (mg/L)
Lake Dewatering (Q1-Q3 2019)	1320	80

5.1.2 Mining

Table 3 presents a summary of the updated predicted groundwater flow rates and groundwater TDS concentrations to the mine development areas for the Base Case Scenario during mining of the open pits and underground. The predictions presented on these tables are conceptually shown on Figure 6 and include: predicted groundwater inflow to Whale Tail Pit, predicted groundwater inflow to the Underground, predicted flow to and from the Whale Tail Attenuation Pond, and predicted discharge to the dewatered North Base of Whale Tail Lake (i.e., the flow of water below the Whale Tail Lake Dike to the dewatered lake bottom). Groundwater inflow to the IVR Pit during mining is not included as the pit is in permafrost (groundwater inflow will be negligible). Some interception of surface water runoff and direct precipitation by the IVR Pit is expected, but this is not a flow component derived from the groundwater modelling. It is addressed in the Updated Site-Wide Water Balance and Water Quality Model (Golder 2019d).



Legend

- ← Flow Component with predictions of Water Quantity and TDS Water Quality
- Waterbody
- Permafrost
- Overburden (0 to 6 m below ground surface)
- Weathered Bedrock (6 to 40 m below ground surface)
- Competent Bedrock (40 to 100 m below ground surface)
- Competent Bedrock (>100 m below ground surface)

NOTES:

Conceptual Only. Not to Scale.

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TITLE

CONCEPTUAL SCHEMATIC SHOWING LOCATION OF FLOW COMPONENTS WITH PREDICTIONS OF GROUNDWATER INFLOW

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FIGURE
6

Table 3: Predicted Groundwater Inflow and Groundwater Quality during Mining – Base Case Scenario – Whale Tail Pit and Underground

Phase	Time Period	Whale Tail Pit		Underground		Whale Tail Attenuation Pond			North Basin of Whale Tail Lake (within the diked area) ³	
		Groundwater Inflow (m³/day)	TDS Concentration² (mg/L)	Groundwater Inflow (m³/day)	TDS Concentration² (mg/L)	Groundwater Inflow (m³/day)	Inflow TDS Concentration (mg/L)	Surface Water Outflow (m³/day)	Groundwater Discharge to Surface (m³/day)	Inflow TDS Concentration (mg/L)
Mining	August-December 2019¹	970	120	NA	NA	350	110	180	650	70
	2020	1160	50	20	3880	120	170	860	720	30
	2021	1310	20	30	4080	90	150	1040	730	20
	2022	1340	20	110	5630	90	130	1080	720	10
	2023	1340	10	180	6890	90	110	1080	720	10
	2024	1340	10	170	7430	90	80	1080	720	10
	2025	1340	10	130	7760	90	40	1080	720	10

Notes:
Pictorial representation of Flow Locations Components shown on Figure 6.
IVR Pit is located in permafrost and was therefore not modelled. Interception of runoff / direct precipitation accounted for in Site Wide Water Balance.
¹ Mining prior to Q4 2019 is within permafrost and groundwater inflow will be negligible.
² TDS concentrations do not account for loading from lakes and Whale Tail Attenuation Pond. TDS from these sources to be accounted for in Site Wide Water Quality analysis.
NA = not applicable; TDS = total dissolved solids; m³/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

Whale Tail Open Pit

In the last quarter of 2019, following dewatering of the North Basin of Whale Tail Lake, mining is expected to intersect unfrozen rock, and groundwater inflow to the pit is predicted to be 970 m³/day. The groundwater inflow to the open pit was predicted to increase from 970 m³/day in 2019 to 1,340 m³/day in 2022 to 2025. The overall inflow to the pit does not increase significantly as the pit deepens because the flow of water is primary through the permeable shallow (weathered) bedrock and the lower portion of the pit is in permafrost. The predicted quantity of groundwater inflow into the open pit during mining for the Base Case Scenario is close to what was predicted in the FEIS Addendum as no changes were made to the shallow bedrock hydraulic conductivity based on the recent packer test data.

Groundwater inflow predictions during mining conservatively assumes that no freeze-back will occur in the pit walls. This assumption was adopted for Whale Tail Pit to be conservative and because during the first few years of mining, the pit will be both widened and deepened, resulting in the continual exposure of unfrozen bedrock. During the later years of mining; however, the pit development will be entirely within the permafrost and significant freeze back in the pit walls is considered possible and has been observed at Meadowbank. Although not simulated, if freeze back does occur as is the case at Meadowbank, actual groundwater inflow to the pit could be substantively lower than the predicted values in Table 3 and Table 4 (i.e., reduce to zero during periods of full freeze back).

TDS concentration in the groundwater inflow to the pit was predicted to decrease during mining from approximately 120 mg/L (2019) to 10 mg/L (2023 to 2025). These TDS concentrations are identical to the predicted TDS concentrations in the FEIS Addendum. The relatively low TDS concentration and decrease in TDS over time reflects the minimal upwelling of higher salinity waters at depth due to the presence of the permafrost at the base of the pit and the high contribution of lake water from the South Base of Whale Lake and from the Whale Tail Attenuation Pond water. Consistent with the FEIS Addendum, the predicted TDS concentrations in this model only account for TDS loading from groundwater. TDS loading from the Whale Tail Attenuation Pond and South Basin of Whale Tail Lake is accounted for in the water quality model (Golder 2019d).

Underground

For the Underground, groundwater inflow was predicted to increase from 20 m³/day in 2020, which is the first year the Underground development will be within unfrozen bedrock, up to 180 m³/day in 2023, which is when the underground reaches its maximum depth of -505 masl. By the final year of mining, the groundwater inflow decreases to 130 m³/day. This decrease reflects that the underground is no longer being deepened and flow to the underground is likely near steady state conditions (reduced drainage from storage). The predicted flows based on the updated model is approximately 13% lower than the predicted values in the FEIS Addendum at the end of mining (150 m³/day). The reduction in groundwater inflow reflects the small decrease in hydraulic conductivity in the deep sub-permafrost bedrock due to the additional packer testing data.

TDS concentrations in the groundwater inflow to the Underground were predicted to increase from 3,880 mg/L in 2020 to 7,760 mg/L in 2025. The predicted increase in TDS concentration is the result of the interception of higher salinity groundwater as the mine is deepened, and the upwelling of higher TDS water from beneath the Underground. The predicted TDS concentrations are within 30 mg/L of the predicted values in the FEIS Addendum for the Base Case Scenario.

5.1.3 Reflooding of Pits and Underground

Table 4 and Table 5 respectively presents a summary of the predicted groundwater inflow rates and groundwater TDS concentration to the mine development areas for the Base Case Scenario during reflooding of the pits and underground. The predictions presented in Table 4 and Table 5 include: predicted groundwater inflow to Whale Tail Pit Lake, predicted groundwater flow to the Underground, predicted flow to and from the Whale Tail Attenuation Pond, and predicted discharge to the dewatered North Base of Whale Tail Lake (i.e., the flow of water below the Whale Tail Lake Dike to the dewatered lake bottom surface). Groundwater inflow to the IVR Pit during refilling was not included as the pit is in permafrost (groundwater inflow will be negligible).

The predictions presented for the reflooding phase utilize a conceptual filling schedule for the Whale Tail Pit and the Underground, based on initial water balance predictions. Fine tuning of the flooding sequence was conducted after the conceptual filling schedule was developed; however, these adjustments will not have a significant impact on the predicted flow rates and salinity for a given elevation range.

For the prediction of pit reflooding, the pit walls were assumed to be frozen at the start of closure / end of mining, which restricted the inflow of groundwater to the pit lake until the pit lake rises and thaws the pit walls. This is considered reasonable as during the later years of mining, the pit development is limited to within the permafrost below Whale Tail Lake. If the pit walls do not remain frozen or melts seasonally, higher inflows than what is predicted could occur resulting in a shorter pit-filling period.

Considering the assumption of freeze-back in the pit walls, groundwater inflow to the Whale Tail Pit was not predicted to occur until 2030, when the pit lake level rises above the top of permafrost elevation near the pit (approximately 40 masl). When the water elevation in the pit lake rises above the permafrost, the freeze back is assumed to dissipate below the lake level and groundwater inflow to the pit was predicted to resume. The groundwater inflow to the pit lake was predicted to increase from 10 m³/day in 2030 to approximately 1,160 m³/day in 2036 as the pit walls progressively become unfrozen and connected to the permeable weathered bedrock. As the pit lake rises further in elevation, the groundwater inflows decrease and eventually the pit lake switches to a groundwater recharge boundary (i.e., the pit lake starts to recharge the sub-permafrost groundwater flow system). These groundwater inflow rates are similar to predictions in the FEIS Addendum and reflect that no changes were made to the shallow bedrock hydraulic conductivity.

The refilling of the Underground is expected to occur over a very short period (i.e. the bottom 500 m will be refilled in the first year). The water level in the Underground is therefore almost immediately higher than the hydraulic heads in bedrock near the Underground, resulting in a small but generally consistent flux of water from the Underground to bedrock. At the end of the reflooding period (2041) the Underground remains a source of groundwater recharge, with a predicted discharge of -10 m³/day. These flow rates are slightly lower (by 0 to 5 m³/day) of the predicted groundwater recharge rates predicted in the FEIS Addendum.

Table 4: Predicted Groundwater Inflow and Groundwater Salinity during Reflooding - Base Case Scenario – Whale Tail Pit, Whale Tail Attenuation Pond, North Basin of Whale Tail Lake

Phase	Approximate Time Period	Water Level in Pit (masl)		Whale Tail Pit		Whale Tail Attenuation Pond			Dewatered North Basin of Whale Tail Lake (within the diked area)	
		From	To	Net Groundwater Inflow/Outflow ¹ (m³/day)	TDS Concentration ² (mg/L)	Groundwater Inflow (m³/day)	Inflow TDS Concentration (mg/L) ²	Surface Water Outflow (m³/day)	Net Groundwater Discharge to Surface ¹ (m³/day)	Inflow TDS Concentration ² (mg/L)
Flooding	2026	-130	-76	NA	NA	145	30	<5	340	<10
	2027	-76	-39	NA	NA	170	24	<5	340	<10
	2028	-39	3	NA	NA	180	21	<5	345	<10
	2029	3	26	NA	NA	185	19	<5	345	<10
	2030	26	43	10	24	190	18	<5	345	<10
	2031	43	61	60	24	180	17	10	345	<10
	2032	61	73	90	21	170	17	30	345	<10
	2033	73	87	120	19	160	17	45	340	<10
	2034	87	101	130	17	155	17	50	340	<10
	2035	101	111	700	<10	125	25	505	330	<10
	2036	111	124	1160	<10	85	29	940	300	<10
	2037	124	133	910	<10	90	22	740	300	<10
	2038	133	142	360	<10	115	16	315	315	<10
	2039	142	149	-30	NA	70	22	135	370	<10
	2040	149	153.5	-10	NA	0	NA	5	155	<10
	2041	153.5	153.5	0	NA	0	NA	0	-10	<10

Notes:
Pictorial representation of Flow Locations Components shown on Figure 6.
IVR Pit is located in permafrost and was therefore not modelled. Interception of runoff / direct precipitation accounted for in Site Wide Water Balance.
¹ Positive values indicate flow to the pit/pond and negative values indicate flow to bedrock.
² TDS concentrations do not account for loading from lakes and Whale Tail Attenuation Pond. TDS from these sources to be accounted for in Site Wide Water Quality analysis.
NA = not applicable; TDS = total dissolved solids; m³/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

Table 5: Predicted Groundwater Inflow and Groundwater Salinity during Refilling – Base Case Scenario – Underground

Phase	Approximate Time Period	Water Level in Underground (masl)		Underground	
		From	To	Net Groundwater Inflow/Outflow ¹ (m³/day)	TDS Concentration ² (mg/L)
Flooding	2026	-505	-76	-30	NA
	2027	-76	-39	<-5	NA
	2028	-39	3	<-5	NA
	2029	3	26	<-5	NA
	2030	26	43	<-5	NA
	2031	43	61	<-5	NA
	2032	61	73	<-5	NA
	2033	73	87	-5	NA
	2034	87	101	-10	NA
	2035	101	111	-10	NA
	2036	111	124	-10	NA
	2037	124	133	-10	NA
	2038	133	142	-25	NA
	2039	142	149	-15	NA
	2040	149	152.5	-10	NA
	2041	153	152.5	-10	NA

Notes:
Pictorial representation of Flow Locations Components shown on Figure 6.
¹ Positive values indicate flow to the underground and negative values indicate flow to bedrock.
² TDS concentrations do not account for loading from lakes and Whale Tail Attenuation Pond. TDS from these sources to be accounted for in Site Wide Water Quality analysis.
NA = not applicable; TDS = total dissolved solids; m³/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

5.2 EA Scenario

The Base Case predictions discussed in the preceding section provides the most likely estimates of groundwater inflow quantity and quality for the Expansion Project based on the available hydraulic conductivity data (Section 2 Table 1). Considering the number of tests; however, and in consideration of the sensitivity analysis conducted in the FEIS Addendum, an EA Scenario was developed as part of the FEIS Addendum. This scenario provides a reasonable yet conservative estimate of groundwater inflow such that there is a high level of confidence that the potential effects of the Expansion Project on groundwater inflow quantity and salinity have not been underestimated. Results from the EA Scenario are used in the Site-Wide Water Balance and Water Quality Models for the Expansion Project. Hydraulic conductivity values adopted in the EA Scenario relative to the Base Case are presented in Section 3.0 and take in to account the recent packer testing data collected in December 2018.

5.2.1 Dewatering

Table 6 presents a summary of the predicted discharge to the North Basin of Whale Tail lake during dewatering. The predicted discharge of 1330 m³/day is within 20 m³/day of the FEIS Addendum predictions (1350 m³/day) and no change in TDS concentration was predicted. The minor variation in predicted discharge from the FEIS reflects the small adjustments made to permafrost extent along the margins of Whale Tail Lake.

Table 6: Predicted Groundwater Discharge to North Basin of Whale Tail Lake during Dewatering – EA Scenario

Phase	EA Scenario	
	Groundwater Discharge (m ³ /day)	TDS Concentration (mg/L)
Lake Dewatering (Q1-Q3 2019)	1330	80

5.2.2 Mining

Table 7 and Table 8 presents a summary of the updated predicted groundwater flow rates and groundwater TDS concentrations to the mine development areas for the EA Scenario during mining of the open pits and underground. The predictions presented on these tables are conceptually shown on Figure 5 and include: predicted groundwater inflow to Whale Tail Pit, predicted groundwater inflow to the Underground, predicted flow to and from the Whale Tail Attenuation Pond, and predicted discharge to the dewatered North Base of Whale Tail Lake (i.e., the flow of water below the Whale Tail Lake Dike to the dewatered lake bottom). Groundwater inflow to the IVR Pit during mining is not included as the pit is in permafrost (groundwater inflow will be negligible). Some interception of surface water runoff and direct precipitation by the IVR Pit is expected, but this is not a flow component derived from the groundwater modelling. It is addressed in the Updated Site-Wide Water Balance and Water Quality Model (Golder 2019d).

Whale Tail Open Pit

The predicted quantity and TDS concentration of groundwater inflow into the open pit during mining for the EA Scenario is similar to what was predicted in the Base Case and assumes no freeze-back in the pit walls. For the EA Scenario, the groundwater inflow to the open pit was predicted to increase from 970 m³/day in 2019 to 1,350 m³/day in 2025 and the TDS concentration was predicted to decrease from 120 mg/L in 2019 to 10 mg/L in 2025. Groundwater inflow is controlled by the shallow bedrock hydraulic conductivity, which was not modified between the Base Case and EA Scenario due to the high number of tests in this unit and the conservatism used in the Base Case Scenario. The shallow bedrock hydraulic conductivity is also unchanged from the FEIS Addendum; therefore, predicted inflows to the open pit are similar to the predictions in the FEIS Addendum.

Underground

For the EA Scenario, the updated groundwater inflow to the Underground was predicted to increase from 60 m³/day in 2020 to a maximum of 420 m³/day in 2023. In the final year of mining, the groundwater inflow decreases slightly to 340 m³/day. These groundwater inflows are approximately 2 to 3 times higher than the Base Case values for the same period of mining. Predicted TDS concentrations for the EA scenario are 30% higher than the Base Case at the end of mining and reflect more upwelling of deeper more saline groundwater beneath the Underground.

The predicted inflows based on the updated model is approximately 20% lower than the predicted values at the end of mining in the FEIS Addendum (430 m³/day). The reduction in groundwater inflow reflects the small decrease in hydraulic conductivity in the deep sub-permafrost bedrock due to the additional packer testing data. The predicted TDS concentrations are approximately 2 to 9 % lower than the predicted values in the FEIS Addendum.

Contributions to the inflow to the Whale Tail Pit and the Underground from the Whale Tail Attenuation Pond and the South Basin of Whale Tail Lake were evaluated for the EA Scenario to support the update to the Site-Wide Water Quality Model. TDS concentrations from these sources are accounted for in the Site-wide Water Quality model through a feedback loop. The quantity contributions predicted by the hydrogeological model are presented in Table 7 and Table 8. In 2020, approximately 64% of groundwater inflow to the pit is originating from the Whale Tail Attenuation Pond. The pond represents the major contributor to groundwater inflow to the pit due to its connection to the pit through the permeable shallow bedrock. The contribution from the pond was predicted to increase to 82% at the end of mining. The contribution from the South Basin of Whale Tail Lake is also predicted to increase from 3% in 2021 to 15% at the end of mining in 2025. In the Underground, the source of groundwater inflow is attributed only to water from the deep bedrock flow system.

Table 7: Predicted Groundwater Inflow and Groundwater Quality during Mining - EA Scenario – Whale Tail Pit and Underground

Phase	Time Period	Whale Tail Pit				Underground			
		Groundwater Inflow (m ³ /day) ³	Inflow TDS Concentration (mg/L) ²	Portion of Inflow from Attenuation Pond (%)	Portion of Inflow from South Basin of Whale Tail Lake (%)	Net Groundwater Inflow (m ³ /day)	Inflow TDS Concentration (mg/L) ²	Portion of Inflow from Attenuation Pond (%)	Portion of Inflow from South Basin of Whale Tail Lake (%)
Mining	August-December 2019 ¹	970	120	1%	<1%	NA	NA	NA	NA
	2020	1170	50	64%	<1%	60	4120	<1%	<1%
	2021	1320	30	79%	3%	70	4580	<1%	<1%
	2022	1360	20	81%	9%	250	6230	<1%	<1%
	2023	1360	20	82%	12%	420	7850	<1%	<1%
	2024	1350	10	82%	14%	410	9090	<1%	<1%
	2025	1350	10	82%	15%	340	10180	<1%	<1%

Notes:

Pictorial representation of Flow Locations Components shown on Figure 5.

IVR Pit is located in permafrost and was therefore not modelled. Interception of runoff / direct precipitation accounted for in Site Wide Water Balance.

¹ Mining prior to Q4 2019 is within permafrost and groundwater inflow will be negligible.

² TDS concentrations do not account for loading from lakes and Whale Tail Attenuation Pond. TDS from these sources to be accounted for in Site Wide Water Quality analysis.

NA = not applicable; TDS = total dissolved solids; m³/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

Table 8: Predicted Groundwater Inflow and Groundwater Salinity during Dewatering and Mining - EA Scenario – Whale Tail Attenuation Pond and Whale Tail Lake (North Basin)

Phase	Time Period	Whale Tail Attenuation Pond				North Basin of Whale Tail Lake (within the diked area) ¹		
		Groundwater Inflow (m ³ /day)	Inflow TDS Concentration (mg/L) ²	Portion of Inflow from South Basin of Whale Tail Lake (%)	Pond Outflow (m ³ /day)	Net Groundwater Inflow (m ³ /day) ³	TDS Concentration (mg/L) ²	Portion of Inflow from South Basin of Whale Tail Lake (%)
Mining	August-December 2019	350	110	<1%	180	650	70	39%
	2020	120	170	<1%	860	720	30	85%
	2021	90	160	5%	1050	730	20	98%
	2022	90	140	23%	1090	720	10	99%
	2023	90	110	49%	1090	720	10	99%
	2024	90	90	74%	1090	720	10	>99%
	2025	90	70	94%	1090	720	10	>99%

Notes:

Pictorial representation of Flow Locations Components shown on Figure 5.

IVR Pit is located in permafrost and was therefore not modelled. Interception of runoff / direct precipitation accounted for in Site Wide Water Balance.

¹ Predictions of groundwater inflow to North Basin of Whale Tail lake represents the discharge of groundwater to the lake basin during dewatering and mining. This excludes discharges to the pit and Whale Tail Attenuation Pond, which are within the North Basin of Whale Tail Lake.

² TDS concentrations do not account for loading from lakes and Whale Tail Attenuation Pond. TDS from these sources are accounted for in the Site Wide Water Quality model.

NA = not applicable; TDS = total dissolved solids; m³/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

5.2.3 Reflooding of Pits and Underground

Table 9 and Table 10 respectively presents a summary of the predicted groundwater inflow rates and groundwater TDS concentration to the mine development areas for the EA Scenario during reflooding of the pits and underground. The predictions presented in Table 9 and Table 10 include: predicted groundwater inflow to Whale Tail Pit Lake, predicted groundwater flow to the Underground, predicted flow to and from the Whale Tail Attenuation Pond, and predicted discharge to the dewatered North Base of Whale Tail Lake (i.e., the flow of water below the Whale Tail Lake Dike to the dewatered lake bottom surface). Again, it should be noted that TDS concentrations do not account for loading from nearby lakes and the Whale Tail Attenuation Pond. TDS from these sources are taken in to account by a feedback loop in the Site Wide Water Quality model. Groundwater inflow to the IVR Pit during refilling was not included as the pit is in permafrost (groundwater inflow will be negligible).

The predictions presented for the reflooding phase utilize a conceptual filling schedule for the Whale Tail Pit and the Underground, based on initial water balance predictions. Fine tuning of the flooding sequence was conducted after the conceptual filling schedule was developed; however, these adjustments will not have a significant impact on the predicted flow rates and salinity for a given elevation range.

Similar to the Base Case, the pit walls were assumed to be frozen at the start of closure / end of mining, which restricted the inflow of groundwater to the pit lake until the pit lake rises and thaws the pit walls. Considering the assumption of freeze-back in the pit walls, groundwater inflow to the Whale Tail Pit was not predicted to occur until 2030, when the pit lake level rises above the top of permafrost elevation near the pit (approximately 40 masl). When the water elevation in the pit lake rises above the permafrost, the freeze back is assumed to dissipate below the lake level and groundwater inflow to the pit was predicted to resume. The groundwater inflow to the pit lake was predicted to increase from 20 m³/day in 2030 to approximately 1,170 m³/day in 2036 as the pit walls progressively become unfrozen and connected to the permeable weathered bedrock. As the pit lake rises further in elevation, the groundwater inflows decrease and eventually the pit lake switches to a groundwater recharge boundary (i.e., the pit lake starts to recharge the sub-permafrost groundwater flow system). These groundwater inflow rates are similar to predictions in the FEIS Addendum and reflect that no changes were made to the shallow bedrock hydraulic conductivity.

At the start of reflooding, a small flux of groundwater inflow (10 m³/day) is predicted to discharge to the Underground. Over time, as hydraulic gradients near the Underground dissipate, the Underground switches to a groundwater recharge boundary. At the end of the filling period (2041) the Underground remains a source of groundwater recharge (-20 m³/day) to the sub-permafrost groundwater regime. These predicted inflows are similar to or lower than those predicted in the FEIS Addendum, which ranged from 50 m³/day inflow at the start of reflooding to -25 m³/day (positive values indicate flow to the pit/pond; negative values indicate flow to bedrock) discharge at the end of reflooding (0 to 70 % lower than the FEIS values depending on the pit lake elevation).

Table 9: Predicted Groundwater Inflow and Groundwater Salinity during Reflooding - EA Scenario – Whale Tail Pit, Whale Tail Attenuation Pond, North Basin of Whale Tail Lake

Phase	Approximate Time Period	Water Level in Pit (masl)		Whale Tail Pit				Whale Tail Attenuation Pond				North Basin of Whale Tail Lake (within the diked area)		
		From	To	Net Groundwater Inflow/Outflow ¹ (m³/day)	Inflow TDS Concentration ² (mg/L)	Portion of Inflow from Attenuation Pond (%)	Portion of Inflow from South Basin of Whale Tail Lake (%)	Groundwater Inflow (m³/day)	Inflow TDS Concentration (mg/L) ²	Portion of Inflow from South Basin of Whale Tail Lake (%)	Pond Outflow (m³/day)	Net Groundwater Inflow/Outflow ¹ (m³/day)	TDS Concentration (mg/L) ²	Portion of Inflow from South Basin of Whale Tail Lake (%)
Flooding	2026	-130	-76	NA	NA	NA	NA	150	35	76%	<5	345	<10	>99%
	2027	-76	-39	NA	NA	NA	NA	170	30	84%	<5	345	<10	>99%
	2028	-39	3	NA	NA	NA	NA	180	25	89%	<5	345	<10	>99%
	2029	3	26	NA	NA	NA	NA	180	25	91%	<5	345	<10	>99%
	2030	26	43	20	24	47%	41%	185	20	93%	<5	345	<10	>99%
	2031	43	61	90	24	47%	41%	170	20	96%	25	345	<10	>99%
	2032	61	73	130	19	44%	50%	160	20	97%	55	340	<10	>99%
	2033	73	87	170	15	46%	53%	150	20	98%	80	340	<10	>99%
	2034	87	101	170	13	50%	50%	145	20	98%	90	335	<10	>99%
	2035	101	111	730	<10	71%	29%	120	25	99%	530	330	<10	>99%
	2036	111	124	1170	<10	81%	19%	85	30	99%	950	300	<10	>99%
	2037	124	133	910	<10	82%	18%	90	20	99%	745	300	<10	>99%
	2038	133	142	360	<10	82%	18%	115	15	99%	315	315	<10	>99%
	2039	142	149	-30	NA	NA	NA	70	20	98%	140	370	<10	>99%
	2040	149	153.5	-10	NA	NA	NA	0	NA	NA	10	155	<10	>99%
	2041	153.5	153.5	0 to -5	NA	NA	NA	0	NA	NA	5	-10	NA	NA

Notes:
Pictorial representation of Flow Locations Components shown on Figure 5.
IVR Pit is located in permafrost and was therefore not modelled. Interception of runoff / direct precipitation accounted for in Site Wide Water Balance.
¹ Positive values indicate flow to the pit/pond and negative values indicate flow to bedrock.
² TDS concentrations do not account for loading from lakes and Whale Tail Attenuation Pond. TDS from these sources to be accounted for in Site Wide Water Quality analysis.
NA = not applicable; TDS = total dissolved solids; m³/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

Table 10: Predicted Groundwater Inflow and Groundwater Salinity during Refilling - EA Scenario – Underground

Phase	Time Period	Water Level in Underground (masl)		Underground			
		From	To	Net Groundwater Inflow/Outflow ¹ (m³/day)	Inflow TDS Concentration ² (mg/L)	Portion of Inflow from Attenuation Pond (%)	Portion of Inflow from South Basin of Whale Tail Lake (%)
Flooding	2026	-505	-76	10	9800	<1%	<1%
	2027	-76	-39	30	12100	<1%	<1%
	2028	-39	3	20	12700	<1%	<1%
	2029	3	26	10	13200	<1%	<1%
	2030	26	43	10	13600	<1%	<1%
	2031	43	61	5	13800	<1%	<1%
	2032	61	73	5	14000	<1%	<1%
	2033	73	87	-5	NA	<1%	<1%
	2034	87	101	-5	NA	NA	NA
	2035	101	111	-10	NA	NA	NA
	2036	111	124	-15	NA	NA	NA
	2037	124	133	-20	NA	NA	NA
	2038	133	142	-35	NA	NA	NA
	2039	142	149	-25	NA	NA	NA
	2040	149	152.5	-25	NA	NA	NA
	2041	153	152.5	-20	NA	NA	NA

Notes:
Pictorial representation of Flow Locations Components shown on Figure 5.
IVR Pit is located in permafrost and was therefore not modelled. Interception of runoff / direct precipitation accounted for in Site Wide Water Balance.
¹ Positive values indicate flow to the underground and negative values indicate flow to bedrock.
² TDS concentrations do not account for loading from lakes and Whale Tail Attenuation Pond. TDS from these sources to be accounted for in Site Wide Water Quality analysis.
NA = not applicable; TDS = total dissolved solids; m³/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

6.0 MODEL PREDICTIONS - FULLY FLOODED OPEN PITS

The following section provides updated groundwater model predictions for the IVR Pit and Whale Tail pit following flooding of the mine development and North Basin of Whale Tail Lake. This data may be used in the future to support updated hydrodynamic modelling of the pit lakes, if required, to evaluate long-term pit lake water quality. Updated predictions are provided for the pit lakes to evaluate if the changes made to the model (estimated hydraulic conductivity of the deep sub-permafrost bedrock) affect previous predictions in the FEIS addendum.

The model predictions were provided for the EA Scenario, and utilizes the same model as the dewatering, mining and reflooding phases. As discussed in the modelling report of the FEIS Addendum (Golder 2018), density-dependent transport of solutes was not considered for the assessment of groundwater conditions as the buoyancy effects were considered negligible in relation to the regional hydraulic head gradient.

Although the two pit lakes are connected following filling, the groundwater flow conditions surrounding the pit lakes are initially very different. As presented in the FEIS Addendum, the Whale Tail Pit lake is predicted by thermal analysis to be connected to the deep sub-permafrost groundwater 11 years into filling and for the permafrost below the pit lake to fully degrade over 50 years. The IVR Pit lake is predicted to be within permafrost during mining and flooding and the permafrost below the pit lake to fully degrade over 1000 years.

6.1 Whale Tail Pit

Table 11 presents predicted outflow from the Whale Tail Pit lake following full reflooding of the pit. The pit lake was predicted to recharge the regional sub-permafrost groundwater system from the first year after full flooding and over the following 300 years. Over time, as the groundwater flow system near the flooded mine workings re-equilibrates and the shallow bedrock re-saturates and/or re-pressurizes, the amount of recharge to the sub-permafrost flow system decreases from 3.3 m³/day in Year 1 to 1.4 m³/day after 200 years. The long-term predicted pit lake discharge to the sub-permafrost groundwater flow system is predicted to be 1.2 m³/day, which is 20% less than the long-term pit lake discharge in the FEIS Addendum (1.5 m³/day) as a result of the slight reduction in deep bedrock hydraulic conductivity. No significant groundwater inflows to the pit lake were predicted.

Table 11: Predicted Whale Tail Pit Lake outflow following Flooding of the Mine Development

Time (Years after Reflooding)	Pit Lake Outflow to Groundwater (m ³ /day)
1	3.3
50	2.1
100	1.8
200	1.4
300	1.2

Considering the hydraulic conductivity assigned to the deep bedrock for the FEIS scenario (3×10^{-9} m/s) based on packer testing data, the approximate area of the pit (0.5 km²), and the measured pre-development downward hydraulic gradient at the Westbay Well (0.008 m/m), the calculated steady-state discharge from the pit is 1 m³/day. This value is in good agreement with the predicted value from the model after 300 years (1.2 m³/day).

6.2 IVR Pit

The IVR Pit is in an area of regional permafrost; therefore, during mining and flooding, groundwater inflows to the pit were assumed to be negligible. Following flooding and the formation of the IVR Pit lake, the permafrost is expected to melt and connect the IVR Pit lake to the sub-permafrost groundwater flow system.

In consideration of the long timeline associated with the melting of the permafrost, the fully flooded analysis of the IVR Pit was limited to a prediction of the long-term steady-state groundwater flow environment that would develop near the pit lake following the full melting of permafrost below the pit footprint. Model results confirmed the assumption that the IVR Pit lake would act as recharge boundary to the regional groundwater system once the permafrost layer beneath the lake melts. The long-term predicted discharge from the IVR Pit lake to the sub-permafrost groundwater flow system was approximately 0.5 m³/day, which is 30% lower than the predicted discharge in the FEIS Addendum (0.7 m³/day) as result of the slight reduction in the deep bedrock hydraulic conductivity.

Because the IVR Pit Lake and Whale Pit lakes will be maintained at the same elevation and directly connected following reflooding of the pit lakes and the North Basin of Whale Tail Lake, lateral movement between the two pit lakes is expected to be negligible.

7.0 SUMMARY AND CONCLUSIONS

Field data collected in November and December 2018, and the updated thermal analysis, supports the conceptual and numerical models developed for the FEIS Addendum for the Expansion Project. This work supports that:

- A downward vertical hydraulic gradient is present in the area of Whale Tail pit. This indicates that the prediction of the Whale Tail Pit and IVR Pit lakes being a groundwater recharge boundary is reasonable.
- That a closed talik is present in the northern portion of Whale Tail Lake and open talik is present in the southern portion of Whale Tail Lake.
- The hydraulic conductivity adopted in the Expansion Project FEIS for the EA Scenario was conservative for the prediction of groundwater effects. Subsequent packer testing indicates the deep sub-permafrost bedrock is lower than what was assumed in the FEIS, which resulted in updated predicted inflows and TDS quality in the underground being lower than what was previously predicted in the FEIS.

Considering the supplemental data collection and thermal modelling, updated predictions of groundwater inflow quantity and TDS were provided for two scenarios:

- Base Case – Most likely estimate of hydrogeological parameters based on hydraulic testing. These predictions represent the best estimate of groundwater inflow and groundwater salinity based on the measured data. The Base Case is used to understand what groundwater conditions are likely to be but is not carried forward in the Site Wide Water Balance Model as it is not conservative for the assessment of environmental effects.

- EA Scenario – Hydraulic conductivity values adopted in the EA Scenario consider the available field measurements of hydraulic conductivity and sensitivity analyses that consider uncertainties in these parameters. The EA Scenario is designed to be a reasonable, yet more conservative, assessment of potential groundwater inflow quantity and quantity such that the potential effects of the Expansion Project on groundwater flow can be assessed. Results from the EA Scenario are used in the Water Balance and Water Quality model for the Expansion Project.

Mining

Groundwater inflow predictions during mining conservatively assumes that no freeze-back will occur in the pit walls. This assumption was adopted for Whale Tail Pit because during the first few years of mining, the pit will be both widened and deepened, resulting in the continual exposure of unfrozen bedrock. During the later years of mining; however, the pit development will be entirely within the permafrost and significant freeze back in the pit walls is considered possible and has been observed at Meadowbank. Although not simulated, if freeze back does occur as is the case at Meadowbank, actual groundwater inflow to the pit could be substantively lower than the predicted values.

For the Base Case Scenario, groundwater inflow to the Whale Tail Pit is predicted to increase from an average of 970 m³/day in 2019 to 1,340 m³/day in 2022 to 2025 and the TDS concentration of the inflow is predicted to decrease from 120 mg/L in 2019 to 10 mg/L in 2025². The groundwater inflow to the Underground is predicted to increase from 20 m³/day in 2020 to 180 m³/day in 2023 and then decrease to 130 m³/day in 2025. The predicted TDS concentration in the Underground inflow is predicted to increase from 3,880 mg/L in 2020 to 7,760 mg/L near the end of mining.

For the EA Scenario, groundwater inflow to the Whale Tail Pit is predicted to increase from an average of 970 m³/day in 2019 to 1,350 m³/day in 2025 and the TDS concentration in the inflow is predicted to decrease from 120 mg/L in Q4 of 2019 to 10 mg/L in 2025¹. The groundwater inflow to the Underground is predicted to increase from 60 m³/day in 2020 to 4200 m³/day in 2023 and then decrease to 340 m³/day in 2025. The predicted TDS concentration in the Underground inflow is predicted to increase from 4,120 mg/L in 2020 to 10,180 mg/l in 2025.

The groundwater inflow to the Whale Tail Pit is similar for both the EA and Base Case Scenarios as a conservatively high estimate of hydraulic conductivity in the shallow weathered bedrock was adopted for both scenarios. Because the shallow bedrock is unchanged from the values used in the FEIS Addendum modelling, the predicted inflows to Whale Tail pit is unchanged from the FEIS addendum.

For the deeper bedrock, where a smaller data set were available, a conservatively higher hydraulic conductivity was assumed in the EA Scenario relative to the Base Case (See Table 1). The predicted groundwater inflows and predicted TDS concentration to the Underground are therefore higher in the EA Scenario. The higher TDS is associated with increased predicted upwelling of deeper more saline groundwater beneath the Underground.

² TDS predictions only account for TDS loading from groundwater and not loading from the Attenuation Pond and South Whale Tail lake. Loading from these sources was accounted for in the Site Wide Water Quality model.

Relative to the FEIS Addendum dataset, additional testing has been conducted that indicates that the deeper bedrock hydraulic conductivity is lower than was assumed in the FEIS addendum; predicted inflows to the Underground in this updated assessment are therefore 13 to 20% lower at the end of mining relative to the FEIS addendum modelling for the Base Case and EA Scenario respectively. TDS concentrations in the inflow to the underground were similar to the FEIS addendum modelling for the Base Case and between 2 to 9% lower than the FEIS addendum modelling for the EA Scenario.

Flooding

Following mining, reflooding of Whale Tail Pit and Underground will begin dissipating the steep hydraulic gradients that developed during mining around the mine workings. By the end of refilling, both the Whale Tail Pit Lake and the Underground are predicted to be sources of groundwater recharge.

During pit-reflooding, the Whale Tail Pit walls were assumed to be frozen at the start of closure (end of mining), which restricts the inflow of groundwater to the pit lake until the pit lake water level rises and thaws the pit walls. This is considered reasonable as during the later years of mining, the pit development is limited to within the permafrost below Whale Tail Lake. If the pit walls do not remain frozen or melt seasonally, higher inflows than predicted could occur resulting in a shorter pit-filling period. Freeze-back was not assumed during mining to conservatively predict the potential inflows to the pit (groundwater inflows would substantively lower with freeze-back); freeze-back was assumed for reflooding to conservatively predict the length of time it could take to refill Whale Tail Pit (a shorter filling schedule would be predicted without freeze-back).

For the Base Case, the groundwater inflow to the pit lake is predicted to increase from 10 m³/day in 2030 to approximately 1160 m³/day in 2036 as the pit walls progressively thaw and connect to the permeable weathered bedrock. Similar flow rates are predicted for the EA Scenario, where groundwater inflow to the pit lake is predicted to increase from 20 m³/day in 2030 to approximately 1,170 m³/day in 2036 as the pit walls progressively thaw and connect to the permeable weathered bedrock. As the pit lake water level rises further in elevation, the groundwater inflows for both scenarios decrease and eventually the pit lake becomes a groundwater recharge boundary (i.e., the pit lake starts to recharge the regional groundwater flow system). Because the shallow bedrock is unchanged from the values used in the FEIS Addendum modelling, the predicted inflows to Whale Tail pit is unchanged from the FEIS addendum.

The reflooding of the Underground is expected to occur over a very short period (i.e. the bottom 500 m will be reflooded in the first year). At the start of reflooding, a small flux of groundwater inflow is predicted to discharge to the Underground. Over time, as hydraulic gradients near the Underground dissipate, the Underground switches to a groundwater recharge boundary. At the end of the flooding, the Underground is predicted to remain a source of groundwater recharge for both the Base Case and EA Scenarios. These predicted inflows are similar to or lower than those predicted in the FEIS Addendum (0 to 70 % lower than the FEIS values depending on the pit lake elevation).

Fully Flooded Mine

Although the Whale Tail Pit Lake and IVR Pit are connected following full flooding, the groundwater flow conditions surrounding the pit lakes are initially very different. The Whale Tail Pit lake is predicted by thermal analysis to be connected to the deep sub-permafrost groundwater flow system during refilling, and the permafrost below the pit lake to fully degrade over 50 years. The IVR Pit lake is predicted to be within permafrost during refilling and the permafrost below the pit lake to fully degrade over 1000 years. The long-term groundwater recharge from the Whale Tail and IVR Pit lakes is predicted to be minimal; 1.5 m³/day and 0.5 m³/day, respectively.

Because the IVR Pit Lake and Whale Pit lakes will be maintained at the same elevation and directly connected following reflooding of the pit lakes and the North Basin of Whale Tail Lake, lateral movement between the two pit lakes is expected to be negligible.

8.0 CLOSURE

We trust this document satisfies your current requirements. If you have any questions or require further assistance, please do not hesitate to contact the undersigned.

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Associate, Senior Hydrogeologist

JL/DC/r

https://golderassociates.com/files/102627/technical%20work/02_hydrog-modelling/01_report/rev0/16108905-291-tm-updated-hydrogmodel_rev0.docx

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PERMIT TO PRACTICE GOLDER ASSOCIATES LTD.	
Signature	
Date	6 May 2019.
PERMIT NUMBER: P-049	
NT/NU Association of Professional Engineers and Geoscientists	

APPENDIX B –2018 WESTBAY SYSTEM GROUNDWATER MONITRORING INVESTIGATION

TECHNICAL MEMORANDUM

DATE February 8, 2019

Project No. 1789310-244-TM-Rev0

TO Michel Groleau
Agnico-Eagle Mines Ltd.

FROM Valerie Bertrand, Dale Holtze, Jennifer Levenick

EMAIL vbertrand@golder.com

2018 WESTBAY SYSTEM GROUNDWATER MONITORING INVESTIGATION

1.0 INTRODUCTION

Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle) is developing the Whale Tail Pit Project that was approved by the Nunavut Impact Review Board (NIRB). The property is a 408 square kilometre (km²) site located on Inuit Owned Land approximately 150 kilometres (km) north of the hamlet of Baker Lake and approximately 50 km northwest of the Meadowbank Mine in the Kivalliq Region of Nunavut.

As part of the Approved Project baseline studies, groundwater samples were collected from a Westbay monitoring well installed in borehole AMQ16-626, drilled in March and April 2016 targeting the area of the talik zone below Whale Tail Lake near future mine developments. Agnico Eagle retained Nuqsana Golder Engineering and Environmental Inc. (Nuqsana Golder) to complete a groundwater monitoring program in November 2018. The objective of the program was to obtain additional pre-development hydraulic head and groundwater quality data in support of the Whale Tail Pit Project Certificate No. 008, Term and Condition No. 15 (TC15) (NIRB 2018).

This technical memorandum provides an interpretation of the data collected from AMQ16-626 in November 2018 with respect to hydraulic gradients and groundwater quality. The collected data was reviewed in the context of conceptual and numerical model predictions for the Whale Tail Pit Project to evaluate if follow-up assessment is required (i.e., if significant differences in the model assumptions or predictions was indicated by the collected data).

2.0 BACKGROUND

2.1 Westbay Well Installation

A Westbay groundwater well system was installed on site between March and April in 2016 to obtain groundwater quality and verify the vertical hydraulic gradient within the talik zone of Whale Tail Lake, in the area of future mine development, to define future effects of the mine workings on the groundwater flow regime and overall site water quality from development to post-closure.

The well was installed in the purpose-specific borehole (AMQ16-626) which was drilled at an inclination of -69 degrees, an azimuth of 152.6 degrees and advanced to a depth of 499 m along the borehole, through massive diorite throughout the borehole. The Westbay well was designed to tap discrete zones of unfrozen bedrock and, if encountered, zones of higher hydraulic conductivity that were observed during drilling and well testing conducted prior to well installation. Six sampling ports were installed at and below the depth of anticipated ramp development (0 to 385 metres below ground surface [mbgs]), listed in Table 1. Borehole drilling, packer test results along the borehole and well installation details are documented in another report (Golder 2016b). A schematic of the Westbay well instrument that was installed in borehole AMQ160626 is included in Appendix A for reference.

Table 1: Borehole AMQ16-626 Westbay System Zones

Sampling Interval	Depth Along Borehole			Interval Depth Vertical Depth		
	From	To	Length	From	To	Thickness
	(mah)	(mah)	(m)	(mbgs)	(mbgs)	(m)
Zone 6	276	287.4	11.4	257.7	268.3	10.6
Zone 5	298.9	310.3	11.4	279.0	289.7	10.6
Zone 4	349.3	359.1	9.8	326.1	335.2	9.1
Zone 3	381.3	392.7	11.4	356.0	366.6	10.6
Zone 2	440.8	452.2	11.4	411.5	422.2	10.6
Zone 1	488.1	499.0	10.9	455.7	465.9	10.2

Notes: Depth values were provided by Westbay Instruments Completion Report.

m = metres; mah = metres along the hole, relative to ground surface; mbgs = metres below ground surface.

Upon completion of the installation in 2016, the well was used to collect groundwater samples from select intervals that were within and below the proposed development; Ports 3, 4, and 6 ranging in depths from 276 m to 392 m. Sampling methods, data interpretation and water quality results were presented in Golder 2016a. The total dissolved solids (TDS) content in the Formation groundwater was determined to range between 3,198 mg/L and 4,042 mg/L (Golder 2016a).

The groundwater quality were used to predict groundwater inflow quantity into future mine developments (Golder 2016d), which were used as input to operational and post-closure hydrogeological and permafrost models (Golder 2018a) and into the Whale Tail pit lake hydrodynamic model (Golder 2018b). These models were ultimately used to assess effects of hydrogeological processes on site contact water quality during development, operations and closure and on pit lake water quality during closure and post-closure.

The results of the compendium of these studies for the Whale Tail Pit Project indicated that mass transfer from the pit to the pit lake is very low, that groundwater seepage into and out of the pit lake are negligible in volume, particularly compared to surface water exchanged annually post-closure when flows are re-established based on average climate year watershed runoff. The combination of results corroborates to support that the hydrogeological regime around the pit lake is not critical to pit lake water quality post-closure.

The data collected as part of the 2018 monitoring program aim to add to the pre-operational database of results and to verify model inputs and model outcomes obtained to date.

2.2 The Groundwater Monitoring Program

The 2018 groundwater monitoring program was completed to support the requirements of the Groundwater Monitoring Program stated in TC15 (NIRB 2018). TC15 requirements were as follows:

Subject to the additional direction and requirements of the Nunavut Water Board, the Proponent shall prepare and implement a Groundwater Monitoring Plan that, at a minimum includes:

- *The collection of additional site-specific hydraulic data (e.g., from new monitoring wells) in key areas during the pre-development, construction and operation phases;*

- *Definition of vertical and horizontal groundwater flows in the project development areas;*
- *Delineates monitoring plans for both vertical and horizontal ground water; and*
- *Thresholds that will trigger the implementation of adaptive management strategies that reflect site-specific conditions encountered at the project site.*

The groundwater monitoring program documented in this technical memorandum consisted of measurements of hydraulic head (vertical gradients) and sampling of the formation groundwater to evaluate groundwater quality with depth.

2.3 Thresholds for Additional Assessment or Adaptive Management

Groundwater monitoring data being collected in the pre-development phase is being compiled into a Project-specific data and will be used in combination with future data collected during operational and closure phases of the Project to evaluate trends in groundwater data with respect to pit inflow quantity and quality.

Measured groundwater inflow rates and groundwater quality will be compared to model predictions on an annual basis. If significant variations from model predictions are observed, the assumptions behind the data will be reviewed and the analysis updated if required. In addition, updates to the groundwater model will be made if operational changes occur as the open pit advances which could significantly alter groundwater inflow or quality.

Variations that would be considered significant include:

- Groundwater inflows to the mine, based on rolling monthly average of inflow over six consecutive months, is 20% higher than predicted groundwater inflow.
- Collected water samples that indicate that the concentration of total dissolved solids (TDS) is more than 25% higher than the estimated water quality.

If the above variations are observed, the groundwater data (quantity and quality) would be assessed to evaluate trends, the potential causes of the greater than expected groundwater inflow quantity or quality, and the potential for long-term effect associated with the groundwater flow or quality. If the greater than predicted flows were correlated to a short-term effect such as freezing in the pit walls, changes in mining rate, freshet or transient drainage of a high storage feature, then further reassessment of groundwater inflows may not be required, and the adaptive management of these short-term effects would be evaluated under the Water Management Plan.

If the greater than predicted flows or quality would be considered as potentially long term, consideration will be given to reviewing the model calibration. The six-month averaging period of observation is based on observed seasonal variations in inflow quantities in mines situated in permafrost regions.

If model re-calibration is deemed necessary, future groundwater inflow quantity and quality would be predicted using this re-calibrated model and new results will be considered as part of the adaptive management of the groundwater quantity contribution to the Water Management Plan.

Modification of groundwater management strategies: the ponds, sumps and water conveyance strategies around the pit can be modified to mitigate the effect of additional groundwater volume or salinity prior to treatment and discharge. The water conveyance strategy will be evaluated and optimized during operations and closure to maintain post-closure commitment.

Groundwater monitoring data collected at this stage is representative of the pre-development condition of the project, and therefore an evaluation of trends in flow quantity and quality is not possible for the operational and closure phases. Results of the monitoring has been compared to assumptions adopted in the initial conditions for groundwater conceptual and numerical models and has been used to assess if the post-closure predictions are likely reasonable in consideration of the observed vertical hydraulic gradients and flow directions in the November 2018 monitoring program.

3.0 2018 GROUNDWATER MONITORING PROGRAM

3.1 Objectives

The objectives of the program are as follows:

- To collect site specific hydraulic head data during Project pre-development through the measurement of the hydrostatic pressure profile from the existing Westbay well.
- Assess the vertical hydraulic gradient and groundwater flow direction in that location of the Whale Tail Lake talik.
- Collect groundwater samples from the Westbay Well for chemical analysis, adding to the database of groundwater quality results.
- Compared water quality results to the threshold adopted for additional assessment and adaptive management.

3.2 Monitoring Methods

3.2.1 Hydraulic Head Measurements and Assessment of Vertical Hydraulic Gradients

Hydraulic heads were derived from the formation pressures measured at each monitoring port installed along the Westbay system. The formation pressure for each monitoring port was measured on November 9, 2018 using the Mosdax sampler manufactured and supplied by Westbay Instruments (refer to Appendix B for instrument calibration record).

3.2.2 Groundwater Sampling

Groundwater samples were collected from fixed ports in the Westbay well system that are positioned at different intervals along the hole to assess baseline groundwater chemistry with depth. Ports 6, 4 and 3, which are located within the anticipated ramp development zone (0 to 385 m), were targeted for sampling because these intervals had been previously developed (drill water had been largely removed from the interval) in 2016. Port 2 was also sampled although it was less developed than the other sample intervals in 2016 in order to verify if the aquifer was naturally flushed of the drilling water. Information on each of the Ports that were purged is presented in Table 2.

Fluorescein tracer was added to the 2016 drilling water to differentiate between the drilling fluid and the formation water. It is assumed that the only source of fluorescein was introduced during the 2016 drilling activities of borehole AMQ16-626 such that it is a reliable tracer of introduced water into the Formation.

Table 2: 2018 AMQ16-626 Westbay Well Development and Groundwater Sampling Information

Sample Port	Sampling Interval (mah)		Volume of Water Removed in 2018 (L)	Sample Date	Groundwater Parameters at Sampling Period (field measured)			
	From	To			Residual Fluorescein (ppb)	Conductivity (mS/cm)	TDS (ppm)	pH
6	276.0	287.4	8.25	13-Nov-18	83.54	9.02	4543	6.37
4	349.3	359.1	13.25	11-Nov-18	66.21	14.56	7275	7.50
3	381.3	392.7	12.5	12-Nov-18	100.05	7.50	3765	8.33
2	440.8	452.2	6.25	10-Nov-18	73.30	17.52	8825	8.90
1	488.1	499.0	0.25	not sampled	-	-	-	-

m = metres, mah = metres along hole, relative to ground surface; L = litres, TDS = total dissolved solids

Throughout the development and upon water sample collection, field chemical parameters (pH, conductivity, TDS, fluorescein content and temperature) were measured in order to track the fluid introduced into the Formation by drilling and to follow the removal of this fluid from the Formation during development and sampling of groundwater. Fluorescein content was measured using the AquaFluor handheld Fluorometer manufactured by Turner Designs. Temperature, pH, TDS and electrical conductivity values were measured with a Hanna Combo tester (HI 98130). A drilling water content of less than 5% (estimated using fluorescein content) is targeted in order to provide a reliable estimate of formation groundwater quality. Higher residual drilling fluid content can be used for this purpose but decreases the precision of the calculation of groundwater quality.

Groundwater sampling was preformed using the Westbay Mosdax sampler in a similar fashion as the initial development and sampling program completed in 2016. The Mosdax sampler collects 1 Litre of groundwater at a time (per sampling instrument descent into the well); multiple sampler runs were carried out to collect one complete groundwater sample set from each interval. Calibration reports of the Mosdax sampler probe are included in Appendix B.

Groundwater samples were collected from Intervals 6, 4, 3, and 2 in triplicate. Groundwater samples were filtered and preserved in the field, as required, and collected in laboratory-supplied bottles which were packed and shipped to the analytical laboratory following the collection of each sample. Duplicate samples collected from Ports 6, 4, 3, and 2 were submitted for analysis, while the third sample set was kept on site as backup and disposed of upon receipt of the samples by the analytical laboratory. An equipment and field blank were also collected for quality assurance/quality control (QA/QC) purposes. Analysis of general chemistry was completed at ALS Environmental (ALS) in Vancouver for the following parameters:

- Physical tests, including hardness, pH, conductivity, total suspended solids and total dissolved solids
- Anions and nutrients, including alkalinity, ammonia, bicarbonate, bromide, carbonate, chloride, fluoride, nitrate, nitrite, phosphorus (total and dissolved) and sulphate
- Metals (dissolved and total), including aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, mercury, molybdenum, nickel, selenium, silicon, silver, sodium, strontium, sulfur, tellurium, thallium, tin, titanium, uranium, vanadium and zinc. Additional metals were also analyzed by the analytical laboratory as part of the metals package, however they are not of interest to the project and will not be discussed herein out: cesium, rhenium, rubidium, sulfur, thorium, tungsten, yttrium and zirconium

Certificates of analysis from ALS are included in Appendix C.

3.3 Evaluation of Formation Water Quality

To properly assess the quality and salinity of true rock formation groundwater, the drilling fluid present in the sampling interval must be removed as much as possible by purging. The amount of drilling fluid present in the Formation is estimated from the concentration of fluorescein in the raw groundwater sample at each interval, compared to the fluorescein content of the drilling fluid used during drilling of the borehole. In 2016 upon well installation, the sampling intervals were purged to remove as much of the drilling fluid as possible within the task schedule, prior to collecting a sample for chemical analysis.

In 2018, the fluorescein, electrical conductivity and TDS of groundwater was monitored during sampling and compared to data from the end of development in 2016 to assess whether the interval remained purged and still reflected true Formation groundwater quality. Fluorescein and conductivity were within the range of values recorded in 2016 and groundwater samples were collected and submitted for chemical analysis.

The following summarizes the calculations made to estimate true Formation water quality and TDS from field measurements of electrical conductivity and laboratory analytical results of raw groundwater samples in 2018 and drilling water fluid in 2016.

- 1) **Estimation of the chemistry of the drilling fluid introduced in the Formation during the 2016 well borehole drilling and installation activities.** The drilling fluid consisted of very low TDS lake water to which was added a concentrated brine. The range of composition of the drill fluid (the dilute brine) was estimated by comparing both the initial and maximum conductivity values measured in samples from the Formation (for each port 6, 4, 3, and 2; conductivity varied between sampling ports) against the conductivity of the concentrated brine¹. This Dilute Brine Factor was used to calculate composition of the drilling fluid introduced into the sampling interval during the 2016 drilling and well installation activities as per equation (1) below.

$$(1) \quad \text{Dilute Brine Factor}_{\text{port } i} = \frac{\text{Field Conductivity}_{\text{port } i}}{\text{Brine Conductivity}_{\text{calculated}}}$$

This calculation assumes an insignificant proportion of formation water is present immediately after drilling, which is a fair assumption given that a high volume of drilling water was lost to the Formation (Golder, 2016a).

The drilling brine composition for each parameter was calculated from the product of the dilution brine factors and the chemistry of the drilling brine fluid for each port per equation (2).

$$(2) \quad \text{Dilute Brine}_{\text{port } i} = \text{Laboratory Result}_{\text{Brine}} \times \text{Dilution Brine Factor}_{\text{port } i}$$

- 2) **Calculation of the proportion of drill brine remaining in the Formation upon sampling.** This was calculated based on the amount of residual fluorescein measured upon sample collection at each port in 2018 compared to the initial fluorescein content of the drilling fluid measured in 2016 (i.e. 512.7 ppb).
- 3) **Removal of the drilling fluid chemistry from the raw groundwater sample analysis.** The concentration of constituents from the drilling fluid are removed from the reported analytical results for each chemical constituent per the below equation (3). The November 2018 laboratory results are provided in Appendix C.

$$(3) \quad \text{Groundwater Quality}_{\text{calculated}} = \text{Laboratory Result} - \frac{\text{Proportion of Drill Brine} \times \text{Dilute Brine Chemistry}}{\text{Proportion of Formation Water}}$$

¹ Brine conductivity was estimated from the calculated TDS of the drilling brine fluid using a conversion factor of 0.75 which is appropriate for brine solutions (Rusydi, 2017). Brine TDS was calculated based on constituent concentrations (refer to Table 3 and Appendix C). Laboratory-reported TDS and conductivity were not reliable as they exceeded instrument calibration.

The estimated drilling brine chemistry, proportion of residual drilling brine and Formation water for each sampling port are summarized in Table 4. The calculated groundwater quality for Ports 6, 4, 3 and 2 are summarized in Table 5.

4.0 RESULTS AND DISCUSSION

4.1 Hydraulic Head Profile and Groundwater Flow Direction Below Whale Tail Lake

The planned Whale Tail Pit sits within the closed talik below the North Basin of Whale Tail Lake. The closed talik is inferred to transition to open talik below the South Basin due to the increased width and depth of the lake towards the south. The water table below both basins will be equivalent to the lake surface elevation.

Permafrost underlies the land surrounding the lake, which restricts the lateral flow of groundwater to the talik and restricts the recharge of the sub-permafrost groundwater flow system by precipitation. Groundwater flow is controlled by surface water elevations in lakes with open talik; water moves vertically through the open talik to the underlying sub-permafrost groundwater flow system. In effect, lakes with open taliks in continuous permafrost regions are equivalent to large monitoring wells.

AMQ16-626 was installed to evaluate groundwater quality in the unfrozen bedrock and to verify the hydraulic gradient that exists below Whale Tail Lake. The hydraulic gradient, in combination with the bedrock hydraulic conductivity, will control the potential flux to or from Whale Tail Lake, and the flooded Whale Tail Pit post-closure.

Table 3 summarizes the calculated hydraulic heads based on the measured pressure in each of the ports. Although Zone 6 (shallowest port) is included in Table 3, it is suspected that this port may be in permafrost or near the permafrost contact, which could affect the measured hydraulic head. This inference is supported by the measured formation temperature, which is less than zero. Although the measured hydraulic head in the shallowest port is consistent with the overall trend, data from the deeper ports, which are confirmed to be in unfrozen rock by the formation temperature, were used to assess the vertical gradient.

Table 3: AMQ16-626 Westbay Well Hydraulic Heads and Formation Temperatures (November 9, 2018)

Port/ Zone	Measurement Interval (mah)		Measurement Interval (mbgs)		Port Depth (mah)	Port Depth (mbgs)	Calculated Depth to Water (mbgs)	Calculated Hydraulic Head (masl)	Formation Temperature (°C)
	From	To	From	To					
6	276.0	287.4	257.7	268.3	276.2	257.9	1.9	154.0	-0.17
4	349.3	359.1	326.1	335.2	349.5	326.3	1.6	153.6	0.24
3	381.3	392.7	356.0	366.6	381.5	356.2	1.1	153.4	0.36
2	440.8	452.2	411.5	422.2	441.0	411.7	0.9	152.9	0.87
1	488.1	499.0	455.7	465.9	488.3	455.9	0.5	152.6	1.29

Source: Golder (2016a).

m = metres; mah = metres along hole relative to ground surface (borehole angled to surface); mbgs = metres below ground surface (vertical down from surface); masl = metres above sea level (elevation)

The data collected at AMQ16-626, indicates the presence of a downward hydraulic gradient. Assuming the measured hydraulic head is representative of the midpoint of the measurement interval, the downward gradient between Port 1 and Port 4 is 0.008 m/m. This gradient is consistent with the estimated gradient derived from looking at the relative elevation of Whale Tail Lake and DS1 (0.008 m/m), as reported in Agnico Eagles response to TC15 (Agnico Eagle 2018). DS1 is the predicted receptor from water in the area of Whale Tail Pit and Underground (Golder 2016c).

For the depth interval over which the hydraulic head was measured (326 to 456 mbgs), the estimated hydraulic conductivity of the bedrock for the FEIS for the Whale Tail Pit Project was 1×10^{-8} to 3×10^{-8} m/s (Golder 2016c). In support of TC15 and the development of the Project, additional packer testing was conducted subsequent to the FEIS and the data indicate the hydraulic conductivity of bedrock over this depth interval is likely lower (1×10^{-9} m/s based on the geometric average of the test data) (Golder 2018a). Considering the measured gradient (0.008), the historical range of bedrock hydraulic conductivity adopted in the FEIS (1×10^{-8} to 3×10^{-8}) and the now refined hydraulic conductivity (1×10^{-9} m/s) and an assumed effective porosity of 0.001 (Maidment 1992; Stober and Bucher 2007), the estimated downward groundwater flow velocity is between approximately 0.25 m/yr and 8 m/yr. The lower bound of this range is considered more reasonable, as it uses the refined hydraulic conductivity data discussed above, which is based on the geometric mean of all the packer test measurements (pre- and post-FEIS).

Gradients measured during this monitoring program are considered a reasonable interpretation of what long-term gradients could be post-closure following the formation of the pit lake. Recharge and discharge from the base of Whale Tail Lake or a flooded pit lake will be controlled by the vertical hydraulic gradients and the bedrock hydraulic conductivity near the base of the permafrost. Considering the approximate area of the Whale Tail Pit (0.5 km^2), the range in bedrock hydraulic conductivity (1×10^{-9} to 3×10^{-8} m/s), and the measured downward gradient (0.008), the data would indicate long-term groundwater flux would be approximately $0.3 \text{ m}^3/\text{day}$ to $11 \text{ m}^3/\text{day}$. Similar to the estimated groundwater velocity, the lower bound of this range is considered more reasonable, as it uses the refined estimate of hydraulic conductivity. Overall, the estimated flux is similar to the long-term predicted discharge from the pit lake at post-closure ($1.7 \text{ m}^3/\text{day}$; Golder 2016c) and supports the conclusion in the FEIS that long-term predicted flows from the pit lake to the groundwater flow system will be negligible relative to the surface water exchange into the pit lake (Golder 2018c).

4.2 Groundwater Quality

Field measurements of electrical conductivity and fluorescein concentration serve, in part, to evaluate whether the groundwater accessed via the Westbay well sampling ports continues to be representative of Formation groundwater quality.

The 2016 and 2018 electrical conductivity and fluorescein trends measured throughout the sampling program in Ports 6, 4, 3, 2, and 1 are summarized in Figures 1 and 2, respectively. Groundwater samples were collected from Ports 6, 4, 3, and 2. Port 1 groundwater quality was deemed not representative of Formation groundwater and was not sampled. The field measurements of electrical conductivity, TDS and fluorescein recorded at the time of sampling are summarized in Table 3. The values are averages from the subsamples collected to obtain the required volume of water for analysis.

Port 6

The temperature measured by the Mosdax sampler during the pressure profile and sampling at Port 6 was below zero ($-0.17 \text{ }^{\circ}\text{C}$, refer to Table 3) and slush was present in the sampling canister from this Port. The cryopeg zone (temperature below 0 degrees, but not frozen) is interpreted to extend to at least 258 m depth (top interval of Port 6) within the vicinity of the Westbay well. Groundwater from the cryopeg (Port 6) could have a heterogeneous composition (non-saline ice and slightly saline groundwater) where free water is primarily transmitted through the more permeable unfrozen zones. Groundwater collected from Port 6 is interpreted to be located within the cryopeg have the potential to yield variable water quality even following periods of sufficient development.

Notwithstanding this, the estimation of true Formation groundwater quality was still completed per the method described in Section 2.3. Table 5 presents the minimum and maximum range of calculated concentrations of formation water at each port sampled in 2018 and 2016 for comparison.

The 2018 field-measured groundwater fluorescein content and electrical conductivity at the port remained within the same range albeit slightly higher than values recorded at the end of the well development period in 2016. This suggests that groundwater quality at that location remained representative of true Formation water since it was last sampled in 2016. The results of the 2018 groundwater quality estimation (Table 5) are also within the same order of magnitude but slightly higher than those reported in 2016 suggesting that residual drilling brine fluid is still present in Formation water at a proportion slightly higher than at the end of development in 2016. This can occur where drilling fluid that is still present in undeveloped zones in the aquifer (for example, in zones between sampling Ports) migrates back into the developed zones tapped by the sampling Ports following the normal movement of groundwater along the downward vertical gradient.

The estimated Formation groundwater minimum and maximum TDS concentrations in 2018 are 25% and 38% higher than the minimum and maximum TDS values estimated in 2016. The difference is higher than the TDS variability threshold of 25%. This is attributed to the higher proportion of drilling brine fluid in the Formation at Port 6 collected in 2018.

Arsenic concentration in groundwater at Port 6 is estimated to be low based on 2018 calculations, within the range of 2016 estimation.

The 2016 data is considered potentially more accurate, but 2018 data is still valid. The initial model input is still considered accurate and the new data does not warrant revising the conceptual model of groundwater TDS.

Ports 3 and 4

The 2018 field-measured groundwater fluorescein content and electrical conductivity at these sampling ports were similar (slightly higher) to measured values recorded at the end of the well development period in 2016, suggesting that groundwater quality remained representative of true Formation water at these zones. These slightly higher 2018 readings suggest that a small influx of drilling fluid that was still present in undeveloped zones migrated back into the developed zones as for Port 6. The higher proportion of drilling brine fluid in the Formation and in the samples collected may result in a lower accuracy of calculated groundwater quality from samples collected in 2018 compared to those collected in 2016 after a more complete purge; nonetheless, the data is still considered valid.

Figure 2 illustrates how electrical conductivity and fluorescein concentrations evolved in parallel during the short development period at Ports 3 and 4, inferring that groundwater in the vicinity of the Westbay well has not been affected by an outside brine source that could have originated from salt water used in exploration drilling nearby, approximately 26 metres from the Westbay well.

Estimated true Formation groundwater quality is shown in Table 5 presenting the minimum and maximum range of calculated concentrations of Formation water at each port sampled in 2018 and 2016. The results of the 2018 groundwater quality data are within the same order of magnitude to those reported in 2016 albeit slightly higher than in 2016. Port 3 minimum and maximum estimated TDS values are 35% and 28% higher than the calculated minimum and maximum values from 2016 data. At Port 4, they are 76% and 86% higher than the calculated minimum and maximum values from 2016 data. Variability is higher than the threshold of 25%. This is attributed to the higher proportion of drilling brine fluid in the Formation collected in 2018 compared to 2016.

Arsenic concentrations at both Ports 4 and 3 are estimated to be in the same order of magnitude as concentration ranges calculated in 2016.

The 2016 data is considered potentially more accurate, but 2018 data is still valid. The initial model input is still considered accurate and the new data does not warrant revising the conceptual model of groundwater TDS.

Port 2

Due to time constraints in 2016, this Port had not been extensively developed, leaving a higher proportion of drilling brine in the groundwater prior to sampling. A groundwater sample was collected in 2018 to verify the progression of water quality at that location; to assess whether drilling brine might have flushed out of the horizon since 2016 through natural groundwater flow. The 2018 field-measured groundwater fluorescein content and electrical conductivity were within a similar range than after development in 2016. Values were slightly lower than in 2016 but the trend was rising throughout the brief purging period in 2018. Electrical conductivity and fluorescein progressed at different rates during purging (conductivity rose faster than fluorescein; Figure 2) suggesting interference by a source of saline water that is not tagged with fluorescein, such as possibly, adjacent exploration borehole drilling water. Given the continued high proportion of drilling brine potentially mixed with another source of saline water that cannot be quantified at this time, a proper estimation of true Formation groundwater quality is not deemed possible for from this Port.

Summary

The higher TDS values calculated at Ports 6, 4, and 3 in 2018 are above the threshold value of 25%. These higher values are attributed to the presence of a higher content of non-Formation drilling brine in groundwater in 2018 compared to 2016. Consequently, the initial model input is still considered accurate and the new data does not warrant revising the conceptual model of groundwater TDS.

Arsenic concentration at all sampling ports is still low, the maximum calculated to be at Port 6 measured in 2016. Based on the results of the groundwater sampling completed to date, arsenic presence is low in the formation water.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

Groundwater samples were collected from each interval in triplicate and submitted in duplicate for analysis to the analytical laboratory as part of the quality assurance/quality control ('QA/QC') protocol. In addition, field and equipment blanks were also submitted for analysis of select parameters. The analytical laboratory performs equipment blanks as a method of internal QA/QC verification.

Analytical repeatability was tested by assessing the similarity between duplicate pairs of results. For each duplicate pairs of analysis where both results were higher than 5 times the method detection limit (MDL), the relative percent difference (RPD) was calculated as follows:

$$RPD = \frac{\text{absolute [difference (concentration of a given parameter)]}}{[\text{average (concentration of a given parameter)}]} \times 100$$

Per USEPA recommended methods (USEPA, 1994), an RPD of 20% or less was considered acceptable. Where one or both results of the duplicate pair were less than 5 times the MDL, a margin of +/- MDL was considered acceptable.

Table 6 presents the RPD or +/- MDL value calculated from the duplicate pair of results. Approximately 50% of duplicate pairs of analyses had one or both results below the method detection limit and consequently could not be assessed for repeatability. QA/QC results for the duplicate samples were within acceptable tolerance limits (RPD or +/- MDL) with the exception of duplicate concentrations of total suspended solids in Port 4 as well as duplicate concentrations of total chromium and nickel in Port 3. Trace components and major elements for all samples are considered adequately repeatable.

Groundwater samples were analyzed for TDS in the field and in 2018 by the analytical laboratory (ALS). The original brine fluid was analyzed by Multilab analytical laboratory. TDS values were also calculated from the laboratory results in order to assess potential discrepancies between the ionic balance and uncertainty of the results (refer to Tables 4 and 6). The results of the field, calculated, and laboratory measured values were within reasonable range limits for all

samples, with the exception of the brine fluid. The TDS result reported for the brine fluid (36,946 mg/L) was significantly less than the calculated value (130,500 mg/L). The laboratory measured TDS and consequently electrical conductivity (55.42 mS/cm) of the brine fluid were deemed unreliable due to the ionic imbalance discrepancy. This assumption was confirmed during a telephone discussion between Nuqsana Golder and the analytical laboratory (H2Lab, formerly Multilab chemist Jean-Francois Bouffard) on January 15, 2019, where the chemist indicated the TDS and electrical conductivity values reported for the brine fluid were outside the suitable range for the analytical instrument and may not be accurate. The certificate of analysis for the brine fluid is included in Appendix D. The calculated TDS of the brine fluid was used to correct the groundwater quality data as discussed in Section 2.3 of the report.

Uncertainty in the calculated groundwater water quality results from the variability in drill water composition augmented by probable mixing between aquifer zones having different levels of development (purging of drill water); this has a higher potential influence on the accuracy of 2018 calculated groundwater quality because of the higher proportion of drilling brine fluid remaining in the raw water samples compared to 2016 samples; thus while 2018 data remain valid to estimate water quality at Port 3, 4 and 6, 2016 results may be a more accurate representation of Formation groundwater quality than 2018 data.

6.0 CONCLUSION

The 2018 Westbay Well field program was carried out in support of the Whale Tail Pit Project Certificate No. 008, Term and Condition No. 15, to obtain additional pre-development groundwater quality data and to verify the hydraulic gradient. These data were used to verify modelling assumptions related to the groundwater quality and the hydraulic gradient near the mine development areas.

Hydraulic head measurements indicate that a downward vertical hydraulic gradient is present in the North Basin of Whale Tail Lake, which is consistent with the conceptual understanding of groundwater flow directions and the predicted conditions post-closure following the formation of the Whale Tail Pit Lake. Revisions to the numerical or conceptual models is not considered necessary based on the vertical gradients as the data is consistent the model assumptions.

Groundwater quality was estimated from the samples collected, removing the anticipated proportion of residual drilling water in the Formation (in the raw water sample). The 2018 program estimated groundwater quality at Ports 6, 4, and 3 are in the same range as previously estimated. The calculated groundwater TDS are slightly higher in 2018; the calculated increase in TDS ranges from 25% to 86% which is above the threshold value of 25% variability for TDS. The variation is attributed to the higher proportion of residual drilling water in the sample. In consideration that higher TDS is not considered to represent an increase in Formation water TDS, the assumptions for the conceptual model, which are based on the more reliable and applicable 2016 data, are still considered to be appropriate. Therefore, adaptive management is not considered necessary at this time.

The concentrations of metals and arsenic are low. The maximum calculated arsenic concentration remains similar to what was calculated for Port 6 in 2016. Given that the arsenic concentrations are similar to the assumptions adopted in the geochemical models (low arsenic in Formation groundwater), groundwater arsenic content is still not likely to have a significant effect on mine surface water quality.

7.0 STUDY LIMITATIONS

This technical memorandum was prepared for the exclusive use of Agnico Eagle Mines Limited. The technical memorandum, which specifically includes all tables and attachments, is based on data and information collected by Golder Associates Ltd. and is based solely on the conditions of the property at the time of the work, supplemented by historical information and data obtained by Golder Associates Ltd. as described in this technical memorandum.

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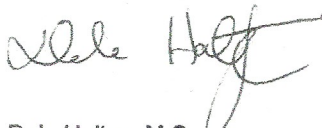
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The findings and conclusions of this technical memorandum are valid only as of the date of this technical memorandum and for the locations investigated. If new information is discovered in future work, including excavations, borings, or other studies, Golder Associates Ltd. should be requested to re-evaluate the conclusions of this technical memorandum and provide amendments as required.

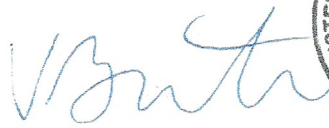
8.0 CLOSURE

We trust this report meets your needs at this time. Should you have any questions, please do not hesitate to contact the undersigned.

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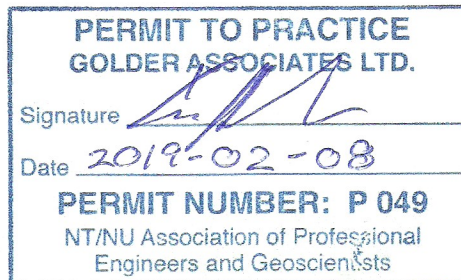
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https://golderassociates.sharepoint.com/sites/19830g/9100_westbay/deliverables/rev0/1789310-244-tm-westbay_gw_monitoring_rev0.docx

Attachments: Tables 4, 5, 6

Figure 1 – 2016 and 2018 Development Record

Figure 2 – 2018 Development Record

Appendix A – AMQ160626 Westbay System Installation Details

Appendix B – Westbay Instruments Mosdax Sampler Calibration Reports

Appendix C – 2018 Laboratory Certificates of Analysis

Appendix D – 2016 Laboratory Certificate of Analysis – Brine Fluid

9.0 REFERENCES

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Table 4
Drilling Brine Composition
Westbay Well in Whale Tail Lake Talik
Whale Tail Project, Nunavut

Sample		Brine Fluid	Calculated Drilling Brine Port 6		Calculated Drilling Brine Port 4		Calculated Drilling Brine Port 3	
			Initial Brine	Maximum Brine	Initial Brine	Maximum Brine	Initial Brine	Maximum Brine
Date		17-Apr-16	21-Jul-16	21-Jul-16	24-Apr-16	27-Apr-16	02-Sep-16	02-Sep-16
Field measured parameters	Units							
Fluorescein Concentration	mg/L	512.70	138.00	158.10	512.70	341.90	445.90	437.20
Drilling Fluid Proportion		1.00	0.27	0.31	1.00	0.67	0.87	0.85
Formation Water Proportion		0.00	0.73	0.69	0.00	0.33	0.13	0.15
Initial Conductivity Reading	uS/cm	0	10240	12210	3810	19400	52280	53800
Dilution of Brine Factor in Port		0.00	0.06	0.07	0.02	0.11	0.30	0.31
Conventional Parameters								
Total dissolved solids (calculated)	mg/L	130500	7680	3122	2858	14550	39210	40350
Total dissolved solids (lab)	mg/L	36946	-	-	-	-	-	-
pH	S.U.	10	11.25	7.40	12	11	11	11
Conductivity (lab)	uS/cm	55420	-	-	-	-	-	-
Conductivity (calculated)	uS/cm	174000	10240	4684	3810	19400	52280	53800
Reported Hardness	mg CaCO ₃ /L	105554	6212	2230	2311	11769	31715	32637
Alkalinity	mg CaCO ₃ /L	145.0	8.5	38.0	3.2	16.2	43.6	44.8
Bicarbonate (HCO3)	mg CaCO ₃ /L	27.0	1.6	38.0	0.6	3.0	8.1	8.3
Major ions								
Calcium (Ca)	mg/L	42266	2487	2966	925	4712	12699	13068
Magnesium (Mg)	mg/L	3.92	0.23	0.28	0.09	0.44	1.18	1.21
Potassium (K)	mg/L	1717	101	120	38	191	516	531
Sodium (Na)	mg/L	838	49	59	18	93	252	259
Bromide (Br)	mg/L	1066	63	75	23	119	320	330
Chloride (Cl)	mg/L	83700	4926	5873	1833	9332	25149	25880
Fluoride (F)	mg/L	0.060	0.004	0.004	0.001	0.007	0.018	0.019
Sulphate (SO4)	mg SO ₄ /L	<0.6	0	0	0	0	0	0
Nutrients								
Nitrates (NO3)	mg N/L	0.540	0.032	0.038	0.012	0.060	0.162	0.167
Nitrites (NO2)	mg N/L	0.060	0.004	0.004	0.001	0.007	0.018	0.019

Table 4
Drilling Brine Composition
Westbay Well in Whale Tail Lake Talik
Whale Tail Project, Nunavut

Sample		Brine Fluid	Calculated Drilling Brine Port 6		Calculated Drilling Brine Port 4		Calculated Drilling Brine Port 3	
			Initial Brine	Maximum Brine	Initial Brine	Maximum Brine	Initial Brine	Maximum Brine
Date		17-Apr-16	21-Jul-16	21-Jul-16	24-Apr-16	27-Apr-16	02-Sep-16	02-Sep-16
Field measured parameters	Units							
Fluorescein Concentration	mg/L	512.70	138.00	158.10	512.70	341.90	445.90	437.20
Drilling Fluid Proportion		1.00	0.27	0.31	1.00	0.67	0.87	0.85
Formation Water Proportion		0.00	0.73	0.69	0.00	0.33	0.13	0.15
Initial Conductivity Reading	uS/cm	0	10240	12210	3810	19400	52280	53800
Dilution of Brine Factor in Port		0.00	0.06	0.07	0.02	0.11	0.30	0.31
Metals (dissolved)								
Aluminium (Al)	mg/L	0.498	0.0293	0.0349	0.0109	0.0555	0.1496	0.154
Antimony (Sb)	mg/L	0.0354	0.0021	0.0025	0.0008	0.0039	0.0106	0.0109
Silver (Ag)	mg/L	<0.0001	0.0	0.0	0.0	0.0	0.0	0.0
Arsenic (As)	mg/L	0.766	0.045	0.054	0.017	0.085	0.23	0.237
Barium (Ba)	mg/L	0.113	0.007	0.008	0.002	0.013	0.034	0.035
Berillium (Be)	mg/L	<0.0005	0.0	0.0	0.0	0.0	0.0	0.0
Bismuth (Bi)	mg/L	<0.0005	0.0	0.0	0.0	0.0	0.0	0.0
Boron (B)	mg/L	13.2	0.8	0.9	0.3	1.5	4.0	4.1
Cadmium (Cd)	mg/L	<0.00002	0.0	0.0	0.0	0.0	0.0	0.0
Chromium (Cr)	mg/L	<0.0006	0.0	0.0	0.0	0.0	0.0	0.0
Cobalt (Co)	mg/L	0.0406	0.0024	0.0028	0.0009	0.0045	0.0122	0.0126
Copper (Cu)	mg/L	0.0039	0.0002	0.0003	0.0001	0.0004	0.0012	0.0012
Tin (Sn)	mg/L	<0.001	0	0	0	0	0	0
Iron (Fe)	mg/L	2.6	0.15	0.18	0.06	0.29	0.78	0.8
Lithium (Li)	mg/L	34.52	2.03	2.42	0.76	3.85	10.37	10.67
Manganese (Mn)	mg/L	<0.0005	0	0	0	0	0	0
Mercury (Hg)	mg/L	0.0	0.00002	0.00003	0.00001	0.00004	0.00012	0.00012
Dissolved Mercury (Hg)	mg/L	-	0.00002	0.00003	0.00001	0.00004	0.00012	0.00012
Molybdenum (Mo)	mg/L	<0.0005	0	0	0	0	0	0
Nickel (Ni)	mg/L	1.35	0.08	0.09	0.03	0.15	0.41	0.42
Lead (Pb)	mg/L	<0.0003	0	0	0	0	0	0
Selenium (Se)	mg/L	3.83	0.23	0.27	0.08	0.43	1.15	1.18
Silica (Si)	mg/L	2.93	0.17	0.21	0.06	0.33	0.88	0.91
Strontium (Sr)	mg/L	656.0	38.61	46.03	14.36	73.14	197.1	202.83
Telluride (Te)	mg/L	<0.0005	0	0	0	0	0	0
Thallium (Tl)	mg/L	<0.002	0	0	0	0	0	0
Titanium (Ti)	mg/L	45.2	2.66	3.17	0.99	5.04	13.58	13.98
Uranium (U)	mg/L	-	0	0	0	0	0	0
Vanadium (V)	mg/L	<0.001	0	0	0	0	0	0
Zinc (Zn)	mg/L	<0.0005	0	0	0	0	0	0
QA/QC								
Calculated TDS (lab)	-	130500	-	-	-	-	-	-
Lab measured vs Calculated TDS	-	28%	-	-	-	-	-	-
Lab measured TDS vs Conductivity	-	0.67	-	-	-	-	-	-
Calculated TDS vs Calculated Conductivity	-	0.75	-	-	-	-	-	-

Table 5
Rock Formation Groundwater Quality Corrected to Remove Residual Drilling Water
Whale Tail Lake Talik
Whale Tail Project, Nunavut

Sample		Port 6				Port 4				Port 3			
Date		2-Aug-2016		13-Nov-2018		20-Jul-2016		11-Nov-2018		14-Sep-2016		12-Nov-2018	
Drilling Fluid Proportion		0.04	0.24	0.16		0.09	0.18	0.13		0.08	0.18	0.20	
Formation Water Proportion		0.96	0.76	0.84		0.91	0.82	0.87		0.92	0.82	0.80	
Sampling interval depth (metres along borehole)		274.0 m - 287.4 m				349.3 m - 359.1 m				381.3 m - 392.7 m			
Sampling interval vertical depth (metres)		257.7 m - 268.3 m				326.1 m - 335.2 m				356.0 m - 366.6 m			
Estimated concentration range (calculated)		minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum
Average Field measured parameters													
Fluorescein	ppb	41.77		83.54		93.00		66.21		81.90		100.05	
Total dissolved solids	mg/L	-	-	4543		-	-	7275		-	-	3765	
pH	S.U.	-	-	6.36		-	-	7.50		-	-	8.35	
Conductivity	uS/cm	4610		9083		6650		14555		4450		7500	
Estimated Water Quality													
Conventional parameters													
Total dissolved solids	mg/L	3198	4042	4681	5171	3581	3966	7970	9945	3483	3918	<4980	<5100
pH	S.U.	7.41	7.27	6.50	6.57	7.87	7.82	6.88	6.91	7.96	7.91	7.31	7.41
Conductivity	uS/cm	4797	6042	8041	8496	5366	5938	13084	15511	5220	5866	<7350	<7530
Reported Hardness	mg CaCO ₃ /L	2397	3030	2883	3127	2627	2910	4169	5582	1680	1891	<2600	<2740
Alkalinity	mg CaCO ₃ /L	40	51	30	31	18	20	9	11	52	58	51	52
Bicarbonate (HCO3)	mg CaCO ₃ /L	40	51	31	32	18	20	11	12	52	58	60	61
Major ions													
Calcium (Ca)	mg/L	960	1213	1071	1164	1032	1143	1563	2125	671	756	<1040	<1090
Magnesium (Mg)	mg/L	22	27	51	51	12	14	62	66	1	1	1	1
Potassium (K)	mg/L	8	10	<20	<20	38	42	67	67	16	18	<38	<40
Sodium (Na)	mg/L	232	293	287	293	267	296	341	365	306	344	285	313
Bromide (Br)	mg/L	25	32	34	37	32	35	51	77	22	25	<32.5	<32.7
Chloride (Cl)	mg/L	2089	2641	2453	2697	2582	2860	3818	5722	1714	1929	<2700	<2700
Fluoride (F)	mg/L	0.21	0.27	<1.0	<1.0	0.5	0.5	<1.0	<1.0	1.1	1.2	<1.0	<1.0
Sulphate (SO4)	mg SO ₄ /L	-	-	<15	<15	-	-	<15	<15	-	-	<15	<15
Nutrients													
Ammonia N (NH3+NH4)	mg N/L	-	-	<0.437	<0.443	-	-	0.180	0.181	-	-	0.169	0.173
Nitrates (NO3)	mg N/L	0.063	0.079	<0.25	<0.25	0.06	0.06	<0.25	<0.25	0.016	0.018	<0.25	<0.25
Nitrites (NO2)	mg N/L	0.010	0.013	<0.050	<0.050	0.011	0.012	<0.050	<0.050	0.038	0.043	<0.050	<0.050
Total Phosphorous (P)	mg P/L	0.021	0.026	<0.0043	<0.0043	0.011	0.012	0.01	0.01	0.049	0.055	0.01	0.01

Table 5
Rock Formation Groundwater Quality Corrected to Remove Residual Drilling Water
Whale Tail Lake Talik
Whale Tail Project, Nunavut

Sample		Port 6				Port 4				Port 3			
Date		2-Aug-2016		13-Nov-2018		20-Jul-2016		11-Nov-2018		14-Sep-2016		12-Nov-2018	
Drilling Fluid Proportion		0.04	0.24	0.16		0.09	0.18	0.13		0.08	0.18	0.20	
Formation Water Proportion		0.96	0.76	0.84		0.91	0.82	0.87		0.92	0.82	0.80	
Sampling interval depth (metres along borehole)		274.0 m - 287.4 m				349.3 m - 359.1 m				381.3 m - 392.7 m			
Sampling interval vertical depth (metres)		257.7 m - 268.3 m				326.1 m - 335.2 m				356.0 m - 366.6 m			
Estimated concentration range (calculated)		minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum
Dissolved Metals													
Aluminium (Al)	mg/L	<0.006	<0.006	<0.0050	<0.0050	-	-	0.000	0.008	-	-	<0.0115	<0.0126
Antimony (Sb)	mg/L	0.0002	0.0003	0.001	0.001	0.003	0.004	0.001	0.002	0.0026	0.0029	0.001	0.001
Silver (Ag)	mg/L	<0.0001	<0.0001	<0.00010	<0.00010	<0.0001	<0.0001	<0.00010	<0.00010	<0.0001	<0.0001	<0.00010	<0.00010
Arsenic (As)	mg/L	0.0050	0.0063	<0.0021	<0.0024	0.0031	0.0035	<0.0020	<0.0020	<0.0005	<0.0005	<0.0034	<0.0034
Barium (Ba)	mg/L	0.528	0.667	0.947	0.976	0.134	0.148	0.533	0.561	0.057	0.065	0.098	0.104
Berillium (Be)	mg/L	<0.0005	<0.0005	<0.00050	<0.00050	<0.0005	<0.0005	<0.00050	<0.00050	<0.0005	<0.0005	<0.00050	<0.00050
Bismuth (Bi)	mg/L	<0.0005	<0.0005	<0.00050	<0.00050	<0.0005	<0.0005	<0.00050	<0.00050	<0.0005	<0.0005	<0.00050	<0.00050
Boron (B)	mg/L	0.30	0.38	0.24	0.28	0.58	0.64	0.82	1.05	0.53	0.60	0.28	0.33
Cadmium (Cd)	mg/L	-	0.000033	<0.000050	<0.000050	<0.00002	<0.00002	<0.000050	<0.000050	<0.00002	<0.00002	<0.000050	<0.000050
Chromium (Cr)	mg/L	0.0070	0.0089	<0.00050	<0.00050	0.0054	0.0060	<0.00050	<0.00050	0.0048	0.0055	<0.00050	<0.00050
Cobalt (Co)	mg/L	0.0015	0.0019	<0.000050	<0.000050	0.0017	0.0018	<0.000050	<0.000050	0.0011	0.0012	<0.000050	<0.000050
Copper (Cu)	mg/L	0.0055	0.0069	<0.00050	<0.00050	0.0020	0.0023	<0.00050	<0.00050	0.0046	0.0052	<0.00050	<0.00050
Tin (Sn)	mg/L	0.0010	<0.001	<0.0010	<0.0010	0.0011	0.0012	<0.0010	<0.0010	<0.001	<0.001	<0.0010	<0.0010
Iron (Fe)	mg/L	0.17	0.21	0.264	0.276	0.15	0.16	0.078	0.120	0.08	0.09	<0.018	<0.019
Lithium (Li)	mg/L	0.33	0.41	0.15	0.24	0.64	0.71	1.06	1.63	0.31	0.34	<0.749	<0.779
Manganese (Mn)	mg/L	0.04	0.05	0.115	0.116	0.022	0.024	0.093	0.096	0.008	0.009	0.022	0.023
Mercury (Hg)	mg/L	0.0008	0.0010	<0.000010	<0.000010	0.0028	0.0031	<0.000010	<0.000010	0.00215	0.00242	<0.000010	<0.000010
Dissolved Mercury (Hg)	mg/L	0.0005	0.0006	<0.000010	<0.000010	0.0031	0.0034	<0.000010	<0.000010	0.00217	0.00244	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.02	0.02	0.029	0.031	0.0062	0.0068	0.013	0.013	0.019	0.021	0.018	0.019
Nickel (Ni)	mg/L	0.05	0.06	<0.00050	<0.00050	0.05	0.05	<0.00050	<0.00050	0.04	0.05	<0.00050	<0.00050
Lead (Pb)	mg/L	<0.0003	<0.0003	<0.00030	<0.00030	0.0027	0.0030	<0.00030	<0.00030	<0.0003	<0.0003	<0.00030	<0.00030
Selenium (Se)	mg/L	0.11	0.14	<0.0020	<0.0020	0.12	0.13	<0.0020	<0.0020	0.08	0.09	<0.0020	<0.0020
Silica (Si)	mg/L	4.00	5.06	3.19	3.31	4.18	4.63	2.48	2.63	4.29	4.82	3.51	3.51
Strontium (Sr)	mg/L	13.2	16.7	14.3	16.0	18.9	20.9	27.7	36.5	12.7	14.2	<16.9	<17.2
Telluride (Te)	mg/L	<0.0005	<0.0005	<0.00050	<0.00050	<0.0005	<0.0005	<0.00050	<0.00050	<0.0005	<0.0005	<0.00050	<0.00050
Thallium (Tl)	mg/L	<0.0008	<0.0008	<0.000050	<0.000050	<0.0008	<0.0008	<0.000050	<0.000050	<0.0008	<0.0008	<0.000050	<0.000050
Titanium (Ti)	mg/L	0.350	0.442	<0.0050	<0.0050	0.336	0.373	<0.0050	<0.0050	0.229	0.257	<0.0050	<0.0050
Uranium (U)	mg/L	<0.001	<0.001	0.025	0.026	<0.001	<0.001	0.051	0.052	0.064	0.072	0.085	0.090
Vanadium (V)	mg/L	0.002	0.002	<0.000050	<0.000050	<0.0005	<0.0005	<0.000050	<0.000050	<0.001	<0.001	0.00020	0.00020
Zinc (Zn)	mg/L	1.3	1.7	<0.00050	<0.00050	0.63	0.70	<0.00050	<0.00050	<0.0005	<0.0005	<0.00050	<0.00050

Table 6
QA/QC of Rock Formation Groundwater Quality
Whale Tail Lake Talik
Whale Tail Project, Nunavut

Sample			Port 6					Port 4					Port 3				
Date			13-Nov-2018				RPD	11-Nov-2018			RPD	12-Nov-2018				RPD	
Certificate No.			L2198327-1		L2198327-2			L2197641-3		L2197641-4		L2197641-5		L2197641-6			
Sample ID	Method	Units	Zone 6	Zone 66			Method	Units	Zone 4	Zone 44			Zone 3	Zone 33			
Parameters			Detection Limit				Detection Limit										
Physical Tests (Water)																	
Conductivity	2	uS/cm	8720	8780	1%		2	uS/cm	13900	14000	1%		7530	7350	2%		
pH	0.1	pH	6.58	6.65	1%		0.1	pH	6.97	6.94	0%		7.40	7.50	1%		
Total Suspended Solids	3	mg/L	8	10	13%		3	mg/L	24	20	18%		8	8	5%		
Total Dissolved Solids	30	mg/L	5580	5410	3%		3	mg/L	9030	8820	2%		5100	4980	2%		
Anions and Nutrients																	
Alkalinity, Bicarbonate (as CaCO3)	1	mg/L	27	26	3%		1	mg/L	10	10	2%		51	50	1%		
Alkalinity, Carbonate (as CaCO3)	1	mg/L	<1.0	<1.0	--		1	mg/L	<1.0	<1.0	--		<1.0	<1.0	--		
Alkalinity, Hydroxide (as CaCO3)	1	mg/L	<1.0	<1.0	--		1	mg/L	<1.0	<1.0	--		<1.0	<1.0	--		
Alkalinity, Total (as CaCO3)	1	mg/L	27	26	3%		1	mg/L	10	10	2%		51	50	1%		
Ammonia, Total (as N)	0.005	mg/L	0.443	0.437	1%		0.005	mg/L	0.157	0.158	1%		0.139	0.136	2%		
Bromide (Br)	2.5	mg/L	41	41	1%		0.05	mg/L	70	60	15%		33	33	1%		
Chloride (Cl)	5	mg/L	3010	3060	2%		0.5	mg/L	5220	4530	14%		2700	2700	0%		
Fluoride (F)	1	mg/L	<1.0	<1.0	--		0.02	mg/L	<1.0	<1.0	--		<1.0	<1.0	--		
Nitrate (as N)	0.25	mg/L	<0.25	<0.25	--		0.005	mg/L	<0.25	<0.25	--		<0.25	<0.25	--		
Nitrite (as N)	0.05	mg/L	<0.050	<0.050	--		0.001	mg/L	<0.050	<0.050	--		<0.050	<0.050	--		
Phosphorus (P)-Total	0.002	mg/L	0.004	0.005	19%		0.002	mg/L	0.01	0.01	13%		0.006	0.008	+/- MDL		
Sulfate (SO4)	15	mg/L	<15	<15	--		0.3	mg/L	<15	<15	--		<15	<15	--		
Physical Tests																	
Hardness (as CaCO3)	4.8	mg/L	3630	3620	0.3%		4.8	mg/L	5160	5150	0%		2600	2740	5%		
Dissolved Metals																	
Aluminum (Al)-Dissolved	0.005	mg/L	<0.0050	<0.0050	1%		0.005	mg/L	0.0085	0.0076	11%		0.0126	0.0115	9%		
Antimony (Sb)-Dissolved	0.0005	mg/L	<0.00050	0.0005	+/- MDL		0.0005	mg/L	0.00163	0.00172	5%		0.00308	0.003	3%		
Arsenic (As)-Dissolved	0.002	mg/L	0.0021	0.0024	13%		0.002	mg/L	<0.0020	<0.0020	--		0.0034	0.0034	0%		
Barium (Ba)-Dissolved	0.001	mg/L	0.818	0.794	3%		0.001	mg/L	0.466	0.489	5%		0.0902	0.0854	5%		
Beryllium (Be)-Dissolved	0.0005	mg/L	<0.00050	<0.00050	--		0.0005	mg/L	<0.00050	<0.00050	--		<0.00050	<0.00050	--		
Bismuth (Bi)-Dissolved	0.0005	mg/L	<0.00050	<0.00050	--		0.0005	mg/L	<0.00050	<0.00050	--		<0.00050	<0.00050	--		
Boron (B)-Dissolved	0.1	mg/L	0.36	0.35	3%		0.1	mg/L	0.9	0.95	5%		1.04	1.02	2%		
Cadmium (Cd)-Dissolved	0.00005	mg/L	<0.000050	<0.000050	--		0.00005	mg/L	<0.000050	<0.000050	--		<0.000050	<0.000050	--		
Calcium (Ca)-Dissolved	1	mg/L	1380	1380	0%		1	mg/L	1970	1970	0%		1040	1090	5%		
Cesium (Cs)-Dissolved	0.0005	mg/L	<0.00050	<0.00050	--		0.0005	mg/L	0.00075	0.00074	1%		<0.00050	<0.00050	--		
Chromium (Cr)-Dissolved	0.0005	mg/L	<0.00050	<0.00050	--		0.0005	mg/L	<0.00050	<0.00050	--		<0.00050	<0.00050	--		
Cobalt (Co)-Dissolved	0.00005	mg/L	<0.000050	<0.000050	--		0.00005	mg/L	<0.000050	<0.000050	--		<0.000050	<0.000050	--		
Copper (Cu)-Dissolved	0.0005	mg/L	<0.00050	<0.00050	--		0.0005	mg/L	<0.00050	<0.00050	--		<0.00050	<0.00050	--		
Gallium (Ga)-Dissolved	0.0005	mg/L	<0.00050	<0.00050	--		0.0005	mg/L	<0.00050	<0.00050	--		<0.00050	<0.00050	--		
Iron (Fe)-Dissolved	0.01	mg/L	0.251	0.256	2%		0.01	mg/L	0.112	0.105	6%		0.018	0.019	5%		
Lead (Pb)-Dissolved	0.0003	mg/L	<0.00030	<0.00030	--		0.0003	mg/L	<0.00030	<0.00030	--		<0.00030	<0.00030	--		
Lithium (Li)-Dissolved	0.02	mg/L	0.533	0.52	2%		0.02	mg/L	1.42	1.52	7%		0.779	0.749	4%		
Magnesium (Mg)-Dissolved	1	mg/L	42.8	42.8	0%		1	mg/L	57.8	53.9	7%		1.2	1.2	0%		
Manganese (Mn)-Dissolved	0.0002	mg/L	0.0961	0.097	1%		0.0002	mg/L	0.0836	0.0812	3%		0.0184	0.0181	2%		
Mercury (Hg)-Dissolved	0.00001	mg/L	<0.000010	<0.000010	--		0.00001	mg/L	<0.000010	<0.000010	--		<0.000010	<0.000010	--		
Molybdenum (Mo)-Dissolved	0.002	mg/L	0.0257	0.0245	5%		0.002	mg/L	0.0112	0.0116	4%		0.0154	0.0144	7%		
Nickel (Ni)-Dissolved	0.0005	mg/L	<0.00050	<0.00050	--		0.0005	mg/L	<0.00050	<0.00050	--		<0.00050	<0.00050	--		
Phosphorus (P)-Dissolved	0.05	mg/L	<0.050	<0.050	--		0.05	mg/L	<0.050	<0.050	--		<0.050	<0.050	--		
Potassium (K)-Dissolved	20	mg/L	<20	<20	--		20	mg/L	67	66	2%		38	40	5%		
Rhenium (Re)-Dissolved	0.0005	mg/L	<0.00050	<0.00050	--		0.0005	mg/L	<0.00050	<0.00050	--		<0.00050	<0.00050	--		
Rubidium (Rb)-Dissolved	0.005	mg/L	0.0151	0.0146	3%		0.005	mg/L	0.0891	0.0914	3%		0.0549	0.0528	4%		
Selenium (Se)-Dissolved	0.002	mg/L	<0.0020	<0.0020	--		0.002	mg/L	<0.0020	<0.0020	--		<0.0020	<0.0020	--		
Silicon (Si)-Dissolved	1	mg/L	2.8	2.7	4%		1	mg/L	2.3	2.2	4%		3	3	0%		
Silver (Ag)-Dissolved	0.0001	mg/L	<0.00010	<0.00010	--		0.0001	mg/L	<0.00010	<0.00010	--		<0.00010	<0.00010	--		
Sodium (Na)-Dissolved	20	mg/L	253	250	1%		20	mg/L	309	320	3%		280	301	7%		
Strontium (Sr)-Dissolved	0.05	mg/L	19.5	19.7	1%		0.05	mg/L	33.6	33.6	0%		16.9	17.2	2%		
Sulfur (S)-Dissolved	5	mg/L	<5.0	<5.0	--		5	mg/L	<5.0	<5.0	--		<5.0	<5.0	--		
Tellurium (Te)-Dissolved	0.0005	mg/L	<0.00050	<0.00050	--		0.0005	mg/L	<0.00050	<0.00050	--		<0.00050	<0.00050	--		
Thallium (Tl)-Dissolved	0.00005	mg/L	<0.000050	<0.000050	--		0.00005	mg/L	<0.000050	<0.000050	--		<0.000050	<0.000050	--		
Thorium (Th)-Dissolved	0.0005	mg/L	<0.00050	<0.00050	--		0.0005	mg/L	<0.00050	<0.00050	--		<0.00050	<0.00050	--		
Tin (Sn)-Dissolved	0.001	mg/L	<0.0010	<0.0010	--		0.001	mg/L	<0.0010	<0.0010	--		<0.0010	<0.0010	--		
Titanium (Ti)-Dissolved	0.005	mg/L	<0.0050	<0.0050	--		0.005	mg/L	<0.0050	<0.0050	--		<0.0050	<0.0050	--		
Tungsten (W)-Dissolved	0.001	mg/L	0.0214	0.0208	3%		0.001	mg/L	0.0455	0.0443	3%		0.0722	0.0687	5%		
Uranium (U)-Dissolved	0.00005	mg/L	<0.000050	<0.000050	--		0.00005	mg/L	<0.000050	<0.000050	--		0.00016	0.000144	11%		
Vanadium (V)-Dissolved	0.0005	mg/L	<0.00050	<0.00050	--		0.0005	mg/L	<0.00050	<0.00050	--		<0.00050	<0.00050	--		
Yttrium (Y)-Dissolved	0.0005	mg/L	<0.00050	<0.00050	--		0.0005	mg/L	<0.00050	<0.00050	--		<0.00050	<0.00050	--		
Zinc (Zn)-Dissolved	0.003	mg/L	0.0244	0.023	6%		0.003	mg/L	0.0096	0.01	4%		<0.0030	<0.0030	--		
Zirconium (Zr)-Dissolved	0.0005	mg/L	<0.00050	<0.00050	--		0.0005	mg/L	<0.00050	<0.00050	--		<0.00050	<0.00050	--		
QA/QC																	
Calculated TDS (lab)	-	mg/L	4779	4826	-	-	-	-	7743	7050	-	-	4165	4237	-		
Lab measured vs Calculated TDS	-	-	156%	162%	-	-	-	-	154%	159%	-	-	148%	148%	-		
Lab measured TDS vs conductivity	-	uS/cm	0.6	0.6	-	-	-	-	0.6	0.6	-	-	0.7	0.7	-		
Notes:																	
Concentrations are mg/L unless otherwise noted.																	
¹ Part F item 2 of Meadowbank Water License. All regulated parameters for total concentration																	
RPD value exceeds 20%																	
FD = Field duplicate																	
RPD = relative percent difference																	
-- not calculated (one or both result below MDL)																	

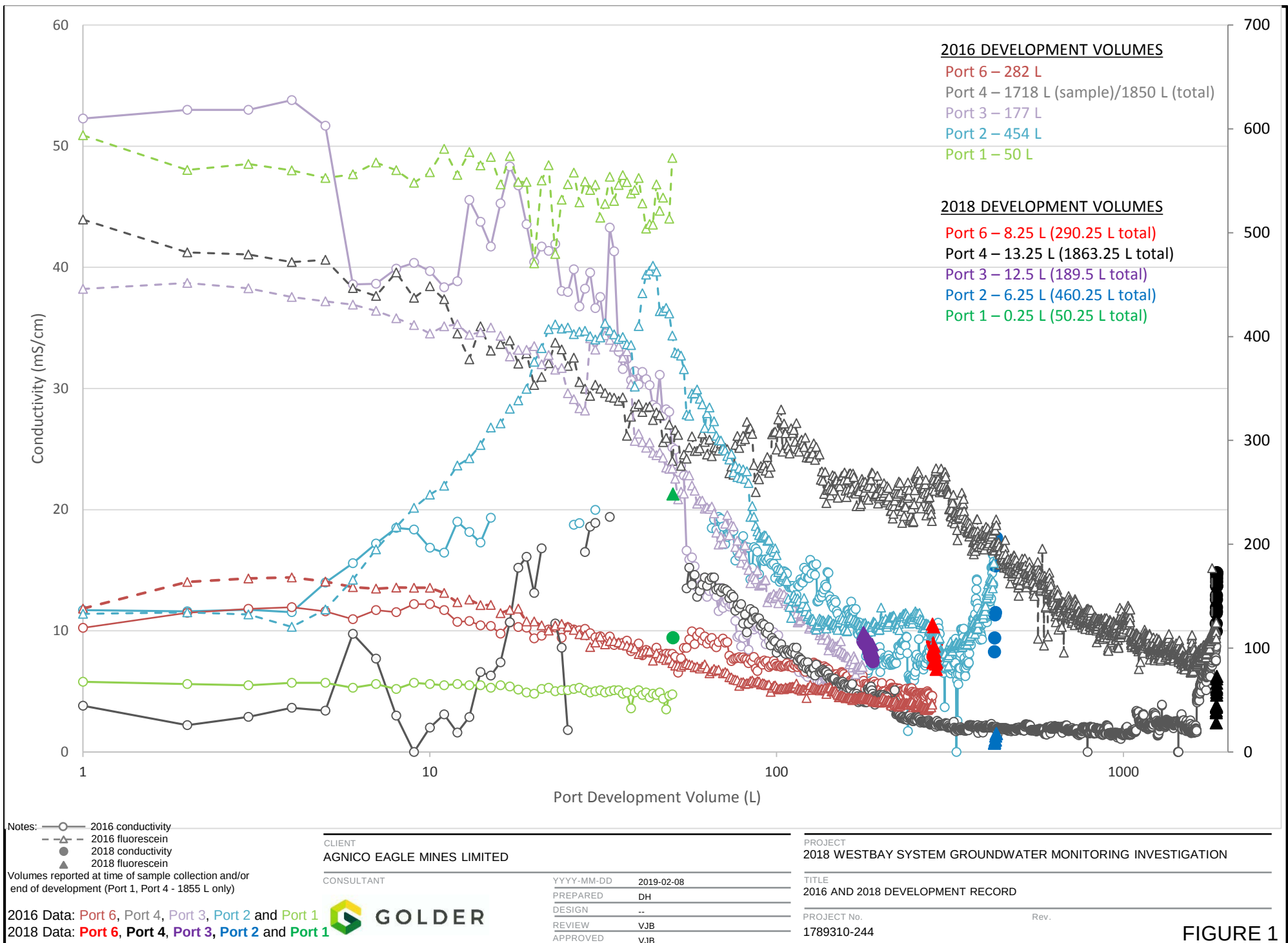
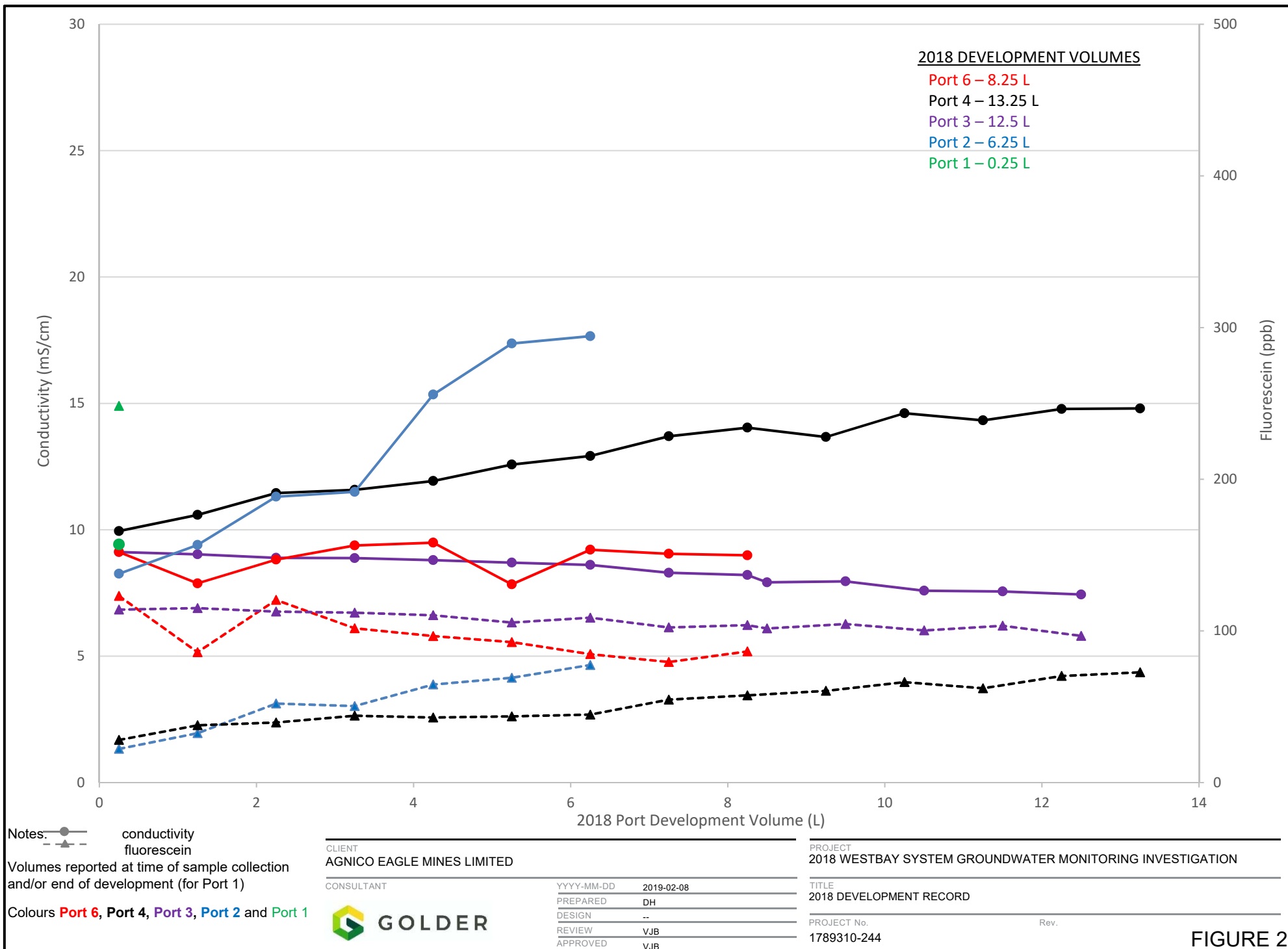


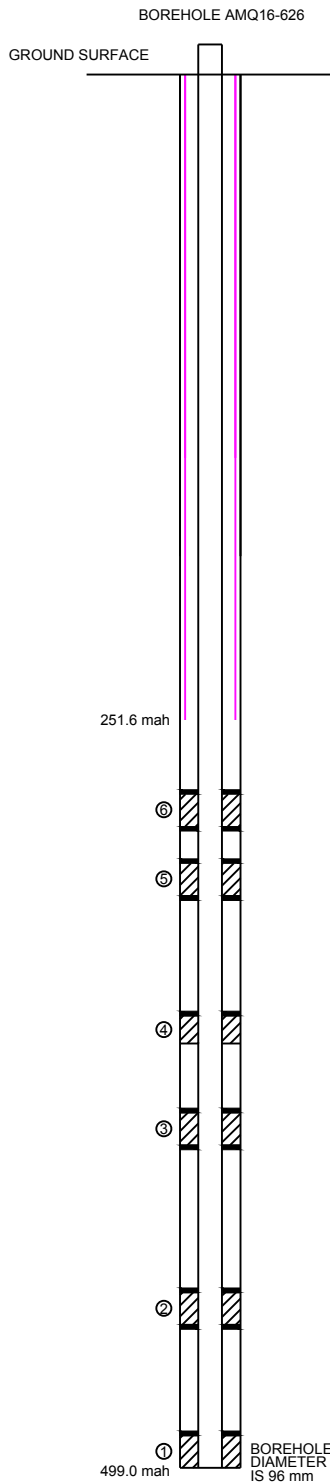
FIGURE 1



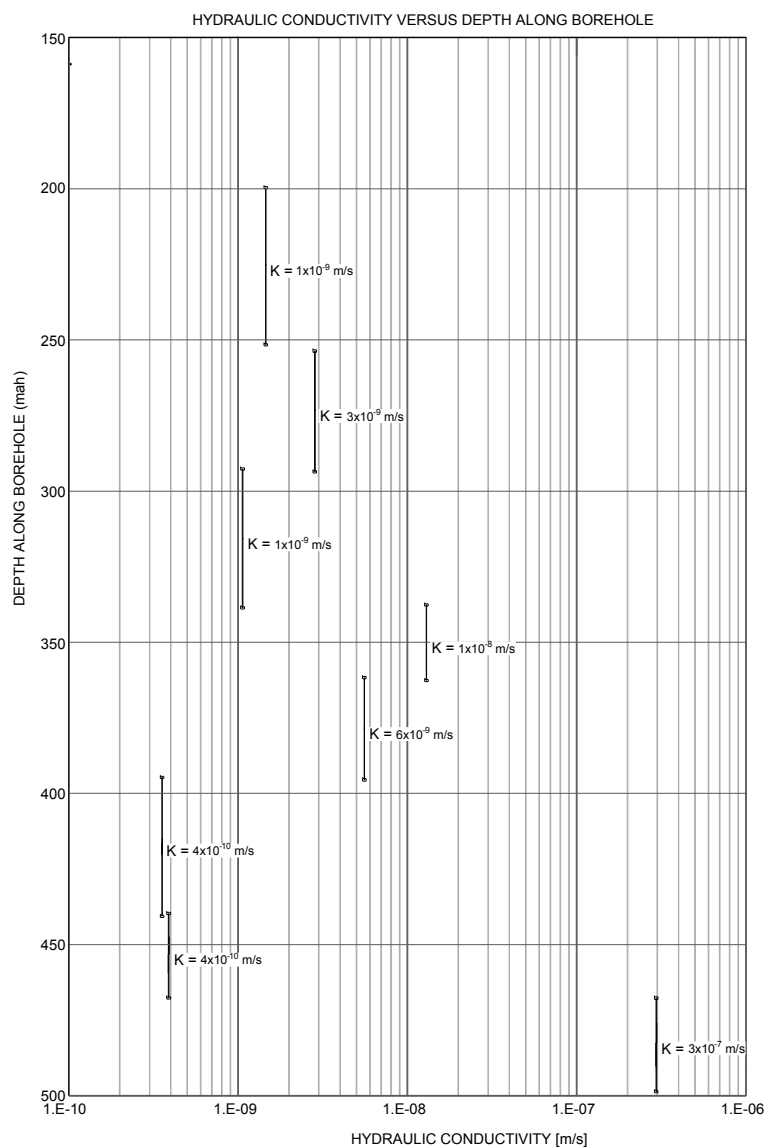
APPENDIX A

AMQ160626 Westbay System Installation Details

\\golder\gds\galiburn\Bathymetry\CAD-GIS\client\Agnico_Eagle_Mines_Ltd\WhiteTail\99_PROJECTS\1649355\02_PRODUCTION\4000\3000\DWG\1649355-4000-3000-03.dwg | Layout: AMQ16-626 WESTBAY SYSTEM INSTALLATION DETAILS | Modified: ppapouhesh 05/26/2016 1:35 PM | Plotted: ppapouhesh 07/06/2016



WESTBAY SYSTEM ZONE DEPTH SUMMARY						
ZONE	DEPTH ALONG HOLE			VERTICAL DEPTH		
	FROM	TO	LENGTH	FROM	TO	THICKNESS
	(mah)	(mah)	(m)	(mbgs)	(mbgs)	(m)
6	276.0	287.4	11.4	257.7	268.3	10.6
5	298.9	310.3	11.4	279	289.7	10.6
4	349.3	359.1	9.8	326.1	335.2	9.1
3	381.3	392.7	11.4	356.0	366.6	10.6
2	440.8	452.2	11.4	411.5	422.2	10.6
1	488.1	499.0	10.9	455.7	465.9	10.2



LEGEND

1	PACKER	K	HYDRAULIC CONDUCTIVITY
2	WESTBAY MONITORING ZONE	mah	METRES ALONG BOREHOLE, RELATIVE TO GROUND SURFACE
3	STEEL CASING	mbgs	METRES BELOW GROUND SURFACE
		m/s	METRES PER SECOND

NOTES

- ALL UNITS ARE IN METERS UNLESS OTHERWISE NOTED
- PERMAFROST ASSUMED 200 m ALONG HOLE ALIGNMENT.
- DRILL RODS TO 251.6 m ALONG HOLE.
- BOREHOLE LOCATED IN UTM NAD 83 ZONE 14, N = 7255363.5 E = 607181.68 ELEVATION = 154.46 m.
- AVERAGE BOREHOLE INCLINATION IS 69°.

NOT TO SCALE
SCHEMATIC ONLY

	2016-07-06	ISSUED FOR FINAL		JJ	PP	DV	DC		
	2016-05-27	ISSUED FOR REVIEW		JJ	PP				
REV	DATE	REVISION DESCRIPTION		DES	CADD	CHK	R/W		
PROJECT  AGNICO EAGLE AGNICO EAGLE MINES LIMITED WHALE TAIL PIT PROJECT NUNAVUT, CANADA									
TITLE AMQ16-626 WESTBAY SYSTEM INSTALLATION DETAILS									
 Golder Associates		PROJECT No.		1649355.4000.3000		FILE No.		1649355-4000-3000-03	
		DESIGN	JJ	2016-07-06		SCALE		NOT TO SCALE	
		CADD	PP	2016-07-06		FIGURE		3	
		CHECK	DV	2016-07-06					
		REVIEW	DC	2016-07-06					



APPENDIX B

Westbay Instruments Mosdax Sampler Calibration Reports

MOSDAX Calibration Report 1: EMS - 1764 Module 323

Full Scale: 2000 (psia)

File: E:\DATA\CALIB-2018\2000\26JAN2-1\01764

Pressure Reference: Paroscientific Model 42K-101 S/N 59937

Range: 2K PSI

Date of last reference to traceable standard: Oct 5 2017

EMS - 1764 Jan 26 17:09:52 2018 Range 1 Temp 3.1° C			EMS - 1764 Jan 26 07:09:09 2018 Range 2 Temp 10.1° C			EMS - 1764 Jan 26 02:21:39 2018 Range 3 Temp 19.9° C		
Ref Pres (psia)	Error (psia)	(% FS)	Ref Pres (psia)	Error (psia)	(% FS)	Ref Pres (psia)	Error (psia)	(% FS)
14.817	0.208	0.010	14.763	0.210	0.011	14.745	0.228	0.011
193.345	-0.073	-0.004	193.566	-0.123	-0.006	193.251	-0.079	-0.004
393.618	-0.272	-0.014	392.913	-0.184	-0.009	392.313	-0.228	-0.011
589.887	-0.183	-0.009	591.481	-0.211	-0.011	591.070	-0.177	-0.009
787.108	-0.110	-0.006	790.656	-0.114	-0.006	790.016	-0.162	-0.008
992.089	-0.024	-0.001	990.073	0.058	0.003	988.877	-0.001	0.000
1191.192	0.036	0.002	1184.170	0.092	0.005	1189.677	-0.007	0.000
1390.713	0.133	0.007	1382.638	0.117	0.006	1383.376	0.058	0.003
1589.940	0.097	0.005	1583.021	0.197	0.010	1582.918	0.132	0.007
1781.966	0.014	0.001	1783.679	0.027	0.001	1783.642	-0.023	-0.001
1987.965	-0.329	-0.016	1991.373	-0.178	-0.009	1990.362	-0.278	-0.014
1817.144	-0.012	-0.001	1816.737	0.061	0.003	1807.379	-0.041	-0.002
1618.742	0.102	0.005	1611.101	0.226	0.011	1611.387	0.144	0.007
1413.125	0.180	0.009	1410.177	0.278	0.014	1410.184	0.103	0.005
1213.194	0.108	0.005	1209.052	0.204	0.010	1209.054	0.151	0.008
1009.488	0.089	0.004	1008.134	0.118	0.006	1007.771	0.068	0.003
807.541	-0.027	-0.001	809.316	-0.034	-0.002	807.386	-0.029	-0.001
606.650	-0.114	-0.006	608.601	-0.077	-0.004	608.200	-0.110	-0.005
406.828	-0.184	-0.009	406.467	-0.147	-0.007	407.925	-0.205	-0.010
205.695	-0.015	-0.001	205.759	-0.012	-0.001	206.304	-0.075	-0.004
14.824	0.214	0.011	14.783	0.231	0.012	14.730	0.212	0.011
EMS - 1764 Jan 25 20:49:38 2018 Range 4 Temp 29.9° C			EMS - 1764 Jan 25 15:45:50 2018 Range 5 Temp 39.9° C					
Ref Pres (psia)	Error (psia)	(% FS)	Ref Pres (psia)	Error (psia)	(% FS)			
14.664	0.129	0.006	14.630	0.147	0.007			
193.289	-0.074	-0.004	193.274	-0.098	-0.005			
392.551	-0.259	-0.013	393.384	-0.239	-0.012			
590.683	-0.199	-0.010	590.646	-0.204	-0.010			
790.879	-0.111	-0.006	792.587	-0.140	-0.007			
989.404	-0.070	-0.003	989.121	-0.059	-0.003			
1188.900	-0.088	-0.004	1188.417	-0.084	-0.004			
1383.144	0.006	0.000	1390.226	0.040	0.002			
1582.510	-0.017	-0.001	1582.457	0.023	0.001			
1783.117	-0.170	-0.008	1783.077	-0.054	-0.003			
1990.420	-0.360	-0.018	1990.337	-0.125	-0.006			
1817.923	-0.145	-0.007	1809.812	-0.012	-0.001			
1612.561	0.046	0.002	1612.027	0.084	0.004			
1409.796	0.050	0.003	1410.656	0.064	0.003			
1208.930	0.011	0.001	1207.895	0.018	0.001			
1007.679	0.001	0.000	1007.484	0.004	0.000			
807.799	-0.074	-0.004	807.295	-0.056	-0.003			
607.517	-0.125	-0.006	608.401	-0.142	-0.007			
406.301	-0.139	-0.007	406.285	-0.237	-0.012			
205.701	-0.048	-0.002	205.685	-0.138	-0.007			
14.686	0.149	0.007	14.645	0.098	0.005			

Issued by




MOSDAX Calibration Report 2: EMS - 1764 Module 323

Full Scale: 2000 (psia)

File: E:\DATA\CAL\0-2018\2000\26JAN2-1\01764

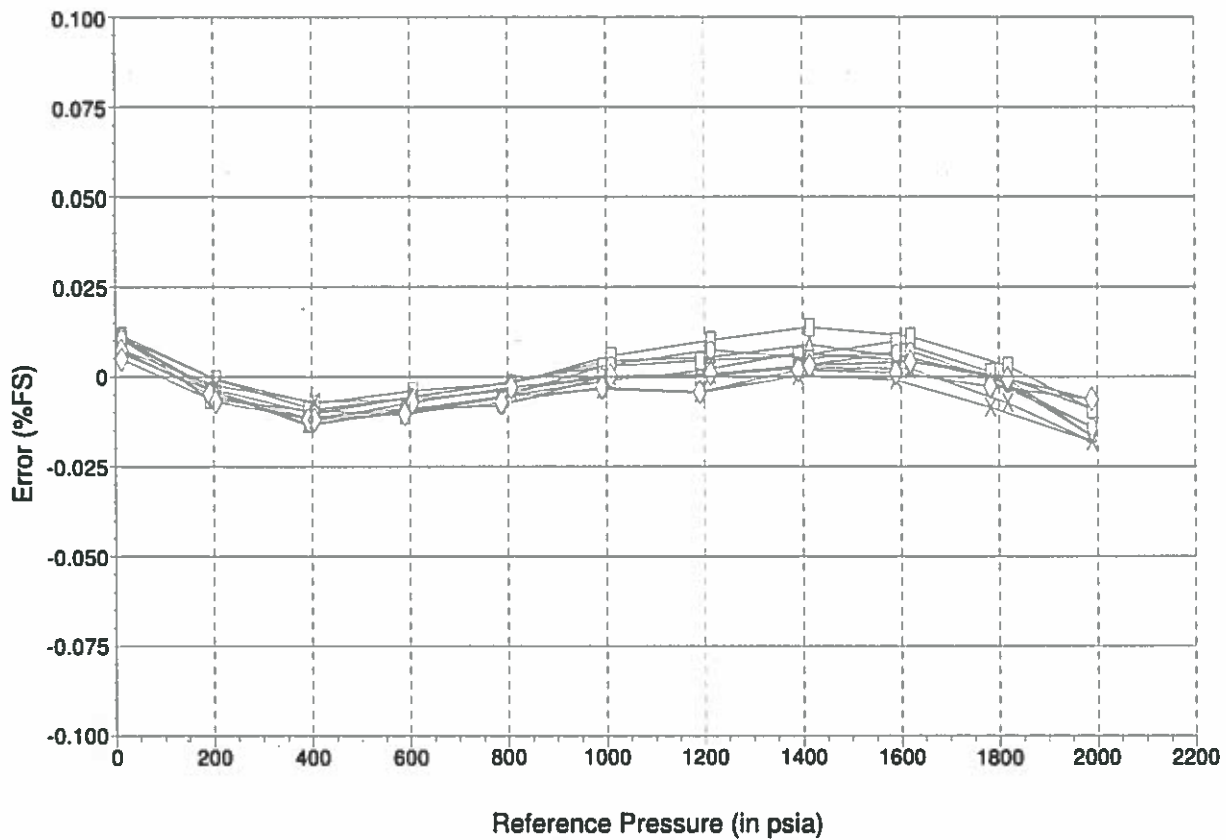
Pressure Reference: Paroscientific Model 42K-101 S/N 59937

Range: 2K PSI

Date of last reference to traceable standard: Oct 5 2017

Plot of Error vs. Reference Pressure

EMS - 1764 Module 323



—△— 3.1° C —□— 10.1° C —○— 19.9° C —×— 29.9° C —◇— 39.9° C

Comments

Issued by



As Received MOSDAX Cal. Report 2: EMS - 1764 Module 323

Full Scale: 2000 (psia)

File: E:\DATA\CAL\0-2018\2000\26JAN2-1\01764

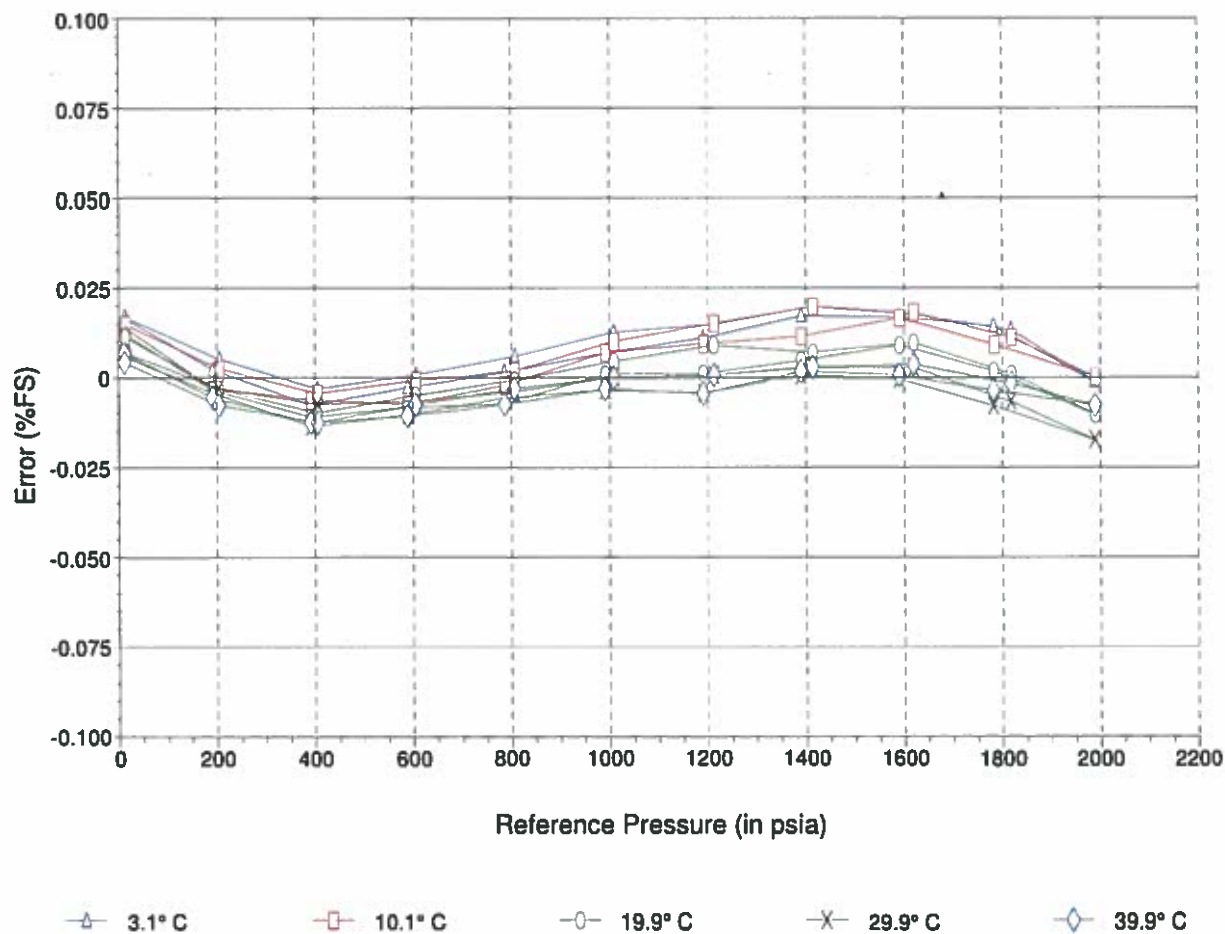
Pressure Reference: Paroscientific Model 42K-101 S/N 59937

Range: 2K PSI

Date of last reference to traceable standard: Oct 5 2017

Plot of Error vs. Reference Pressure

EMS - 1764 Module 323



Comments

Issued by



As Received MOSDAX Cal. Report 1: EMS - 1764 Module 323

Full Scale: 2000 (psia)

File: E:\DATA\CAL\0-2018\2000\26JAN2-1\01764

Pressure Reference: Paroscientific Model 42K-101 S/N 59937

Range: 2K PSI

Date of last reference to traceable standard: Oct 5 2017

EMS - 1764 Jan 26 17:09:52 2018 Range 1 Temp 3.1° C			EMS - 1764 Jan 26 07:09:09 2018 Range 2 Temp 10.1° C			EMS - 1764 Jan 26 02:21:39 2018 Range 3 Temp 19.9° C		
Ref Pres (psia)	Error (psia)	(% FS)	Ref Pres (psia)	Error (psia)	(% FS)	Ref Pres (psia)	Error (psia)	(% FS)
14.817	0.330	0.016	14.763	0.276	0.014	14.745	0.240	0.012
193.345	0.046	0.002	193.566	-0.061	-0.003	193.251	-0.068	-0.003
393.618	-0.152	-0.008	392.913	-0.123	-0.006	392.313	-0.217	-0.011
589.887	-0.055	-0.003	591.481	-0.147	-0.007	591.070	-0.165	-0.008
787.108	0.031	0.002	790.656	-0.043	-0.002	790.016	-0.146	-0.007
992.089	0.136	0.007	990.073	0.140	0.007	988.877	0.020	0.001
1191.192	0.219	0.011	1184.170	0.188	0.009	1189.677	0.022	0.001
1390.713	0.343	0.017	1382.638	0.231	0.012	1383.376	0.095	0.005
1589.940	0.337	0.017	1583.021	0.331	0.017	1582.918	0.179	0.009
1781.966	0.285	0.014	1783.679	0.185	0.009	1783.642	0.037	0.002
1987.965	-0.022	-0.001	1991.373	0.007	0.000	1990.362	-0.203	-0.010
1817.144	0.265	0.013	1816.737	0.223	0.011	1807.379	0.021	0.001
1618.742	0.348	0.017	1611.101	0.363	0.018	1611.387	0.194	0.010
1413.125	0.394	0.020	1410.177	0.394	0.020	1410.184	0.141	0.007
1213.194	0.296	0.015	1209.052	0.302	0.015	1209.054	0.180	0.009
1009.488	0.252	0.013	1008.134	0.201	0.010	1007.771	0.089	0.004
807.541	0.117	0.006	809.316	0.037	0.002	807.386	-0.013	-0.001
606.650	0.016	0.001	608.601	-0.013	-0.001	608.200	-0.098	-0.005
406.828	-0.062	-0.003	406.467	-0.087	-0.004	407.925	-0.194	-0.010
205.695	0.104	0.005	205.759	0.050	0.002	206.304	-0.064	-0.003
14.824	0.336	0.017	14.783	0.297	0.015	14.730	0.225	0.011
EMS - 1764 Jan 25 20:49:38 2018 Range 4 Temp 29.9° C			EMS - 1764 Jan 25 15:45:50 2018 Range 5 Temp 39.9° C					
Ref Pres (psia)	Error (psia)	(% FS)	Ref Pres (psia)	Error (psia)	(% FS)			
14.664	0.116	0.006	14.630	0.132	0.007			
193.289	-0.086	-0.004	193.274	-0.112	-0.006			
392.551	-0.268	-0.013	393.384	-0.250	-0.013			
590.683	-0.206	-0.010	590.646	-0.212	-0.011			
790.879	-0.114	-0.006	792.587	-0.146	-0.007			
989.404	-0.069	-0.003	989.121	-0.063	-0.003			
1188.900	-0.084	-0.004	1188.417	-0.088	-0.004			
1383.144	0.013	0.001	1390.226	0.034	0.002			
1582.510	-0.007	0.000	1582.457	0.014	0.001			
1783.117	-0.157	-0.008	1783.077	-0.071	-0.004			
1990.420	-0.345	-0.017	1990.337	-0.153	-0.008			
1817.923	-0.132	-0.007	1809.812	-0.030	-0.002			
1612.561	0.056	0.003	1612.027	0.074	0.004			
1409.796	0.058	0.003	1410.656	0.058	0.003			
1208.930	0.015	0.001	1207.895	0.014	0.001			
1007.679	0.001	0.000	1007.484	0.000	0.000			
807.799	-0.077	-0.004	807.295	-0.062	-0.003			
607.517	-0.131	-0.007	608.401	-0.150	-0.007			
406.301	-0.148	-0.007	406.285	-0.249	-0.012			
205.701	-0.059	-0.003	205.685	-0.152	-0.008			
14.686	0.136	0.007	14.645	0.083	0.004			

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MOSDAX Calibration Report 1: EMS - 2652 Module 3008

Full Scale: 2000 (psia)

File: E:\DATA\CAL\0-2018\2000\2JUNE2-1\02652

Pressure Reference: Paroscientific Model 42K-101 S/N 59937

Range: 2K PSI

Date of last reference to traceable standard: Oct 5 2017

EMS - 2652 Jun 02 12:30:14 2018 Range 1 Temp 3.3° C			EMS - 2652 Jun 02 07:51:36 2018 Range 2 Temp 10.3° C			EMS - 2652 Jun 02 03:10:20 2018 Range 3 Temp 20.1° C		
Ref Pres (psia)	Error (psia)	(% FS)	Ref Pres (psia)	Error (psia)	(% FS)	Ref Pres (psia)	Error (psia)	(% FS)
14.846	-0.142	-0.007	14.855	-0.105	-0.005	14.842	-0.118	-0.006
192.843	-0.001	0.000	192.231	-0.010	-0.001	194.509	-0.104	-0.005
393.849	0.122	0.006	393.607	0.068	0.003	390.935	0.064	0.003
587.948	-0.023	-0.001	593.420	0.070	0.003	592.897	0.002	0.000
791.882	-0.022	-0.001	792.296	0.087	0.004	791.655	0.062	0.003
990.911	-0.057	-0.003	991.833	0.075	0.004	991.348	0.019	0.001
1190.327	-0.189	-0.009	1191.049	-0.061	-0.003	1190.921	-0.121	-0.006
1390.264	-0.181	-0.009	1390.953	-0.006	0.000	1390.842	-0.037	-0.002
1589.406	-0.082	-0.004	1589.174	0.014	0.001	1589.397	-0.028	-0.001
1781.525	0.044	0.002	1781.549	0.156	0.008	1781.207	0.088	0.004
1989.515	0.123	0.006	1989.230	0.324	0.016	1989.355	0.295	0.015
1818.398	0.071	0.004	1818.861	0.206	0.010	1816.258	0.129	0.006
1619.022	-0.012	-0.001	1618.518	0.147	0.007	1618.089	0.091	0.005
1412.880	-0.003	0.000	1415.894	0.075	0.004	1413.069	0.081	0.004
1211.907	-0.038	-0.002	1212.127	0.094	0.005	1212.924	0.023	0.001
1009.806	0.075	0.004	1010.514	0.213	0.011	1009.965	0.189	0.009
808.334	0.096	0.005	808.014	0.218	0.011	807.813	0.215	0.011
606.956	0.169	0.008	606.949	0.179	0.009	606.634	0.213	0.011
406.373	0.123	0.006	406.191	0.137	0.007	407.189	0.192	0.010
205.741	0.110	0.006	206.072	0.110	0.005	205.699	0.162	0.008
14.848	-0.083	-0.004	14.863	-0.040	-0.002	14.852	-0.051	-0.003
EMS - 2652 Jun 01 22:31:07 2018 Range 4 Temp 30.0° C			EMS - 2652 Jun 01 17:53:01 2018 Range 5 Temp 39.8° C					
Ref Pres (psia)	Error (psia)	(% FS)	Ref Pres (psia)	Error (psia)	(% FS)			
14.847	-0.019	-0.001	14.838	-0.006	0.000			
194.042	-0.002	0.000	194.229	0.072	0.004			
393.209	0.097	0.005	393.823	0.095	0.005			
593.265	0.087	0.004	592.922	0.099	0.005			
792.056	0.052	0.003	792.743	0.066	0.003			
991.614	0.043	0.002	991.261	0.057	0.003			
1189.236	-0.151	-0.008	1190.280	-0.056	-0.003			
1389.839	-0.128	-0.006	1389.590	-0.057	-0.003			
1588.713	-0.048	-0.002	1588.437	0.020	0.001			
1788.124	0.061	0.003	1789.309	0.187	0.009			
1989.624	0.201	0.010	1989.755	0.368	0.018			
1817.189	0.140	0.007	1818.126	0.224	0.011			
1616.308	0.001	0.000	1615.388	0.129	0.006			
1412.900	0.022	0.001	1413.930	0.177	0.009			
1212.611	0.060	0.003	1208.395	0.080	0.004			
1009.750	0.246	0.012	1009.785	0.309	0.015			
808.478	0.183	0.009	808.128	0.308	0.015			
606.817	0.225	0.011	606.791	0.317	0.016			
406.966	0.233	0.012	407.604	0.144	0.007			
205.745	0.163	0.008	206.494	0.092	0.005			
14.853	-0.013	-0.001	14.839	-0.005	0.000			

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MOSDAX Calibration Report 2: EMS - 2652 Module 3008

Full Scale: 2000 (psia)

File: E:\DATA\CAL\0-2018\2000\2JUNE2-1\02652

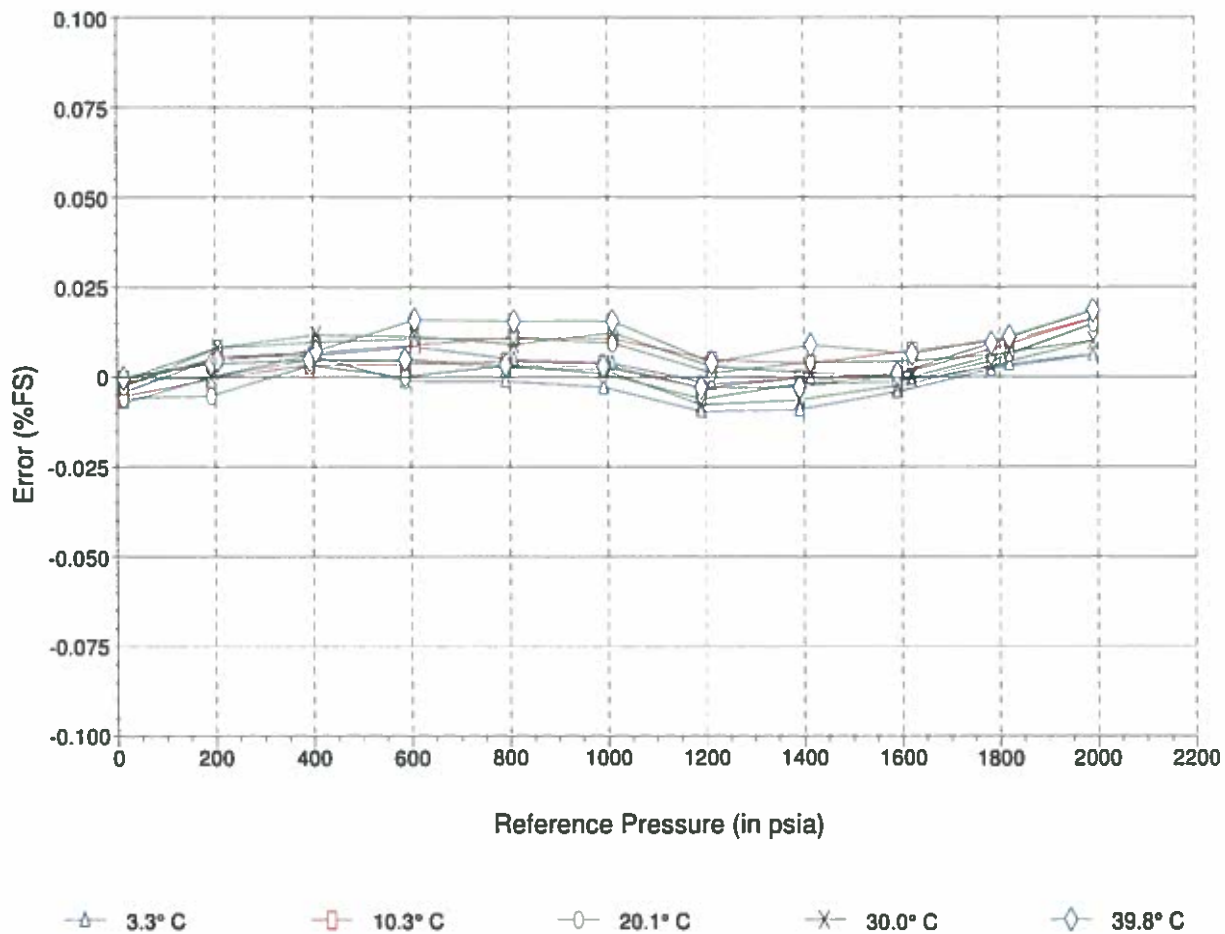
Pressure Reference: Paroscientific Model 42K-101 S/N 59937

Range: 2K PSI

Date of last reference to traceable standard: Oct 5 2017

Plot of Error vs. Reference Pressure

EMS - 2652 Module 3008



Comments

Issued by

As Received MOSDAX Cal. Report 1: EMS - 2652 Module 3008

Full Scale: 2000 (psia)

File: E:\DATA\CAL\0-2018\2000\2JUNE2-1\02652

Pressure Reference: Paroscientific Model 42K-101 S/N 59937

Range: 2K PSI

Date of last reference to traceable standard: Oct 5 2017

EMS - 2652 Jun 02 12:30:14 2018 Range 1 Temp 3.3° C			EMS - 2652 Jun 02 07:51:36 2018 Range 2 Temp 10.3° C			EMS - 2652 Jun 02 03:10:20 2018 Range 3 Temp 20.1° C		
Ref Pres (psia)	Error (psia)	(% FS)	Ref Pres (psia)	Error (psia)	(% FS)	Ref Pres (psia)	Error (psia)	(% FS)
14.846	0.013	0.001	14.855	0.042	0.002	14.842	0.032	0.002
192.843	0.170	0.008	192.231	0.155	0.008	194.509	0.061	0.003
393.849	0.313	0.016	393.607	0.255	0.013	390.935	0.244	0.012
587.948	0.190	0.009	593.420	0.277	0.014	592.897	0.196	0.010
791.882	0.218	0.011	792.296	0.315	0.016	791.655	0.268	0.013
990.911	0.211	0.011	991.833	0.321	0.016	991.348	0.236	0.012
1190.327	0.110	0.005	1191.049	0.204	0.010	1190.921	0.105	0.005
1390.264	0.152	0.008	1390.953	0.279	0.014	1390.842	0.196	0.010
1589.406	0.286	0.014	1589.174	0.318	0.016	1589.397	0.211	0.011
1781.525	0.449	0.022	1781.549	0.476	0.024	1781.207	0.331	0.017
1989.515	0.569	0.028	1989.230	0.662	0.033	1989.355	0.540	0.027
1818.398	0.484	0.024	1818.861	0.530	0.027	1816.258	0.372	0.019
1619.022	0.362	0.018	1618.518	0.453	0.023	1618.089	0.330	0.017
1412.880	0.333	0.017	1415.894	0.362	0.018	1413.069	0.314	0.016
1211.907	0.264	0.013	1212.127	0.362	0.018	1212.924	0.250	0.013
1009.806	0.346	0.017	1010.514	0.462	0.023	1009.965	0.407	0.020
808.334	0.338	0.017	808.014	0.447	0.022	807.813	0.422	0.021
606.956	0.385	0.019	606.949	0.388	0.019	606.634	0.408	0.020
406.373	0.315	0.016	406.191	0.325	0.016	407.189	0.373	0.019
205.741	0.282	0.014	206.072	0.277	0.014	205.699	0.328	0.016
14.848	0.072	0.004	14.863	0.107	0.005	14.852	0.098	0.005
EMS - 2652 Jun 01 22:31:07 2018 Range 4 Temp 30.0° C			EMS - 2652 Jun 01 17:53:01 2018 Range 5 Temp 39.8° C					
Ref Pres (psia)	Error (psia)	(% FS)	Ref Pres (psia)	Error (psia)	(% FS)			
14.847	0.148	0.007	14.838	0.193	0.010			
194.042	0.167	0.008	194.229	0.252	0.013			
393.209	0.270	0.013	393.823	0.259	0.013			
593.265	0.263	0.013	592.922	0.253	0.013			
792.056	0.233	0.012	792.743	0.216	0.011			
991.614	0.229	0.011	991.261	0.209	0.010			
1189.236	0.040	0.002	1190.280	0.104	0.005			
1389.839	0.070	0.003	1389.590	0.117	0.006			
1588.713	0.156	0.008	1588.437	0.215	0.011			
1788.124	0.271	0.014	1789.309	0.410	0.020			
1989.624	0.418	0.021	1989.755	0.624	0.031			
1817.189	0.351	0.018	1818.126	0.450	0.023			
1616.308	0.205	0.010	1615.388	0.327	0.016			
1412.900	0.220	0.011	1413.930	0.354	0.018			
1212.611	0.252	0.013	1208.395	0.241	0.012			
1009.750	0.432	0.022	1009.785	0.462	0.023			
808.478	0.364	0.018	808.128	0.458	0.023			
606.817	0.403	0.020	606.791	0.471	0.024			
406.966	0.406	0.020	407.604	0.307	0.015			
205.745	0.332	0.017	206.494	0.271	0.014			
14.853	0.154	0.008	14.839	0.194	0.010			

Issued by

As Received MOSDAX Cal. Report 2: EMS - 2652 Module 3008

Full Scale: 2000 (psia)

File: E:\DATA\CAL\0-2018\2000\2JUNE2-1\02652

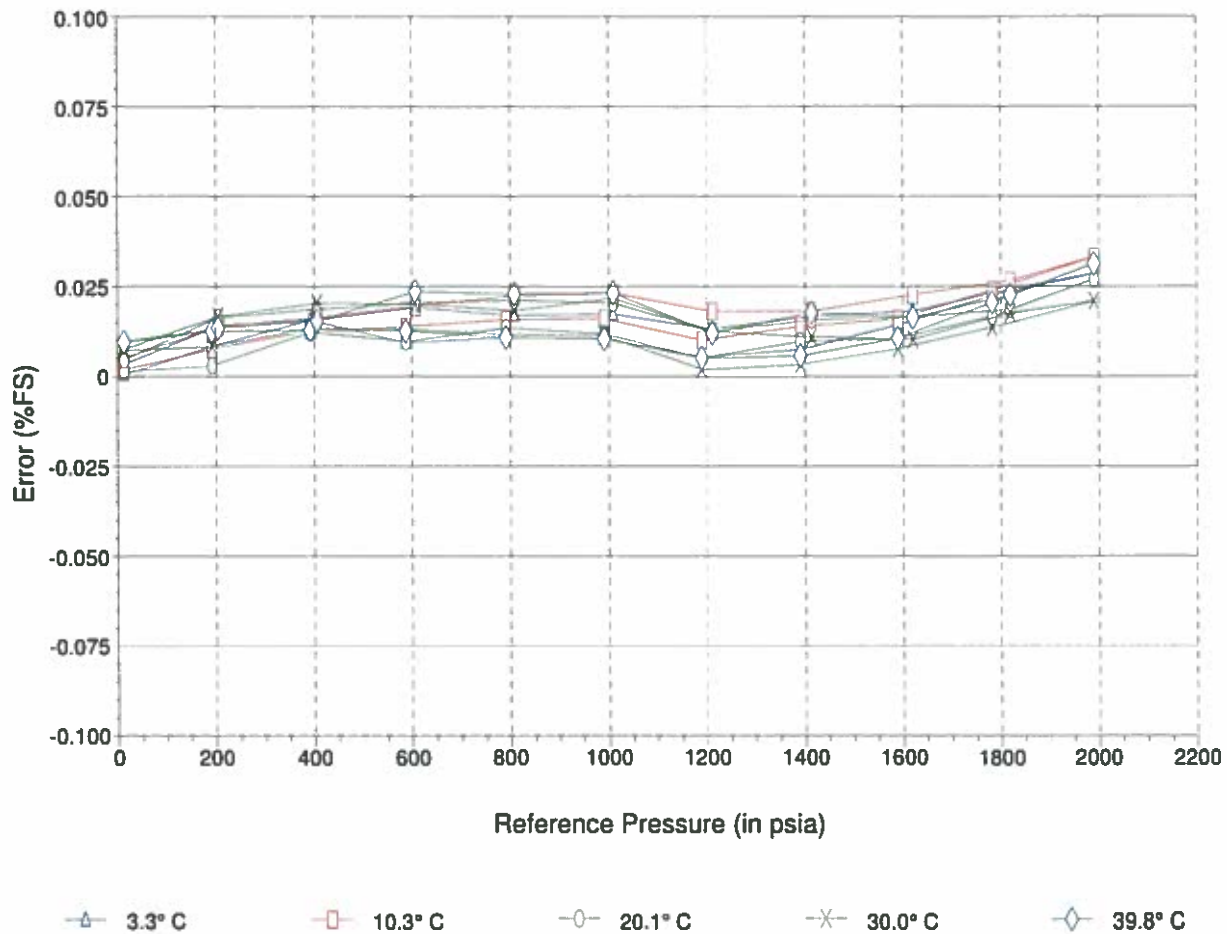
Pressure Reference: Paroscientific Model 42K-101 S/N 59937

Range: 2K PSI

Date of last reference to traceable standard: Oct 5 2017

Plot of Error vs. Reference Pressure

EMS - 2652 Module 3008



Comments

Issued by

APPENDIX C

2018 Laboratory Certificates of Analysis



Golder Associates Ltd. (Ottawa)
ATTN: Dale Holtze
1931 Robertson Road
Ottawa ON K2H 5B7

Date Received: 16-NOV-18
Report Date: 22-NOV-18 16:58 (MT)
Version: FINAL REV. 2

Client Phone: 613-592-9600

Certificate of Analysis

Lab Work Order #: L2197641
Project P.O. #: NOT SUBMITTED
Job Reference: 1789310
C of C Numbers: 17-720417
Legal Site Desc:

Comments: ADDITIONAL 21-NOV-18 16:20
ADDITIONAL 19-NOV-18 17:56

Joanne Lee
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2197641-1 GW 10-NOV-18 17:30 ZONE 2	L2197641-2 GW 10-NOV-18 17:30 ZONE 22	L2197641-3 GW 11-NOV-18 17:30 ZONE 4	L2197641-4 GW 11-NOV-18 17:30 ZONE 44	L2197641-5 GW 12-NOV-18 17:30 ZONE 3
Grouping	Analyte					
SEAWATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	6260	6260	5160	5150	2600
Total Metals	Aluminum (Al)-Total (mg/L)	0.118	0.126	0.0140	0.0139	0.0128
	Antimony (Sb)-Total (mg/L)	0.00126	0.00129	0.00180	0.00186	0.00322
	Arsenic (As)-Total (mg/L)	<0.0020	<0.0020	0.0021	0.0022	0.0032
	Barium (Ba)-Total (mg/L)	0.102	0.0985	0.493	0.510	0.0918
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Total (mg/L)	1.86	1.72	0.97	1.00	1.10
	Cadmium (Cd)-Total (mg/L)	<0.000050	<0.000050	<0.000050	0.000055	<0.000050
	Calcium (Ca)-Total (mg/L)	2710	2580	2040	1920	991
	Cesium (Cs)-Total (mg/L)	0.00190	0.00184	0.00075	0.00077	<0.00050
	Chromium (Cr)-Total (mg/L)	0.00246	0.00119	0.0130	0.0127	0.00999
	Cobalt (Co)-Total (mg/L)	0.000120	0.000101	0.000237	0.000231	0.000166
	Copper (Cu)-Total (mg/L)	0.00272	0.00303	0.00113	0.00102	<0.00050
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Total (mg/L)	0.555	0.584	0.366	0.354	0.076
	Lead (Pb)-Total (mg/L)	0.00460	0.00472	<0.00030	<0.00030	<0.00030
	Lithium (Li)-Total (mg/L)	2.33	2.14	1.48	1.65	0.802
	Magnesium (Mg)-Total (mg/L)	<1.0	<1.0	55.3	53.3	1.2
	Manganese (Mn)-Total (mg/L)	0.0215	0.0228	0.0816	0.0752	0.0181
	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Total (mg/L)	0.0096	0.0092	0.0130	0.0141	0.0172
	Nickel (Ni)-Total (mg/L)	0.00276	0.00190	0.00818	0.00817	0.00703
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	106	100	67.1	70.8	35.9
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Rubidium (Rb)-Total (mg/L)	0.171	0.171	0.0933	0.101	0.0559
	Selenium (Se)-Total (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Silicon (Si)-Total (mg/L)	3.2	3.6	2.2	1.9	2.7
	Silver (Ag)-Total (mg/L)	0.00034	0.00038	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Total (mg/L)	379	372	326	318	275
	Strontium (Sr)-Total (mg/L)	47.3	47.5	34.8	34.4	16.9
	Sulfur (S)-Total (mg/L)	<5.0	<5.0	<5.0	<5.0	<5.0
	Tellurium (Te)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID				
		Description				
		Sampled Date				
		Sampled Time				
		Client ID				
		L2197641-6				
		GW				
		12-NOV-18				
		17:30				
		ZONE 33				
Grouping	Analyte					
SEAWATER						
Physical Tests	Hardness (as CaCO ₃) (mg/L)	2740				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0126				
	Antimony (Sb)-Total (mg/L)	0.00339				
	Arsenic (As)-Total (mg/L)	0.0038				
	Barium (Ba)-Total (mg/L)	0.0956				
	Beryllium (Be)-Total (mg/L)	<0.00050				
	Bismuth (Bi)-Total (mg/L)	<0.00050				
	Boron (B)-Total (mg/L)	1.19				
	Cadmium (Cd)-Total (mg/L)	<0.000050				
	Calcium (Ca)-Total (mg/L)	1080				
	Cesium (Cs)-Total (mg/L)	<0.00050				
	Chromium (Cr)-Total (mg/L)	0.00674				
	Cobalt (Co)-Total (mg/L)	0.000111				
	Copper (Cu)-Total (mg/L)	<0.00050				
	Gallium (Ga)-Total (mg/L)	<0.00050				
	Iron (Fe)-Total (mg/L)	0.064				
	Lead (Pb)-Total (mg/L)	<0.00030				
	Lithium (Li)-Total (mg/L)	0.850				
	Magnesium (Mg)-Total (mg/L)	1.2				
	Manganese (Mn)-Total (mg/L)	0.0171				
	Mercury (Hg)-Total (mg/L)	<0.000010				
	Molybdenum (Mo)-Total (mg/L)	0.0184				
	Nickel (Ni)-Total (mg/L)	0.00436				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	39.7				
	Rhenium (Re)-Total (mg/L)	<0.00050				
	Rubidium (Rb)-Total (mg/L)	0.0564				
	Selenium (Se)-Total (mg/L)	<0.0020				
	Silicon (Si)-Total (mg/L)	2.8				
	Silver (Ag)-Total (mg/L)	<0.00010				
	Sodium (Na)-Total (mg/L)	300				
	Strontium (Sr)-Total (mg/L)	17.2				
	Sulfur (S)-Total (mg/L)	<5.0				
	Tellurium (Te)-Total (mg/L)	<0.00050				
	Thallium (Tl)-Total (mg/L)	<0.000050				
	Thorium (Th)-Total (mg/L)	<0.00050				
	Tin (Sn)-Total (mg/L)	<0.0010				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2197641-1 GW 10-NOV-18 17:30 ZONE 2	L2197641-2 GW 10-NOV-18 17:30 ZONE 22	L2197641-3 GW 11-NOV-18 17:30 ZONE 4	L2197641-4 GW 11-NOV-18 17:30 ZONE 44	L2197641-5 GW 12-NOV-18 17:30 ZONE 3
Grouping	Analyte						
SEAWATER							
Total Metals	Titanium (Ti)-Total (mg/L)	0.0070	0.0075	<0.0050	<0.0050	<0.0050	
	Tungsten (W)-Total (mg/L)	0.0815	0.0854	0.0470	0.0462	0.0736	
	Uranium (U)-Total (mg/L)	0.000283	0.000304	<0.000050	<0.000050	0.000160	
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Total (mg/L)	0.0374	0.0410	0.0625	0.0605	0.0395	
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0219	0.0176	0.0085	0.0076	0.0126	
	Antimony (Sb)-Dissolved (mg/L)	0.00125	0.00128	0.00163	0.00172	0.00308	
	Arsenic (As)-Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	0.0034	
	Barium (Ba)-Dissolved (mg/L)	0.0986	0.0996	0.466	0.489	0.0902	
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Dissolved (mg/L)	1.76	1.88	0.90	0.95	1.04	
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Calcium (Ca)-Dissolved (mg/L)	2510	2510	1970	1970	1040	
	Cesium (Cs)-Dissolved (mg/L)	0.00189	0.00195	0.00075	0.00074	<0.00050	
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Copper (Cu)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Dissolved (mg/L)	0.013	0.013	0.112	0.105	0.018	
	Lead (Pb)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	
	Lithium (Li)-Dissolved (mg/L)	2.25	2.16	1.42	1.52	0.779	
	Magnesium (Mg)-Dissolved (mg/L)	<1.0	<1.0	57.8	53.9	1.2	
	Manganese (Mn)-Dissolved (mg/L)	0.0171	0.0164	0.0836	0.0812	0.0184	
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Molybdenum (Mo)-Dissolved (mg/L)	0.0090	0.0093	0.0112	0.0116	0.0154	
	Nickel (Ni)-Dissolved (mg/L)	0.00118	0.00122	<0.00050	<0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	99	98	67	66	38	
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	Rubidium (Rb)-Dissolved (mg/L)	0.173	0.174	0.0891	0.0914	0.0549	
	Selenium (Se)-Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	
	Silicon (Si)-Dissolved (mg/L)	2.8	2.7	2.3	2.2	3.0	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID				
		Description				
		Sampled Date				
		Sampled Time				
		Client ID				
		L2197641-6				
		GW				
		12-NOV-18				
		17:30				
		ZONE 33				
Grouping	Analyte					
SEAWATER						
Total Metals	Titanium (Ti)-Total (mg/L)	<0.0050				
	Tungsten (W)-Total (mg/L)	0.0756				
	Uranium (U)-Total (mg/L)	0.000164				
	Vanadium (V)-Total (mg/L)	<0.00050				
	Yttrium (Y)-Total (mg/L)	<0.00050				
	Zinc (Zn)-Total (mg/L)	0.0477				
	Zirconium (Zr)-Total (mg/L)	<0.00050				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0115				
	Antimony (Sb)-Dissolved (mg/L)	0.00300				
	Arsenic (As)-Dissolved (mg/L)	0.0034				
	Barium (Ba)-Dissolved (mg/L)	0.0854				
	Beryllium (Be)-Dissolved (mg/L)	<0.00050				
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050				
	Boron (B)-Dissolved (mg/L)	1.02				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050				
	Calcium (Ca)-Dissolved (mg/L)	1090				
	Cesium (Cs)-Dissolved (mg/L)	<0.00050				
	Chromium (Cr)-Dissolved (mg/L)	<0.00050				
	Cobalt (Co)-Dissolved (mg/L)	<0.000050				
	Copper (Cu)-Dissolved (mg/L)	<0.00050				
	Gallium (Ga)-Dissolved (mg/L)	<0.00050				
	Iron (Fe)-Dissolved (mg/L)	0.019				
	Lead (Pb)-Dissolved (mg/L)	<0.00030				
	Lithium (Li)-Dissolved (mg/L)	0.749				
	Magnesium (Mg)-Dissolved (mg/L)	1.2				
	Manganese (Mn)-Dissolved (mg/L)	0.0181				
	Mercury (Hg)-Dissolved (mg/L)	<0.000010				
	Molybdenum (Mo)-Dissolved (mg/L)	0.0144				
	Nickel (Ni)-Dissolved (mg/L)	<0.00050				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	40				
	Rhenium (Re)-Dissolved (mg/L)	<0.00050				
	Rubidium (Rb)-Dissolved (mg/L)	0.0528				
	Selenium (Se)-Dissolved (mg/L)	<0.0020				
	Silicon (Si)-Dissolved (mg/L)	3.0				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2197641-1 GW 10-NOV-18 17:30 ZONE 2	L2197641-2 GW 10-NOV-18 17:30 ZONE 22	L2197641-3 GW 11-NOV-18 17:30 ZONE 4	L2197641-4 GW 11-NOV-18 17:30 ZONE 44	L2197641-5 GW 12-NOV-18 17:30 ZONE 3
Grouping	Analyte					
SEAWATER						
Dissolved Metals	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Dissolved (mg/L)	353	368	309	320	280
	Strontium (Sr)-Dissolved (mg/L)	44.9	45.3	33.6	33.6	16.9
	Sulfur (S)-Dissolved (mg/L)	<5.0	<5.0	<5.0	<5.0	<5.0
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Tungsten (W)-Dissolved (mg/L)	0.0806	0.0789	0.0455	0.0443	0.0722
	Uranium (U)-Dissolved (mg/L)	0.000235	0.000238	<0.000050	<0.000050	0.000160
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0030	<0.0030	0.0096	0.0100	<0.0030
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2197641-6 GW 12-NOV-18 17:30 ZONE 33				
Grouping	Analyte					
SEAWATER						
Dissolved Metals	Silver (Ag)-Dissolved (mg/L)	<0.00010				
	Sodium (Na)-Dissolved (mg/L)	301				
	Strontium (Sr)-Dissolved (mg/L)	17.2				
	Sulfur (S)-Dissolved (mg/L)	<5.0				
	Tellurium (Te)-Dissolved (mg/L)	<0.00050				
	Thallium (Tl)-Dissolved (mg/L)	<0.000050				
	Thorium (Th)-Dissolved (mg/L)	<0.00050				
	Tin (Sn)-Dissolved (mg/L)	<0.0010				
	Titanium (Ti)-Dissolved (mg/L)	<0.0050				
	Tungsten (W)-Dissolved (mg/L)	0.0687				
	Uranium (U)-Dissolved (mg/L)	0.000144				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Yttrium (Y)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0030				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2197641-1 GW 10-NOV-18 17:30 ZONE 2	L2197641-2 GW 10-NOV-18 17:30 ZONE 22	L2197641-3 GW 11-NOV-18 17:30 ZONE 4	L2197641-4 GW 11-NOV-18 17:30 ZONE 44	L2197641-5 GW 12-NOV-18 17:30 ZONE 3
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	16700	16800	13900	14000	7530
	pH (pH)	8.13	8.22	6.97	6.94	7.40
	Total Suspended Solids (mg/L)	17.3	32.5	24.3	20.3	7.9
	Total Dissolved Solids (mg/L)	10900	10800	9030	8820	5100
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	61.8	61.2	10.2	10.4	50.5
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	61.8	61.2	10.2	10.4	50.5
	Ammonia, Total (as N) (mg/L)	0.142	0.141	0.157	0.158	0.139
	Bromide (Br) (mg/L)	76.1	76.8	69.7	60.1	32.7
	Chloride (Cl) (mg/L)	5900	5910	5220	4530	2700
	Fluoride (F) (mg/L)	<1.0 ^{DLDS}	<1.0 ^{DLDS}	<1.0 ^{DLDS}	<1.0 ^{DLDS}	<1.0 ^{DLDS}
	Nitrate (as N) (mg/L)	<0.25 ^{DLDS}	<0.25 ^{DLDS}	<0.25 ^{DLDS}	<0.25 ^{DLDS}	<0.25 ^{DLDS}
	Nitrite (as N) (mg/L)	<0.050 ^{DLDS}	<0.050 ^{DLDS}	<0.050 ^{DLDS}	<0.050 ^{DLDS}	<0.050 ^{DLDS}
	Phosphorus (P)-Total (mg/L)	0.0120	0.0132	0.0067	0.0059	0.0061
	Sulfate (SO4) (mg/L)	<15 ^{DLDS}	<15 ^{DLDS}	<15 ^{DLDS}	<15 ^{DLDS}	<15 ^{DLDS}

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID				
		Description				
		Sampled Date				
		Sampled Time				
		Client ID				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	7350				
	pH (pH)	7.50				
	Total Suspended Solids (mg/L)	7.5				
	Total Dissolved Solids (mg/L)	4980				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	50.1				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	50.1				
	Ammonia, Total (as N) (mg/L)	0.136				
	Bromide (Br) (mg/L)	32.5				
	Chloride (Cl) (mg/L)	2700				
	Fluoride (F) (mg/L)	<1.0 ^{DLDS}				
	Nitrate (as N) (mg/L)	<0.25 ^{DLDS}				
	Nitrite (as N) (mg/L)	<0.050 ^{DLDS}				
	Phosphorus (P)-Total (mg/L)	0.0082				
	Sulfate (SO4) (mg/L)	<15 ^{DLDS}				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
WSMT	Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2197641-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2197641-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2197641-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Total	MS-B	L2197641-1, -2, -3, -4, -5, -6
Matrix Spike	Lithium (Li)-Total	MS-B	L2197641-1, -2, -3, -4, -5, -6
Matrix Spike	Potassium (K)-Total	MS-B	L2197641-1, -2, -3, -4, -5, -6
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2197641-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Total	MS-B	L2197641-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Total	MS-B	L2197641-1, -2, -3, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CL-L-IC-N-VA	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
HARDNESS-CALC-VA	Seawater	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-DIS-C-CVAFS-VA	Seawater	Diss. Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7
This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
HG-TOT-C-CVAFS-VA	Seawater	Total Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7
This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedure involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			

Reference Information

MET-D-L-HRMS-VA	Seawater	Diss. Metals in Seawater by HR-ICPMS	EPA 200.8
Trace metals in seawater are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) based on US EPA Method 200.8, (Revision 5.5). The procedures may involve laboratory sample filtration based on APHA Method 3030B.			
MET-T-L-HRMS-VA	Seawater	Tot. Metals in Seawater by HR-ICPMS	EPA 200.8
Trace metals in seawater are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) based on US EPA Method 200.8, (Revision 5.5). The procedures may involve preliminary sample treatment by acid digestion based on APHA Method 3030E.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
P-T-PRES-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorus
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.			
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.			
Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-LOW-VA	Water	Low Level TDS (3.0mg/L) by Gravimetric	APHA 2540C
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total dissolved solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

17-720417

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

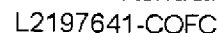
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Canada Toll Free: 1 800 668 9878

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Page of

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION



Golder Associates Ltd. (Ottawa)
ATTN: Dale Holtze
1931 Robertson Road
Ottawa ON K2H 5B7

Date Received: 19-NOV-18
Report Date: 22-NOV-18 17:29 (MT)
Version: FINAL

Client Phone: 613-592-9600

Certificate of Analysis

Lab Work Order #: L2198327
Project P.O. #: NOT SUBMITTED
Job Reference: 1789310
C of C Numbers: 18-1789310
Legal Site Desc:

Joanne Lee
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2198327-1 Groundwater 13-NOV-18 17:00 ZONE 6	L2198327-2 Groundwater 13-NOV-18 17:00 ZONE 66	L2198327-3 Groundwater 13-NOV-18 15:00 EB	L2198327-4 Groundwater 13-NOV-18 15:30 TB	
Grouping	Analyte					
SEAWATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	3630	3620	<4.8	<4.8	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0118	0.0127	<0.0050		
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Arsenic (As)-Total (mg/L)	0.0024	0.0024	<0.0020		
	Barium (Ba)-Total (mg/L)	0.859	0.894	<0.0010		
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Boron (B)-Total (mg/L)	0.41	0.40	<0.10		
	Cadmium (Cd)-Total (mg/L)	<0.000050	<0.000050	<0.000050		
	Calcium (Ca)-Total (mg/L)	1330	1370	<1.0		
	Cesium (Cs)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Chromium (Cr)-Total (mg/L)	0.00383	0.00381	<0.00050		
	Cobalt (Co)-Total (mg/L)	0.000072	0.000093	<0.000050		
	Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Iron (Fe)-Total (mg/L)	0.314	0.322	<0.010		
	Lead (Pb)-Total (mg/L)	<0.00030	<0.00030	<0.00030		
	Lithium (Li)-Total (mg/L)	0.558	0.563	<0.020		
	Magnesium (Mg)-Total (mg/L)	40.6	39.8	<1.0		
	Manganese (Mn)-Total (mg/L)	0.101	0.103	<0.00020		
	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	<0.000010		
	Molybdenum (Mo)-Total (mg/L)	0.0279	0.0270	<0.0020		
	Nickel (Ni)-Total (mg/L)	0.00288	0.00262	<0.00050		
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Total (mg/L)	9.7	10.1	<1.0		
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Rubidium (Rb)-Total (mg/L)	0.0166	0.0164	<0.0050		
	Selenium (Se)-Total (mg/L)	<0.0020	<0.0020	<0.0020		
	Silicon (Si)-Total (mg/L)	2.6	2.5	<1.0		
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
	Sodium (Na)-Total (mg/L)	232	238	<1.0		
	Strontium (Sr)-Total (mg/L)	18.1	18.6	<0.010		
	Sulfur (S)-Total (mg/L)	<5.0	<5.0	<5.0		
	Tellurium (Te)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050	<0.000050		
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2198327-1 Groundwater 13-NOV-18 17:00 ZONE 6	L2198327-2 Groundwater 13-NOV-18 17:00 ZONE 66	L2198327-3 Groundwater 13-NOV-18 15:00 EB	L2198327-4 Groundwater 13-NOV-18 15:30 TB	
Grouping	Analyte					
SEAWATER						
Total Metals	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050	<0.0050		
	Tungsten (W)-Total (mg/L)	0.0214	0.0223	<0.0010		
	Uranium (U)-Total (mg/L)	<0.000050	<0.000050	<0.000050		
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Zinc (Zn)-Total (mg/L)	0.109	0.113	<0.0030		
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	0.00050	<0.00050	<0.00050	
	Arsenic (As)-Dissolved (mg/L)	0.0021	0.0024	<0.0020	<0.0020	
	Barium (Ba)-Dissolved (mg/L)	0.818	0.794	<0.0010	<0.0010	
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Dissolved (mg/L)	0.36	0.35	<0.10	<0.10	
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Calcium (Ca)-Dissolved (mg/L)	1380	1380	<1.0	<1.0	
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Copper (Cu)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Dissolved (mg/L)	0.251	0.256	<0.010	<0.010	
	Lead (Pb)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
	Lithium (Li)-Dissolved (mg/L)	0.533	0.520	<0.020	<0.020	
	Magnesium (Mg)-Dissolved (mg/L)	42.8	42.8	<1.0	<1.0	
	Manganese (Mn)-Dissolved (mg/L)	0.0961	0.0970	<0.00020	<0.00020	
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Molybdenum (Mo)-Dissolved (mg/L)	0.0257	0.0245	<0.0020	<0.0020	
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	<20	<20	<20	<20	
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Rubidium (Rb)-Dissolved (mg/L)	0.0151	0.0146	<0.0050	<0.0050	
	Selenium (Se)-Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	
	Silicon (Si)-Dissolved (mg/L)	2.8	2.7	<1.0	<1.0	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2198327-1 Groundwater 13-NOV-18 17:00 ZONE 6	L2198327-2 Groundwater 13-NOV-18 17:00 ZONE 66	L2198327-3 Groundwater 13-NOV-18 15:00 EB	L2198327-4 Groundwater 13-NOV-18 15:30 TB	
Grouping	Analyte					
SEAWATER						
Dissolved Metals	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Sodium (Na)-Dissolved (mg/L)	253	250	<20	<20	
	Strontium (Sr)-Dissolved (mg/L)	19.5	19.7	<0.050	<0.050	
	Sulfur (S)-Dissolved (mg/L)	<5.0	<5.0	<5.0	<5.0	
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Tungsten (W)-Dissolved (mg/L)	0.0214	0.0208	<0.0010	<0.0010	
	Uranium (U)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.0244	0.0230	<0.0030	<0.0030	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2198327-1 Groundwater 13-NOV-18 17:00 ZONE 6	L2198327-2 Groundwater 13-NOV-18 17:00 ZONE 66	L2198327-3 Groundwater 13-NOV-18 15:00 EB	L2198327-4 Groundwater 13-NOV-18 15:30 TB	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	8720	8780	<2.0	<2.0	
	pH (pH)	6.58	6.65	5.76	5.98	
	Total Suspended Solids (mg/L)	8.3	9.5	<3.0	<3.0	
	Total Dissolved Solids (mg/L)	5580	5410	<3.0	<3.0	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	27.2	26.4	<1.0	<1.0	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	27.2	26.4	<1.0	<1.0	
	Ammonia, Total (as N) (mg/L)	0.443	0.437	<0.0050	<0.0050	
	Bromide (Br) (mg/L)	40.9	41.4	<0.050	<0.050	
	Chloride (Cl) (mg/L)	3010	3060	<0.50	<0.50	
	Fluoride (F) (mg/L)	<1.0 ^{DLDS}	<1.0 ^{DLDS}	<0.020	<0.020	
	Nitrate (as N) (mg/L)	<0.25 ^{DLDS}	<0.25 ^{DLDS}	<0.0050	<0.0050	
	Nitrite (as N) (mg/L)	<0.050 ^{DLDS}	<0.050 ^{DLDS}	<0.0010	<0.0010	
	Phosphorus (P)-Total (mg/L)	0.0043	0.0052	<0.0020	<0.0020	
	Sulfate (SO4) (mg/L)	<15 ^{DLDS}	<15 ^{DLDS}	<0.30	<0.30	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.

Qualifiers for Individual Samples Listed:

Sample Number	Client Sample ID	Qualifier	Description
L2198327-1	ZONE 6	WSMT	Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
L2198327-2	ZONE 66	WSMT	Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
L2198327-3	EB	WSMT	Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2198327-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2198327-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2198327-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2198327-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
HARDNESS-CALC-VA	Seawater	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-DIS-C-CVAFS-VA	Seawater	Diss. Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7
This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
HG-TOT-C-CVAFS-VA	Seawater	Total Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7
This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedure involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method			

Reference Information

245.7).

MET-D-L-HRMS-VA Seawater Diss. Metals in Seawater by HR-ICPMS EPA 200.8

Trace metals in seawater are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) based on US EPA Method 200.8, (Revision 5.5). The procedures may involve laboratory sample filtration based on APHA Method 3030B.

MET-T-L-HRMS-VA Seawater Tot. Metals in Seawater by HR-ICPMS EPA 200.8

Trace metals in seawater are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) based on US EPA Method 200.8, (Revision 5.5). The procedures may involve preliminary sample treatment by acid digestion based on APHA Method 3030E.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-LOW-VA Water Low Level TDS (3.0mg/L) by Gravimetric APHA 2540C

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total dissolved solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

18-1789310

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



12198327-COFC

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # 18-1789310

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APPENDIX D

2016 Laboratory Certificate of Analysis – Brine Fluid

Certificat d'analyse

Client : Agnico-Eagle CSD - Amaruq Study

Responsable : Mme Odrée-Maude Vachon

Adresse : CSD

tél.: (819) 759-3555 ()

fax.: (000) 000-0000

Numéro de projet : V-52584

Lieu de prélèvement : Brine Fluid

Date de prélèvement : 17 avril 2016

Échantillon : Brine Fluid

Heure de prélèvement : N/D

Nom du préleveur : N/D

Date de réception : 19 avril 2016

Type d'échantillon : Eau surface

Réseau:

Certificat corrigé, remplace le certificat V-52584 émis le 09 mai 2016

Les résultats ne se rapportent qu'aux échantillons soumis pour analyse.

Les échantillons seront conservés pendant 30 jours à partir de la date du rapport à moins d'avis écrit du client.

Sauf indication contraire, tous les échantillons ont été reçus en bon état.

Toute reproduction, sinon en entier, est interdite sans l'autorisation écrite du laboratoire.

Certificat d'analyse

Numéro de projet : V-52584

Échantillon : Brine Fluid

Date de prélèvement : 17 avril 2016

Lieu de prélèvement : Brine Fluid

Heure de prélèvement : N/D

Paramètres	Résultats	Méthode d'analyse	Date d'analyse
Aluminium (Al)	0.498 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Antimoine (Sb)	0.0354 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Argent (Ag)	<0.0001 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Arsenic (As)	0.7662 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Baryum (Ba)	0.1126 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Béryllium (Be)	<0.0005 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Bicarbonate (HCO ₃)	27 mg CaCO ₃ /L	M-TIT-1.0	19 avril 2016
Bismuth (Bi)	<0.0005 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Bore (B)	13.2 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Bromures	1066 mg/L	Sous-traitance\Multilab Direct	22 avril 2016
Cadmium (Cd)	<0.00002 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Calcium (Ca)	42266 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Carbone inorganique total (C.I.T.)	2.1 mg/L	M-COT-1.0	19 avril 2016
Carbone organique total (C.O.T.)	28.5 mg/L	M-COT-1.0	19 avril 2016
Chlorure (Cl)	83700 mg/L	Sous-traitance\Multilab Direct	29 avril 2016
Chrome (Cr)	<0.0006 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Cobalt (Co)	0.0406 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Conductivité	55420 µmhos/cm	M-TIT-1.0	19 avril 2016
Cuivre (Cu)	0.0039 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Dureté	105554 mg CaCO ₃ /L	Sous-traitance\Multilab Direct	20 avril 2016
Étain (Sn)	<0.001 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Fer (Fe)	2.60 mg/L	Sous-traitance\Multilab Direct	22 avril 2016
Fluorures (F)	0.06 mg/L	Sous-traitance\Multilab Direct	27 avril 2016
Lithium (Li)	34.52 mg/L	Sous-traitance\Multilab Direct	22 avril 2016
Magnésium (Mg)	3.92 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Manganèse (Mn)	<0.0005 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Mercure (Hg)	0.00039 mg/L	Sous-traitance\Multilab Direct	21 avril 2016
Molybdène (Mo)	<0.0005 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
NH ₃ (NH ₃ non-ionisé)	1.52 mg N/L	Sous-traitance\Multilab Direct	20 avril 2016
NH ₄	0.67 mg N/L	Sous-traitance\Multilab Direct	20 avril 2016
Nickel (Ni)	1.350 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Nitrates (NO ₃)	0.54 mg N/L	Sous-traitance\Multilab Direct	19 avril 2016
Nitrites (NO ₂)	0.06 mg N/L	Sous-traitance\Multilab Direct	21 avril 2016
pH	10.02	M-TIT-1.0	19 avril 2016
Plomb (Pb)	<0.0003 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Potassium (K)	1717 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Radium (RA 226)	<0.066 Becquerels/L	M-RA-2.0	02 mai 2016
Sélénium (Se)	3.83 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Silice (Si)	2.93 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Sodium (Na)	838 mg/L	Sous-traitance\Multilab Direct	20 avril 2016

Sauf indication contraire, tous les échantillons ont été reçus en bon état.

Toute reproduction, sinon en entier, est interdite sans l'autorisation écrite du laboratoire.

Certificat d'analyse

Numéro de projet : V-52584

Échantillon : Brine Fluid

Lieu de prélèvement : Brine Fluid

Date de prélèvement : 17 avril 2016

Heure de prélèvement : N/D

Paramètres	Résultats	Méthode d'analyse	Date d'analyse
Solides dissous	36946 mg/L	M-TIT-1.0	19 avril 2016
Solides totaux	149736 mg/L	M-SOLI-1.0	27 avril 2016
Strontium (Sr)	656 mg/L	Sous-traitance\Multilab Direct	22 avril 2016
Tellure (Te)	<0.0005 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Thallium (Tl)	<0.002 mg/L	Sous-traitance\Multilab Direct	22 avril 2016
Titane (Ti)	45.2 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Uranium (U)	<0.001 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Vanadium (V)	<0.0005 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Zinc (Zn)	<0.001 mg/L	Sous-traitance\Multilab Direct	20 avril 2016
Alcalinité	145 mg CaCO ₃ /L	M-TIT-1.0	20 avril 2016
Sulfate (SO ₄)	<0.6 mg SO ₄ /L	Sous-traitance\Multilab Direct	12 mai 2016

Sauf indication contraire, tous les échantillons ont été reçus en bon état.
Toute reproduction, sinon en entier, est interdite sans l'autorisation écrite du laboratoire.

Limite de détection rapportée

Numéro de projet : V-52584

Échantillon : Brine Fluid

Date de prélèvement : 17 avril 2016

Lieu de prélèvement : Brine Fluid

Heure de prélèvement : N/D

Paramètre	Valeur	Unité	Méthode	Accréditation
Aluminium (Al)	0.006	mg/L	Sous-traitance	
Antimoine (Sb)	0.0001	mg/L	Sous-traitance	Oui
Argent (Ag)	0.0001	mg/L	Sous-traitance	Oui
Arsenic (As)	0.0005	mg/L	Sous-traitance	Oui
Baryum (Ba)	0.0005	mg/L	Sous-traitance	Oui
Béryllium (Be)	0.0005	mg/L	Sous-traitance	
Bicarbonate (HCO ₃)	2	mg CaCO ₃ /L	M-TIT-1.0	
Bismuth (Bi)	0.0005	mg/L	Sous-traitance	
Bore (B)	0.01	mg/L	Sous-traitance	Oui
Bromures	0.01	mg/L	Sous-traitance	
Cadmium (Cd)	0.00002	mg/L	Sous-traitance	Oui
Calcium (Ca)	0.03	mg/L	Sous-traitance	Oui
Carbone inorganique total (C.I.T.)	0.2	mg/L	M-COT-1.0	--
Carbone organique total (C.O.T.)	0.2	mg/L	M-COT-1.0	Oui
Chlorure (Cl)	0.5	mg/L	Sous-traitance	Oui
Chrome (Cr)	0.0006	mg/L	Sous-traitance	Oui
Cobalt (Co)	0.0005	mg/L	Sous-traitance	
Conductivité	1	µmhos/cm	M-TIT-1.0	Oui
Cuivre (Cu)	0.0005	mg/L	Sous-traitance	Oui
Dureté	1	mg CaCO ₃ /L	Sous-traitance	
Étain (Sn)	0.001	mg/L	Sous-traitance	Oui
Fer (Fe)	0.01	mg/L	Sous-traitance	Oui
Fluorures (F)	0.02	mg/L	Sous-traitance	Oui
Lithium (Li)	0.005	mg/L	Sous-traitance	
Magnésium (Mg)	0.02	mg/L	Sous-traitance	Oui
Manganèse (Mn)	0.0005	mg/L	Sous-traitance	Oui
Mercure (Hg)	0.00001	mg/L	Sous-traitance	Oui
Molybdène (Mo)	0.0005	mg/L	Sous-traitance	Oui
NH ₃ (NH ₃ non-ionisé)	0.01	mg N/L	Sous-traitance	-
NH ₄	0.01	mg N/L	Sous-traitance	-
Nickel (Ni)	0.0005	mg/L	Sous-traitance	Oui
Nitrates (NO ₃)	0.01	mg N/L	Sous-traitance	Oui
Nitrites (NO ₂)	0.01	mg N/L	Sous-traitance	Oui
pH			M-TIT-1.0	Oui
Plomb (Pb)	0.0003	mg/L	Sous-traitance	Oui
Potassium (K)	0.05	mg/L	Sous-traitance	
Radium (RA 226)	0.002	Becquerels/L	M-RA-2.0	Oui
Sélénium (Se)	0.001	mg/L	Sous-traitance	Oui
Silice (Si)	0.01	mg/L	Sous-traitance	
Sodium (Na)	0.05	mg/L	Sous-traitance	Oui

Sauf indication contraire, tous les échantillons ont été reçus en bon état.

Toute reproduction, sinon en entier, est interdite sans l'autorisation écrite du laboratoire.

Limite de détection rapportée

Numéro de projet : V-52584

Échantillon : Brine Fluid

Date de prélèvement : 17 avril 2016

Lieu de prélèvement : Brine Fluid

Heure de prélèvement : N/D

Paramètre	Valeur	Unité	Méthode	Accréditation
Solides dissous	1	mg/L	M-TIT-1.0	
Solides totaux	2	mg/L	M-SOLI-1.0	Oui
Strontium (Sr)	0.005	mg/L	Sous-traitance	
Tellure (Te)	0.0005	mg/L	Sous-traitance	
Thallium (Tl)	0.002	mg/L	Sous-traitance	
Titane (Ti)	0.01	mg/L	Sous-traitance	
Uranium (U)	0.001	mg/L	Sous-traitance	
Vanadium (V)	0.0005	mg/L	Sous-traitance	Oui
Zinc (Zn)	0.001	mg/L	Sous-traitance	Oui
Alcalinité	2	mg CaCO ₃ /L	M-TIT-1.0	
Sulfate (SO ₄)	0.6	mg SO ₄ /L	Sous-traitance	Oui

Sauf indication contraire, tous les échantillons ont été reçus en bon état.
Toute reproduction, sinon en entier, est interdite sans l'autorisation écrite du laboratoire.

Certificat contrôle qualité

Numéro de projet : V-52584

Échantillon : Brine Fluid

Date de prélèvement : 17 avril 2016

Lieu de prélèvement : Brine Fluid

Heure de prélèvement : N/D

Paramètres

Alcalinité mg CaCO₃/L Nom Standard STD alcalinité

Valeur obtenue 144

Justesse 99.3%

Intervalle 123 - 167

Aluminium (Al) mg/L Blanc <0.006

Nom Standard DMR-0009-2016-Eu

Valeur obtenue 6.82

Justesse 92.9%

Intervalle 5.10 - 7.64

Antimoine (Sb) mg/L Blanc <0.0001

Nom Standard DMR-0009-2016-Eu

Valeur obtenue 0.2049

Justesse 92.3%

Intervalle 0.178 - 0.266

Argent (Ag) mg/L Blanc <0.0001

Nom Standard DMR-0009-2016-Ag

Valeur obtenue 0.6004

Justesse 82.9%

Intervalle 0.579 - 0.869

Arsenic (As) mg/L Blanc <0.0005

Nom Standard DMR-0009-2016-Eu

Valeur obtenue 0.2700

Justesse 95.4%

Intervalle 0.198 - 0.368

Baryum (Ba) mg/L Blanc <0.0005

Nom Standard DMR-0009-2016-Eu

Valeur obtenue 2.572

Justesse 94.2%

Intervalle 1.94 - 2.92

Béryllium (Be) mg/L Blanc <0.0005

Nom Standard DMR-0009-2016-Eu

Valeur obtenue 1.900

Justesse 88.2%

Intervalle 1.36 - 2.04

Bismuth (Bi) mg/L Blanc <0.0005

Bore (B) mg/L Blanc <0.01

Nom Standard DMR-0009-2016-Eu

Valeur obtenue 3.43

Justesse 83.7%

Intervalle 2.36 - 3.54

Sauf indication contraire, tous les échantillons ont été reçus en bon état.

Toute reproduction, sinon en entier, est interdite sans l'autorisation écrite du laboratoire.

Certificat contrôle qualité

Numéro de projet : V-52584

Échantillon : Brine Fluid

Date de prélèvement : 17 avril 2016

Lieu de prélèvement : Brine Fluid

Heure de prélèvement : N/D

Paramètres

Bromures mg/L
Blanc <0.01
Nom Standard DMR-0123-2016-Br
Valeur obtenue 5.39
Justesse 95.7%
Intervalle 4.50 - 6.76

Cadmium (Cd) mg/L
Blanc <0.00002
Nom Standard DMR-0009-2016-Eu
Valeur obtenue 0.89802
Justesse 99.8%
Intervalle 0.720 - 1.080

Calcium (Ca) mg/L
Blanc <0.03
Nom Standard DMR-0009-2016-Eu
Valeur obtenue 17.1
Justesse 98.3%
Intervalle 13.9 - 20.9

Chlorure (Cl) mg/L
Blanc <0.5
Nom Standard DMR-0175-2016-Cl
Valeur obtenue 53.7
Justesse 96.7%
Intervalle 46 - 58

Chrome (Cr) mg/L
Blanc <0.0006
Nom Standard DMR-0009-2016-Eu
Valeur obtenue 4.115
Justesse 98.4%
Intervalle 3.24 - 4.86

Cobalt (Co) mg/L
Blanc <0.0005
Nom Standard DMR-0009-2016-Eu
Valeur obtenue 1.549
Justesse 99.9%
Intervalle 1.24 - 1.86

Conductivité µmhos/cm
Nom Standard STD cond maison
Valeur obtenue 1407
Justesse 99.4%
Intervalle 1203 - 1627

Cuivre (Cu) mg/L
Blanc <0.0005
Nom Standard DMR-0009-2016-Eu
Valeur obtenue 1.379
Justesse 94.7%
Intervalle 1.05 - 1.57

Étain (Sn) mg/L
Blanc <0.001

Sauf indication contraire, tous les échantillons ont été reçus en bon état.

Toute reproduction, sinon en entier, est interdite sans l'autorisation écrite du laboratoire.

Certificat contrôle qualité

Numéro de projet : V-52584

Échantillon : Brine Fluid

Date de prélèvement : 17 avril 2016

Lieu de prélèvement : Brine Fluid

Heure de prélèvement : N/D

Paramètres

Fer (Fe) mg/L	Blanc <0.01 Nom Standard DMR-0009-2016-Eu Valeur obtenue 16.0 Justesse 88.1% Intervalle 11.4 - 17.2
Lithium (Li) mg/L	Blanc <0.005 Nom Standard DMR-0009-2016-Eu Valeur obtenue 0.827 Justesse 97.8% Intervalle 0.677 - 1.015
Magnésium (Mg) mg/L	Blanc <0.02 Nom Standard DMR-0009-2016-Eu Valeur obtenue 8.04 Justesse 89.4% Intervalle 5.82 - 8.72
Manganèse (Mn) mg/L	Blanc <0.0005 Nom Standard DMR-0009-2016-Eu Valeur obtenue 3.781 Justesse 97.2% Intervalle 3.11 - 4.67
Mercure (Hg) mg/L	Blanc <0.00001 Nom Standard DMR-0123-2016-HgEu Valeur obtenue 0.00062 Justesse 93.9% Intervalle 0.00040 - 0.00092
Molybdène (Mo) mg/L	Blanc <0.0005 Nom Standard DMR-0009-2016-Eu Valeur obtenue 0.6382 Justesse 90.1% Intervalle 0.566 - 0.850
Nickel (Ni) mg/L	Blanc <0.0005 Nom Standard DMR-0009-2016-Eu Valeur obtenue 1.110 Justesse 98.2% Intervalle 0.90 - 1.36
Nitrates (NO ₃) mg N/L	Blanc <0.01
Nitrites (NO ₂) mg N/L	Blanc <0.01 Nom Standard DMR-0175-2016-NO ₂ Valeur obtenue 1.97 Justesse 97.5%

Sauf indication contraire, tous les échantillons ont été reçus en bon état.

Toute reproduction, sinon en entier, est interdite sans l'autorisation écrite du laboratoire.

Certificat contrôle qualité

Numéro de projet : V-52584

Échantillon : Brine Fluid

Date de prélèvement : 17 avril 2016

Lieu de prélèvement : Brine Fluid

Heure de prélèvement : N/D

Paramètres

pH	Intervalle 1.72 - 2.32
	Nom Standard STD pH 7.0
	Valeur obtenue 7.01
	Justesse 99.9%
	Intervalle 6.96 - 7.04
Plomb (Pb) mg/L	Blanc <0.0003
	Nom Standard DMR-0009-2016-Eu
	Valeur obtenue 0.9397
	Justesse 96.6%
	Intervalle 0.727 - 1.091
Potassium (K) mg/L	Blanc <0.05
	Nom Standard DMR-0009-2016-Eu
	Valeur obtenue 20.2
	Justesse 89%
	Intervalle 14.6 - 21.8
Radium (RA 226) Becquerels/L	Blanc <0.002
	Nom Standard STD 45462
	Valeur obtenue 0.0700
	Justesse 85%
	Intervalle 0.0700 - 0.0948
Sélénium (Se) mg/L	Blanc <0.001
	Nom Standard DMR-0009-2016-Eu
	Valeur obtenue 1.33
	Justesse 98.5%
	Intervalle 1.08 - 1.62
Sodium (Na) mg/L	Blanc <0.05
	Nom Standard DMR-0009-2016-Eu
	Valeur obtenue 29.0
	Justesse 91%
	Intervalle 21.3 - 31.9
Solides totaux mg/L	Blanc <2
	Nom Standard DMR-0124-2016-3
	Valeur obtenue 289
	Justesse 99%
	Intervalle 243 - 329
Strontium (Sr) mg/L	Blanc <0.005
	Nom Standard DMR-0009-2016-Eu
	Valeur obtenue 1.25
	Justesse 97.7%
	Intervalle 1.02 - 1.54

Sauf indication contraire, tous les échantillons ont été reçus en bon état.

Toute reproduction, sinon en entier, est interdite sans l'autorisation écrite du laboratoire.

Certificat contrôle qualité

Numéro de projet : V-52584

Échantillon : Brine Fluid

Date de prélèvement : 17 avril 2016

Lieu de prélèvement : Brine Fluid

Heure de prélèvement : N/D

Paramètres

Sulfate (SO4) mg SO4/L	Blanc <0.6 Nom Standard DMR-0175-2016-SO4 Valeur obtenue 71.2 Justesse 93.7% Intervalle 60.3 - 73.7
Tellure (Te) mg/L	Blanc <0.0005
Thallium (Tl) mg/L	Blanc <0.002 Nom Standard TI-S140909023-1000ppm Valeur obtenue 989 Justesse 98.9% Intervalle 800 - 1200
Titane (Ti) mg/L	Blanc <0.01
Uranium (U) mg/L	Blanc <0.001 Nom Standard DMR-0009-2016-Eu Valeur obtenue 1.93 Justesse 90.3% Intervalle 1.41 - 2.11
Vanadium (V) mg/L	Blanc <0.0005 Nom Standard DMR-0009-2016-Eu Valeur obtenue 2.023 Justesse 98.3% Intervalle 1.59 - 2.39
Zinc (Zn) mg/L	Blanc <0.001 Nom Standard DMR-0009-2016-Eu Valeur obtenue 4.67 Justesse 97.7% Intervalle 3.82 - 5.74

Sauf indication contraire, tous les échantillons ont été reçus en bon état.
Toute reproduction, sinon en entier, est interdite sans l'autorisation écrite du laboratoire.

Informations supplémentaires

Numéro de projet : V-52584

Échantillon : Brine Fluid

Lieu de prélèvement : Brine Fluid

Date de prélèvement : 17 avril 2016

Heure de prélèvement : N/D

Méthode laboratoire	Méthode de référence
M-MET-3.0	MA.200-Mét. 1.2
M-TIT-1.0	MA.303-Titr Auto 2.0
M-CL-2.0	MA.300-Ions 1.3
M-CI-1.0	MA.300-Anions 1.0
M-NITR-2.0	MA.300-NO3 2.0
M-RA-2.0	APHA 7500-Ra B et EPA P.13 (EMSL-CI)
M-SOLI-1.0	MA.104-S.S. 1.1
M-SULF-2.0	MA.300-Ions 1.3

Sauf indication contraire, tous les échantillons ont été reçus en bon état.
Toute reproduction, sinon en entier, est interdite sans l'autorisation écrite du laboratoire.

**APPENDIX C –WINTER 2018 HYDROGEOLOGICAL FIELD
PROGRAM – AMARUQ PROJECT**

TECHNICAL MEMORANDUM

DATE 25 March 2019 **Reference No.** 18113037-002-TM-Rev0-3000

TO Michel Groleau
Agnico Eagle Mines Limited

CC Jenyfer Mosquera, Jennifer Range

FROM Alex Cassidy and Michal Dobr

EMAIL
Alex_Cassidy@golder.com;
Michal_Dobr@golder.com

WINTER 2018 HYDROGEOLOGICAL FIELD PROGRAM – AMARUQ PROJECT, NUNAVUT

1.0 INTRODUCTION

Golder Associates Ltd (Golder) was retained by Agnico Eagle Mines Limited (Agnico Eagle) to carry out a hydrogeological testing program in support of the development of the IVR Zone, Amaruq Project. The objective of the hydrogeological testing program was to provide additional information on the hydraulic parameters of the deep bedrock in the study area to refine estimates of the groundwater inflow to the proposed underground development below the permafrost.

The hydrogeological field investigations were carried out from 28 November to 9 December 2018 and included the following activities:

- review of rock core from borehole AMQ18-1925 and the preliminary borehole log prepared by Knight Piésold to identify target zones for packer placement
- hydraulic testing using pneumatic packers in borehole AMQ18-1925 (target IVR-112)
- field data compilation and analyses

This technical memorandum provides a summary of the field investigations and the results of data analysis.

2.0 DRILLING PROGRAM

The drilling program was undertaken over the period from 14 November to 7 December 2018 and included drilling of one borehole by Forage Orbit Garant (Orbit). The borehole was drilled at an inclination of -66 degrees to a total depth of 699 meters along hole (mah). The collar location and projected borehole trace is presented on Figure 1. PQ size surface casing was advanced to approximately 6 m through overburden and weathered rock into competent bedrock to prevent caving of the unconsolidated materials during drilling. From 6 to 123 metres the borehole was drilled in 96 mm (HQ) diameter, and from 123 to 699 metres in 76 mm (NQ) diameter. A triple-tube

system was used to recover oriented core from 420 to 650 mah. Detailed information on the borehole, including collar coordinates, ground surface elevation, average orientation and end depth is presented in Table 1.

Table 1: Borehole Details

Borehole ID	Northing (m)	Easting (m)	Ground Surface Elevation (masl)	Borehole Depth (mah)	Average Borehole Azimuth (degrees)	Average Borehole Inclination (degrees)
AMQ-2018-1925	7256185	607632	161	699	315	63.7

Notes:

Coordinates in UTM NAD 83, Zone 14 W.

m – metres; masl – metres above sea level; mah – metres along hole.

3.0 HYDROGEOLOGICAL TESTING

The hydrogeological testing program was conducted between 7 and 9 December 2018. A pneumatic packer tool in a single packer configuration on dedicated rods was used to carry out the testing. The single packer tool was used in place of the proposed double packer setup due to equipment damage at the start of the program. A schematic diagram of the single packer tool configuration is shown in Figure 2.

3.1 Testing Approach

Single-well pressure response tests were carried out to obtain information on local-scale aquifer parameters of the bedrock. Hydrogeological testing targeted the unfrozen portion of the borehole below permafrost, which at the time of the investigation was expected to be below the depth of 425 metres below ground surface (425 m bgs). Testing was initiated at the completion of drilling and progressed from the top of the selected test zone downwards. The final test was conducted over the same interval as the first test to verify the results.

Prior to testing, the borehole was flushed with clean water to remove any residual drill cuttings or drilling fluid. A brine solution with approximately 21% calcium chloride and a density of 1195 kg/m³ was pumped to the bottom of the borehole through drill rods to displace the fresh water and prevent freezing during testing.

To perform a test, the NQ drill string was removed from the borehole and the tool was lowered on BQ size rods to the selected depth. The HQ rods (123 m) remained in the borehole during testing for borehole stability. The NQ section of the borehole was uncased.

The pneumatic packer tool consisted of a single packer attached to testing rods with a perforated gauge carrier mounted below the packer. When the tool was positioned in the selected test interval the packer was inflated with nitrogen gas. This isolated the section of the borehole between the packer and the bottom of the borehole from the remainder of the borehole, while allowing communication between the interior of the test rods and the test interval via the perforated section. The packer was deflated after the test, and the tool was moved to the next test interval. This sequence was repeated until all selected intervals were tested, at which time the packer was removed from the borehole. To monitor the progress of the individual test sequences in real time, an RST Instruments vibrating wire piezometer connected to a datalogger was lowered below the water level in the drill rods and was programmed to collect data every two seconds. A LevelTROLL 700 memory gauge was placed into a gauge carrier directly in the test interval to obtain more accurate pressure response data. The memory gauge was programmed to collect data at two second intervals. The data recorded from the LevelTROLL were used in

the analysis for each tested interval. The calibration certificates for the RST Instruments vibrating wire piezometer and the LevelTROLL 700 memory gauge are provided in Attachment A.

Prior to testing, the core recovered from the borehole was reviewed in detail to assess the borehole stability, and to identify suitable locations for placement of the testing equipment. The test intervals varied in length from 99.6 m to 279.5 m and were selected to provide a continuous hydraulic conductivity profile along the selected borehole interval. A summary of the tests carried out is presented in Table 2.

Table 2: Summary of Hydrogeological Tests

Borehole ID	Interval Tested (mah) ^(a)	Number of Tests Conducted	Date Started	Date Ended
AMQ18-1925	419.5 to 699.0	4	08-Dec-18	09-Dec-18

Note:

(a) Measured along hole referenced to surface.

3.2 Testing Methodology

The following general methodology was planned for the hydrogeological testing:

- pressure static recovery (PSR) sequence
- slug injection (SI) sequence
- slug withdrawal (SW) sequence

The testing procedures and the order of the individual test sequences were adjusted for each test based on the pressure response during the SI sequence. Detailed descriptions of the individual test sequences are provided below.

Pressure Static Recovery

Following packer inflation at the desired depth, a pressure transducer was lowered inside the test rods below the water table to monitor the pressure response of the aquifer in real time. The pressure static recovery (PSR) sequence was carried out to allow the aquifer within the isolated interval to reach static conditions after packer inflation. This sequence lasted between 30 and 60 minutes. After this time, the next test sequence was initiated, even if full hydrostatic conditions were not achieved in the test interval.

Slug Injection / Withdraw

After the PSR sequence, a slug injection (SI) and/or a slug withdrawal (SW) test was carried out. These test sequences consisted of adding or removing an instantaneous slug of water into/from the test rods and monitoring the recovery of the water level for a minimum period of 30 minutes. The addition of a slug was achieved by adding brine into the testing rods. Water removal was achieved by injecting compressed nitrogen through a length of tubing lowered inside the test rods below the water level.

3.3 Test Analysis

3.4 Software

The test analyses were carried out with HydroBench® (Version 3.7.1), a Golder internally developed software package designed to analyze different types of hydrogeological tests. HydroBench is a pressure transient interpretation package using the Bourdet Derivative method (e.g., Gringarten 2008) coupled with a library of analytical reservoir models. Further information on the HydroBench software, including a detailed documentation of the verification of the software, is available on request.

3.5 Results

The hydraulic conductivity values were calculated by dividing the transmissivity value by the length of the corresponding test interval. A density of 1195 kg/m^3 was applied in the data analysis to represent the brine solution used to condition the borehole. The table shows the test sequences carried out in each interval; SI and SW. For each test interval, the test sequence with the most reliable pressure response data set was selected for analyses.

The results of the test analyses indicate hydraulic conductivity values in the range of 7×10^{-12} and $7 \times 10^{-11} \text{ m/s}$. It is however recommended to assume a hydraulic conductivity of less than $1 \times 10^{-10} \text{ m/s}$ for all intervals tested because this value represents the low-end cut-off for accuracy of the testing equipment and the methodology used. Detailed analytical test reports are presented in Attachment B. These reports are computer generated protocols, and some values in these documents may differ from values discussed within the text section of this document.

The results also indicate that the hydraulic conductivity of the deep sub-permafrost bedrock aquifer may be lower than previously assumed in modelling for the Whale Tail Pit and support previous observations from the study area that show a decrease of the bedrock hydraulic conductivity with depth. A summary of the measured hydraulic conductivity values relative to historical measurements are shown in Figure 3.

Table 3: Summary of Hydrogeological Test Results

BH ID	Test No.	Test Interval						Test Sequences Conducted ^(b)	Test Sequence Analysed ^(b)	Transmissivity (T) (m ² /s)	Hydraulic Conductivity (K) (m/s)	Assumed ^(d) Hydraulic Conductivity (K) (m/s)
		From (mah) ^(a)	To (mah) ^(a)	Length (m)	From (mbgs)	To (mbgs)	Vertical Length (m)					
AMQ1 8-1925	1	419.5	699.0	279.5	375.9 ^(c)	626.4	250.5	SI	SI	2 x 10 ⁻⁹	8 x 10 ⁻¹²	<1 x 10 ⁻¹⁰
	2	500.4	699.0	198.6	448.4	626.4	178.0	SI	SI	7 x 10 ⁻⁹	4 x 10 ⁻¹¹	<1 x 10 ⁻¹⁰
	3	599.4	699.0	99.6	537.1	626.4	89.3	SI, SW	SI	7 x 10 ⁻⁹	7 x 10 ⁻¹¹	<1 x 10 ⁻¹⁰
	4	419.5	699.0	279.5	375.9	626.4	250.5	SI, SW	SI	2 x 10 ⁻⁹	7 x 10 ⁻¹²	<1 x 10 ⁻¹⁰

Notes:

- (a) Measured along hole referenced to surface.
- (b) SI = Slug Injection, SW = Slug Withdrawal.
- (c) part of the test interval from 375.9 to 626.4 likely within the permafrost
- (d) A hydraulic conductivity of less than 1 x 10⁻¹⁰ m/s was assumed for all intervals tested because this value represents the low-end cut-off for accuracy of the testing equipment and the methodology used

4.0 CONCLUSIONS

A summary of the findings from the hydrogeological field investigation is provided below:

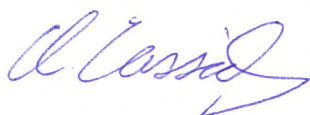
- Hydrogeological testing was carried out in one inclined borehole targeting an interval between 419.5 m to 699 m. The testing was conducted to support the evaluation of the hydraulic conductivity of the deep bedrock below the permafrost.
- A total of 4 tests were conducted with test interval lengths varying from 99.6 m to 279.5 m.
- Based on the results of hydrogeological testing and a review of the drill core no zones of potentially enhanced hydraulic conductivity were identified within the tested section of the borehole.
- An average value of the brine densities recorded during testing was used for transmissivity calculations.
- The assumed hydraulic conductivity of 1×10^{-10} m/s for all tests indicate a very low hydraulic conductivity. The results indicate that the hydraulic conductivity of the deep sub-permafrost bedrock aquifer may be lower than previously assumed in modelling for the Whale Tail Pit and support previous observations from the study area that show a decrease of the bedrock hydraulic conductivity with depth.

5.0 CLOSURE

The reader is referred to the Study Limitations section, which follows the text and forms an integral part of this memorandum.

We trust that the information provided above satisfies your current project requirements. If you have any questions or concerns, please do not hesitate to contact us at your convenience.

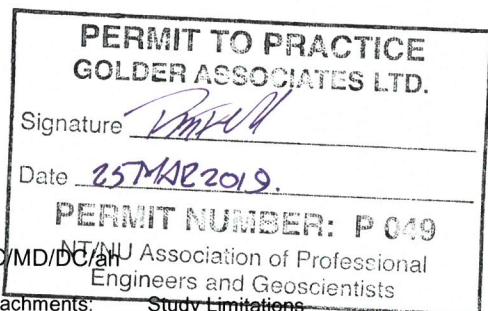
Golder Associates Ltd.



Alex Cassidy
Mine Water Group



Michal Dobr, R.N.Dr.
Principal, Mine Water Group



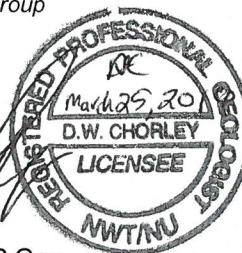
AC/MD/DC/ah

Attachments:

- Study Limitations
- Figures 1, 2 and 3
- Attachment 1: Transducer Calibration Certificates
- Attachment 2: HydroBench® Analysis Reports



Don Chorley, M.Sc., P.Geo.
Senior Hydrogeology Specialist



Reference

- Golder Associates Ltd. 2016. Westbay System Installation Summary – Whale Tail Pit Project, Nunavut. Dated July 7, 2016 (Reference 1649355-003-TM-Rev0-4000).
- Golder Associates Ltd. 2017. Hydrogeological and Permafrost Field Investigations, Amaruq Project 2017 Factual Report. Dated 31 July 2017. (Reference 1649355-008-R-Rev0-5000).
- Gringarten AC. 2008. From Straight Lines to Deconvolution: The Evolution of the State of the Art in Well Test Analysis. SPE Reservoir Evaluation & Engineering 11: 41-62.
- Knight Piésold Consulting. 2015. Whale Tail Pit Permafrost and Hydrogeological Characterization. Prepared for Agnico Eagle Mines: Meadowbank Division.
- Knight Piésold Consulting. 2016. Whale Tail Pit 2016 Geomechanical Site Investigation Summary. Prepared for Agnico Eagle Mines: Meadowbank Division.
- SNC Lavalin. 2017. Preliminary Studies for the Water Management and Geotechnical Infrastructures at Amaruq. Dated 25 May 2017.

STUDY LIMITATIONS

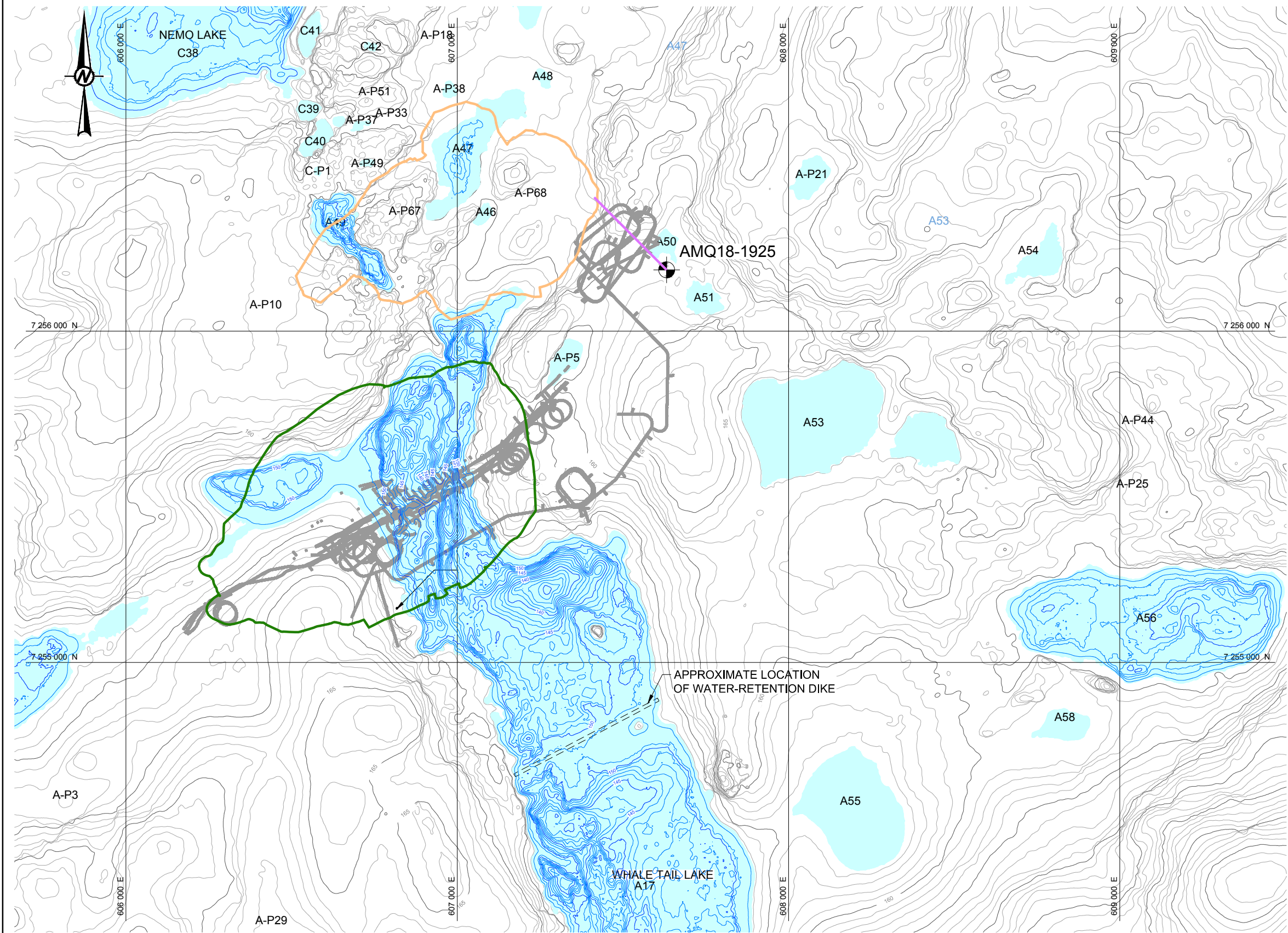
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Path: \\golder-gis\gall\buraby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\09_PROJECTS\1811303702_PRODUCTION\3000\DWG\1 | File Name: 18113037-3000-3100-01.dwg | Last Edited By: bmasongang | Date: 2019-01-31 | Time: 10:53:27 AM | Printed By: bmasongang | Date: 2019-01-31 | Time: 1:40:42 PM



- LEGEND**
- EXISTING GROUND SURVEY
 - EXISTING BATHYMETRY
 - WATER BODY
 - BOREHOLE COLLAR LOCATION
 - APPROXIMATE BOREHOLE TRACE
 - WHALE TAIL PIT
 - IVR PIT
 - UNDERGROUND WORKS

- NOTE(S)**
- ALL UNITS ARE IN METERS UNLESS NOTED OTHERWISE.
 - CONTOUR INTERVAL 1m MINOR AND 5m MAJOR.
- REFERENCE**
- BASE PLAN AND BATHYMETRY DATA RECEIVED FROM AGNICO EAGLE MINES LTD. DATE RECEIVED NOVEMBER 25, 2016.
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CAD FILE: 1665858-2100B-CM-0002.DWG
CAD FILE: 61-000-142-001_R08LOC.DWG
 - UNDERGROUND WORKS RECEIVED FROM AGNICO EAGLE MINE LTD. ON OCTOBER 18, 2017.
DXF FILE: AMQMY17UG_003_DEV_2018_SHIFTED.DXF
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DXF FILE: AMQMY17UG_003_DEV_2023_SHIFTED.DXF
DXF FILE: AMQMY17UG_003_DEV_2024_SHIFTED.DXF

NOT FOR CONSTRUCTION



AGNICO EAGLE MINTES LIMITED
MEADOWBANK DIVISION

CLIENT	AGNICO EAGLE MINTES LIMITED MEADOWBANK DIVISION
CONSULTANT	YYYY-MM-DD 2019-01-31
	DESIGNED JJ
	PREPARED BM
	REVIEWED JJ
	APPROVED MD

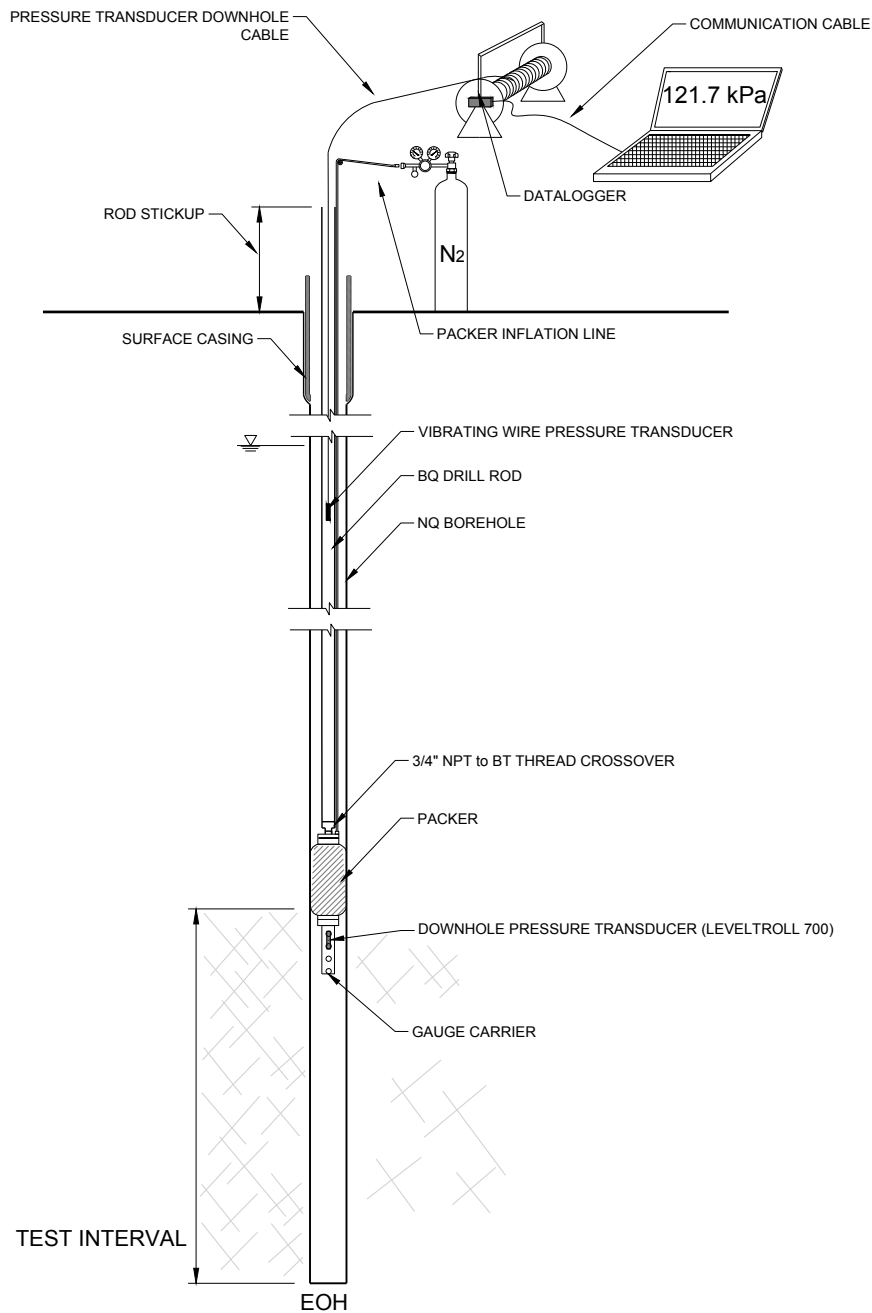


PROJECT
WINTER 2018 HYDROGEOLOGICAL FIELD PROGRAM
AMARUQ PROJECT, NUNAVUT

TITLE
LOCATION OF AMQ18-1925

PROJECT NO.	PHASE/TASK	REV.	FIGURE
18113037	3000/3100	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A3/B



NOT TO SCALE
SCHEMATIC ONLY

CLIENT

AGNICO EAGLE MINES LIMITED

CONSULTANT



YYYY-MM-DD 2019-01-21

DESIGNED A.C.

PREPARED A.C.

REVIEWED J.J.

APPROVED MD

PROJECT

WHALE TAIL DEPOSIT, AMARUQ
WINTER 2018 HYDROGEOLOGICAL INVESTIGATION
KIVALLIQ DISTRICT, NUNAVUT

TITLE

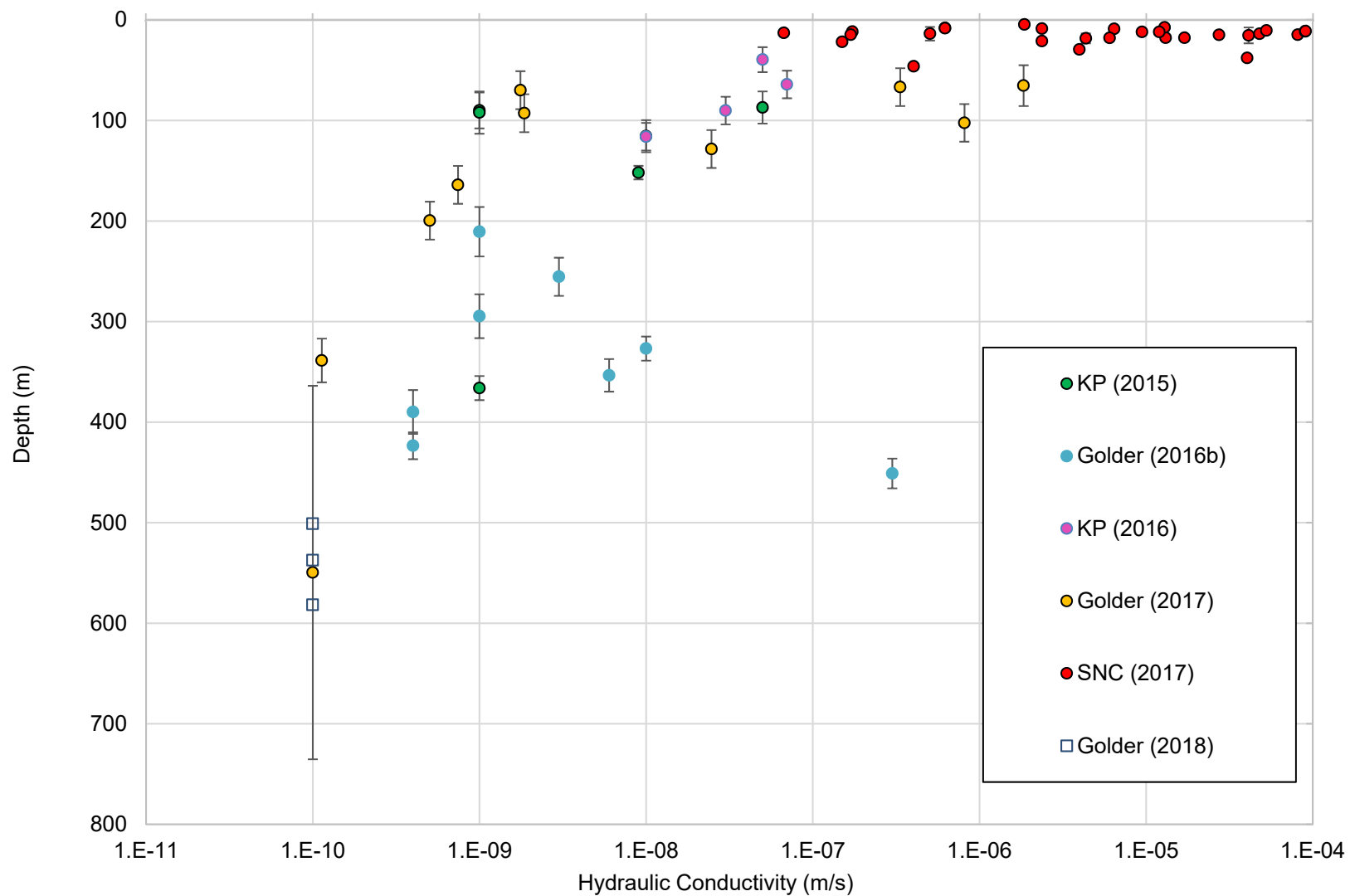
PNEUMATIC SINGLE PACKER TOOL ON DEDICATED RODS

PROJECT NO.
18113037

PHASE
3000

REV.
0

FIGURE
2



CLIENT
AGNICO EAGLE MINES LIMITED

CONSULTANT



YYYY-MM-DD	2019-02-06
PREPARED	A.C.
DESIGN	J.L.
REVIEW	M.D.
APPROVED	J.L.

PROJECT
WHALE TAIL DEPOSIT, AMARUQ
WINTER 2018 HYDROGEOLOGICAL INVESTIGATION
KIVALLIQ DISTRICT, NUNAVUT

TITLE
HYDRAULIC CONDUCTIVITY BY DEPTH BELOW GROUND SURFACE

PROJECT No.
18113037

Phase.
3000

Rev.
0

Fig.
3

ATTACHMENT 1

Transducer Calibration Certificates

Instrument Details:

Instrument Model: **Level TROLL 700**
Full Scale Pressure Range: **1000 PSI / 693 m / 2273 ft / non-vented**
Serial Number: **600912**
Hardware Version: **3**
Firmware Version: **2.13**

Calibration Details:

Calibration Result: **PASS**
Calibration Date: **2018-07-27 01:27:20 (UTC)**
Nominal Range of Applied Temperature: **-5 C to +50 C**
Temperature Accuracy Specification: **+/- 0.1 C From -5 C to +50 C**
Nominal Range of Applied Pressure: **7 PSI to 1000 PSI**
Pressure Accuracy Specification: **+/- 0.1 %FS from -5 C to +50 C, +/- 0.05 %FS at +15 C**

Post-Calibration Check:

Parameter	Applied	Reported	Deviation	Unit
Pressure	1000.0100	1000.1370	0.1270	PSI
Pressure	424.0600	424.1086	0.0486	PSI
Pressure	6.9996	7.0841	0.0845	PSI
Temperature	25.0060	24.9778	-0.0282	C

Calibration Procedures and Equipment Used:

Automated calibration procedures used.
Manu Agilent Model 34980A SerialNo MY44001931
Manu Instrulab Model 4312A-15 SerialNo 30117
Manu Instrulab Model 832-151-01 SerialNo 811
Manu Mensor Model CPC6000 SerialNo 410009W9
Manu Agilent Model 53131A-010 SerialNo MY47002678
Manu MENSOR Model 600 SerialNo 622743

Notes:

- Standards used in this calibration are traceable to the National Institute of Standards and Technology.
- This calibration report shall not be reproduced, except in full, without the written approval of In-Situ, Inc.
- A calibration interval of 12 to 18 months is recommended.



Crafted with pride by

*Russ G***Performed By: WR**

CALIBRATION REPORT

Instrument type VW transducer with data logger
 Calibration Date 15-May-18 Due date: 15-May-19
 Model Number VW2100-1.0-HD
 Pressure Range 1.0 MPa or 145.04 PSI
 Manufacturer RST instruments
 Serial number DT02036 VW45255

Pressure Test Data Sheet

Polynomial Fits			
Applied Pressure	Reported Pressure	Deviation	FS Error
(kPa)	(kPa)	(kPa)	%
0.1	0.13	0.03	0.00
197.9	198.77	0.87	0.09
400.7	401.67	0.97	0.10
596.7	597.90	1.20	0.12
791.6	793.13	1.53	0.15
974.7	976.77	2.07	0.21
Maximum Value:		2.07	0.21

End of calibration data

Performed by A.Brugger

Calibration and Equipment used:

Instrument type DPG4000-2K
 Calibration Date 15-Jan-18
 Manufacturer Omega

Equipment used is traceable to the National Institute of Standards and Technology

Pressure Range: 0-2000 psi
 Accuracy +/- 0.1%
 Serial Number 2892054

ATTACHMENT 2

HydroBench® Analysis Reports

HYDROBENCH REPORT

Project 2018 Hydrogeology Program
Site Amaruq Project Site
Source Well AMQ-18-1925
Test Name Test 1
Test Date/Time
Interval top: 419.46 m bottom: 699.00 m
Description Testing: AC
Analysis: AC
Review: JDJ

Basic Data

Test Interval 279.54 m
Porosity 0.10
Well Radius 0.038 m Tubing Radius 0.023 m
Inclination 24.0 deg
Test Volume 1261.456 l
Well Type Source

Fluid Properties

Viscosity 0.001 Pa*s
Density 1195.0 kg/m³
Compressibility 2.0e-09 1/Pa

Sequence Definition

Name	Category	t(o) [hrs]	P(o) [kPa]	P(i) [kPa]	Rate [l/min]	C [m ³ /Pa]
COM1	Variable Pressure	0.00000	4151.84			1.6e-07
PSR	Recovery	1.13278	4150.86			1.6e-07
SI-INIT	dP-Event	1.76889	4150.53	-51.1 *		1.6e-07
SI	Slug	1.78278	4201.67	4150.5		1.6e-07
COM2	Variable Pressure	3.15556	4200.18			1.6e-07

Analysis Results

Analysis "SI"

Static Pressure: 4149.87 kPa

Shell Parameters:

Name	Transmissivity [m²/s]	Storativity [-]	Radius [m]	Flow Dimension [-]
Shell 1	2.4e-09	5.5e-04	--	2.0

Sequence Parameters:

Name	Wellbore Storage [m³/Pa]	Skin [-]
COM1	1.6e-07	0.0
PSR	1.6e-07	0.0
SI-INIT	1.6e-07	0.0
SI	1.6e-07	0.0
COM2	1.6e-07	0.0

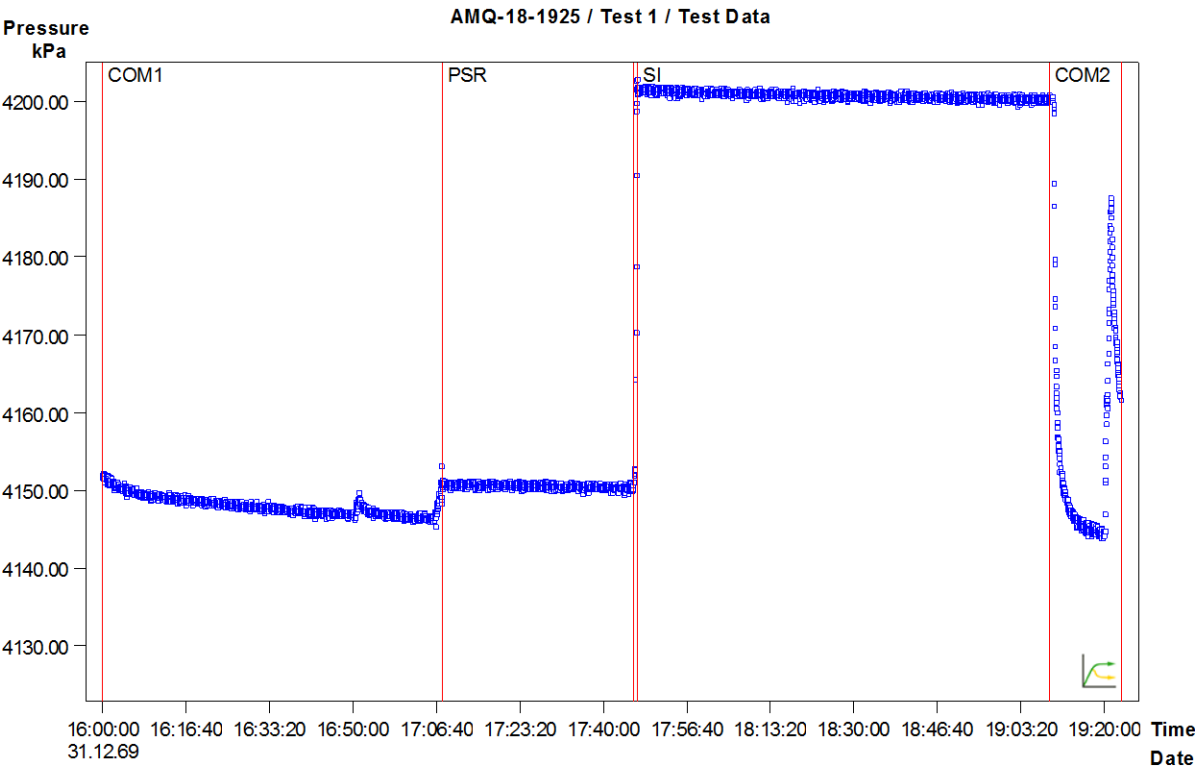


Figure 1: Pressure response and sequence definition

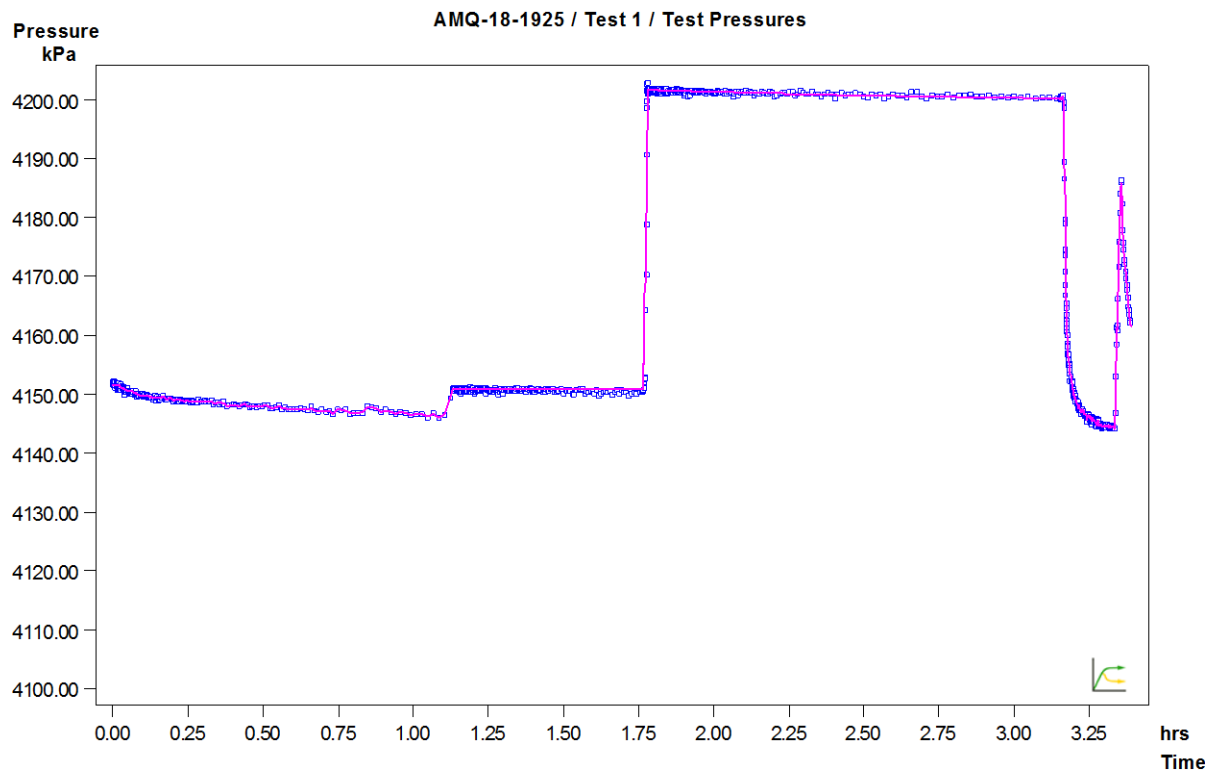


Figure 2: Pressure response (blue) and simulation (pink) cartesian plot

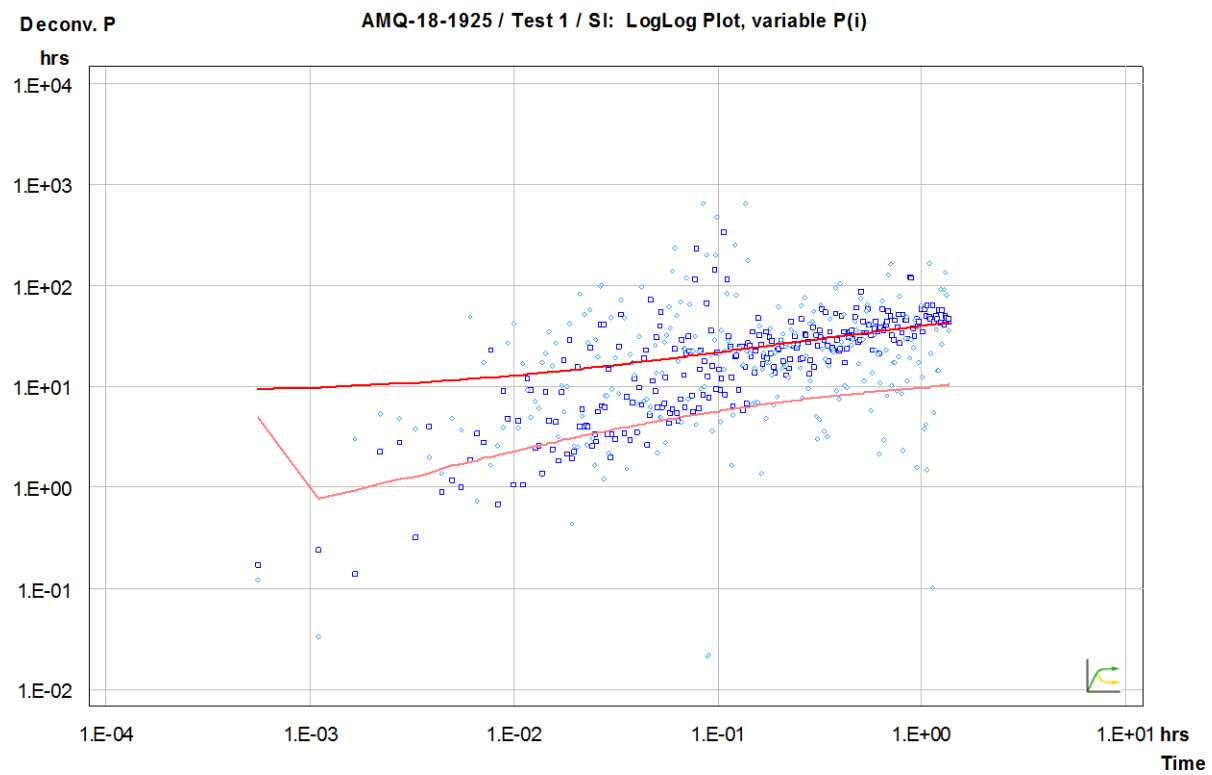


Figure 3: Deconvolved pressure response (dark blue), derivative (light blue) and simulation (red): Log-Log diagnostic plot, SI sequence

HYDROBENCH REPORT

Project 2018 Hydrogeology Program
Site Amaruq Project Site
Source Well AMQ-18-1925
Test Name Test 2
Test Date/Time
Interval top: 500.40 m bottom: 699.00 m
Description Testing: CM
Analysis: AC
Review: JDJ

Basic Data

Test Interval 198.60 m
Porosity 0.10
Well Radius 0.038 m Tubing Radius 0.023 m
Inclination 24.0 deg
Test Volume 896.205 l
Well Type Source

Fluid Properties

Viscosity 0.001 Pa*s
Density 1195.0 kg/m³
Compressibility 2.0e-09 1/Pa

Sequence Definition

Name	Category	t(o) [hrs]	P(o) [kPa]	P(i) [kPa]	Rate [l/min]	C [m ³ /Pa]
COM1	Variable Pressure	0.00000	4993.77			1.6e-07
PSR	Recovery	1.01278	4991.46			1.6e-07
SI-INIT	dP-Event	1.68167	4991.14	-45.5 *		1.6e-07
SI	Slug	1.79111	5036.64	4991.1		1.6e-07
COM2	Variable Pressure	2.62722	5035.46			1.6e-07

Analysis Results

Analysis "SI"

Static Pressure: 4990.99 kPa

Shell Parameters:

Name	Transmissivity [m ² /s]	Storativity [-]	Radius [m]	Flow Dimension [-]
Shell 1	7.0e-09	3.9e-04	--	2.0

Sequence Parameters:

Name	Wellbore Storage [m ³ /Pa]	Skin [-]
COM1	1.6e-07	0.0
PSR	1.6e-07	0.0
SI-INIT	1.6e-07	0.0
SI	1.6e-07	0.0
COM2	1.6e-07	0.0

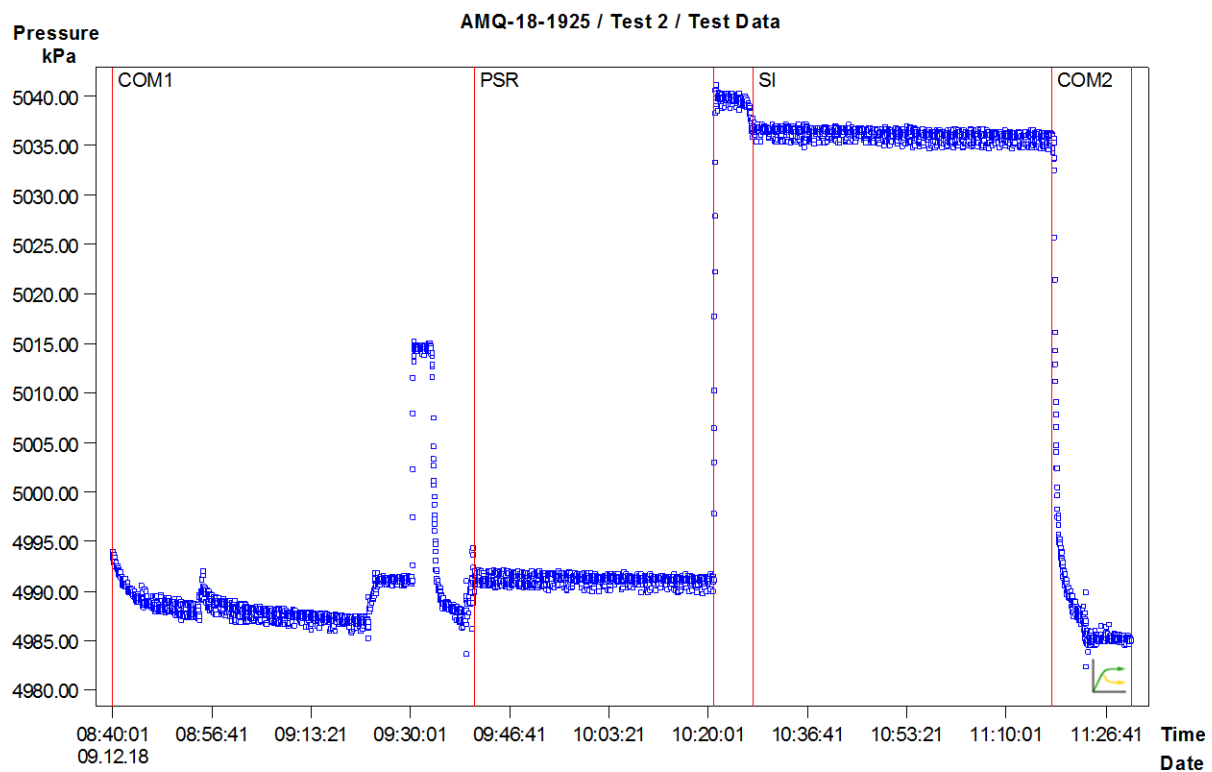


Figure 1: Pressure response and sequence definition

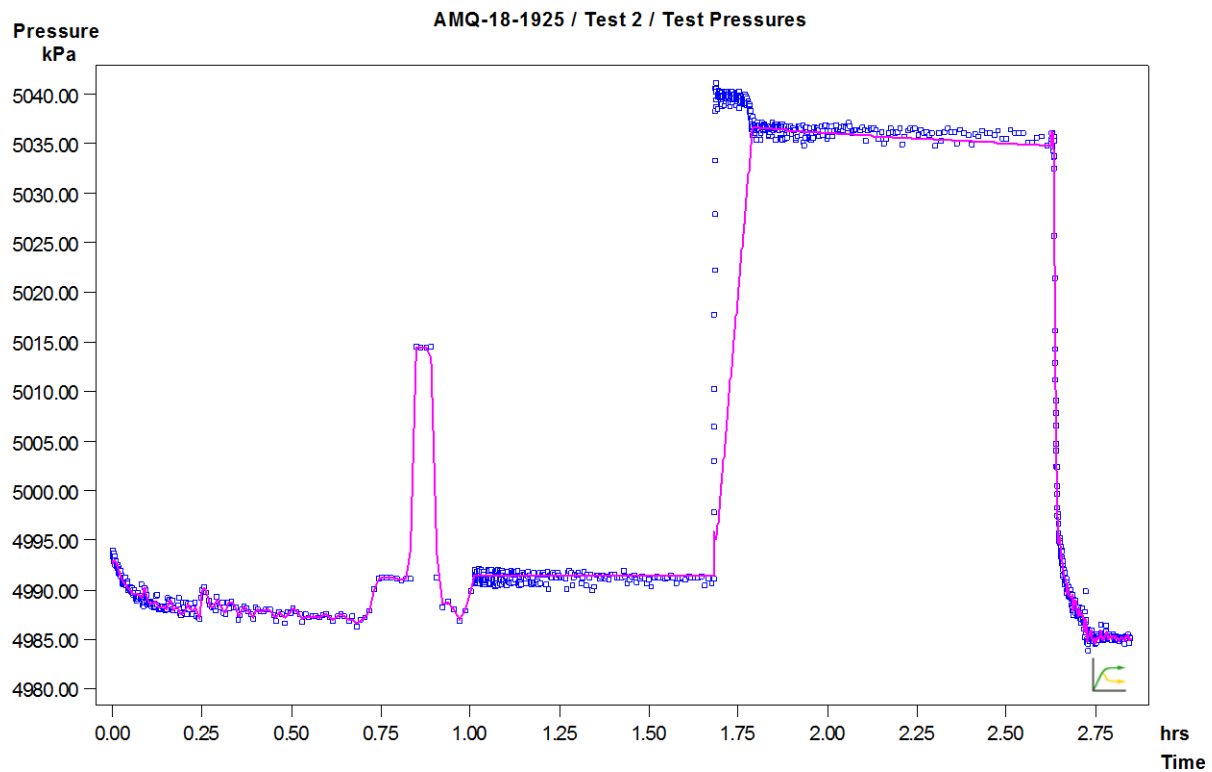


Figure 2: Pressure response (blue) and simulation (pink) cartesian plot

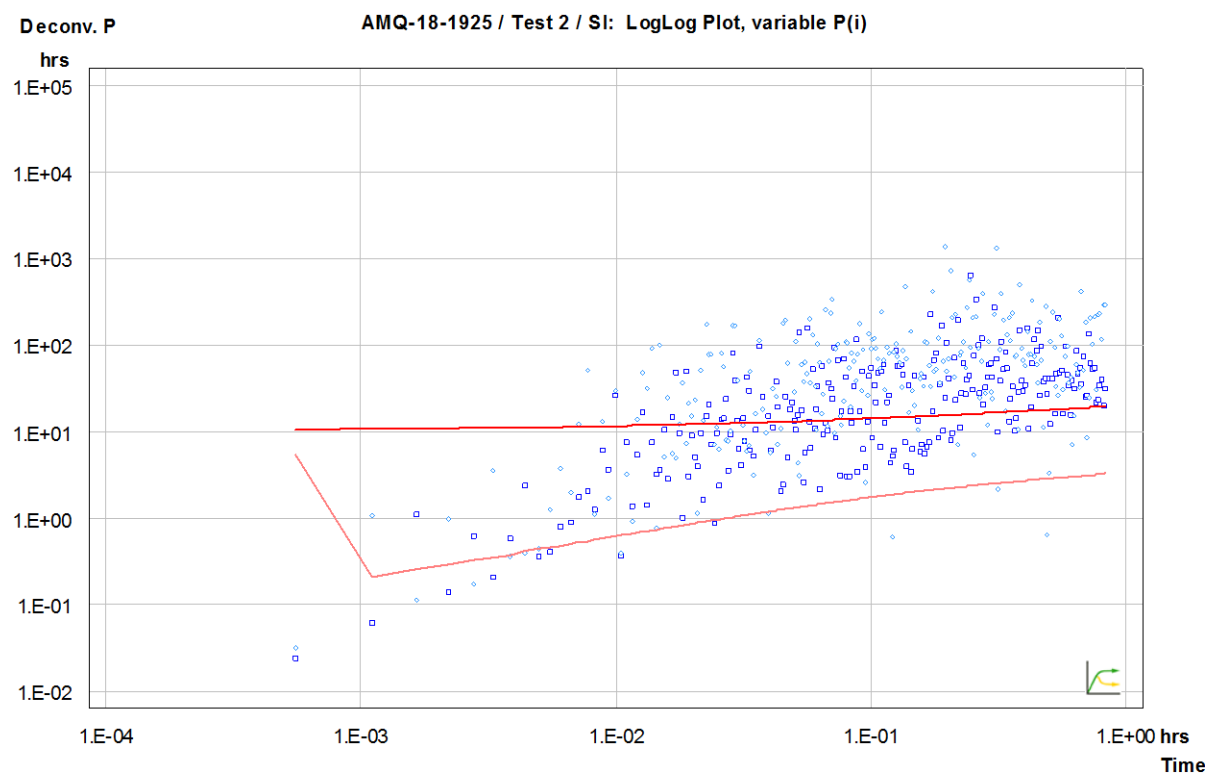


Figure 3: Deconvolved pressure response (dark blue), derivative (light blue) and simulation (red): Log-Log diagnostic plot, SI sequence

HYDROBENCH REPORT

Project	2018 Hydrogeology Program
Site	Amaruq Project Site
Source Well	AMQ-18-1925
Test Name	Test 3
Test Date/Time	
Interval	top: 599.38 m bottom: 699.00 m
Description	Testing: CM Analysis: AC Review: JDJ

Basic Data

Test Interval	99.62 m		
Porosity	0.10		
Well Radius	0.038 m	Tubing Radius	0.023 m
Inclination	24.0 deg		
Test Volume	449.547 l		
Well Type	Source		

Fluid Properties

Viscosity	0.001 Pa*s
Density	1195.0 kg/m ³
Compressibility	2.0e-09 1/Pa

Sequence Definition

Name	Category	t(o) [hrs]	P(o) [kPa]	P(i) [kPa]	Rate [l/min]	C [m³/Pa]
COM1	Variable Pressure	0.00000	6056.00			1.6e-07
PSR	Recovery	0.67889	6045.48			1.6e-07
SI-INIT	dP-Event	1.76444	6045.09	-26.2 *		1.6e-07
SI	Slug	1.77389	6071.28	6045.1		1.6e-07
COM2	Variable Pressure	2.88000	6070.23			1.6e-07
PSR2	Recovery	2.90611	6068.51			1.6e-07
SW-INIT	dP-Event	3.01056	6068.36	82.2 *		1.6e-07
SW	Slug	3.02778	5986.11	6068.4		1.6e-07
COM3	Variable Pressure	3.96056	5985.60			1.6e-07

Analysis Results

Analysis "SI"

Static Pressure: 6044.76 kPa

Shell Parameters:

Name	Transmissivity [m²/s]	Storativity [-]	Radius [m]	Flow Dimension [-]
Shell 1	7.3e-09	2.0e-04	--	2.0

Sequence Parameters:

Name	Wellbore Storage [m³/Pa]	Skin [-]
COM1	1.6e-07	0.0
PSR	1.6e-07	0.0
SI-INIT	1.6e-07	0.0
SI	1.6e-07	0.0
COM2	1.6e-07	0.0
PSR2	1.6e-07	0.0
SW-INIT	1.6e-07	0.0
SW	1.6e-07	0.0
COM3	1.6e-07	0.0

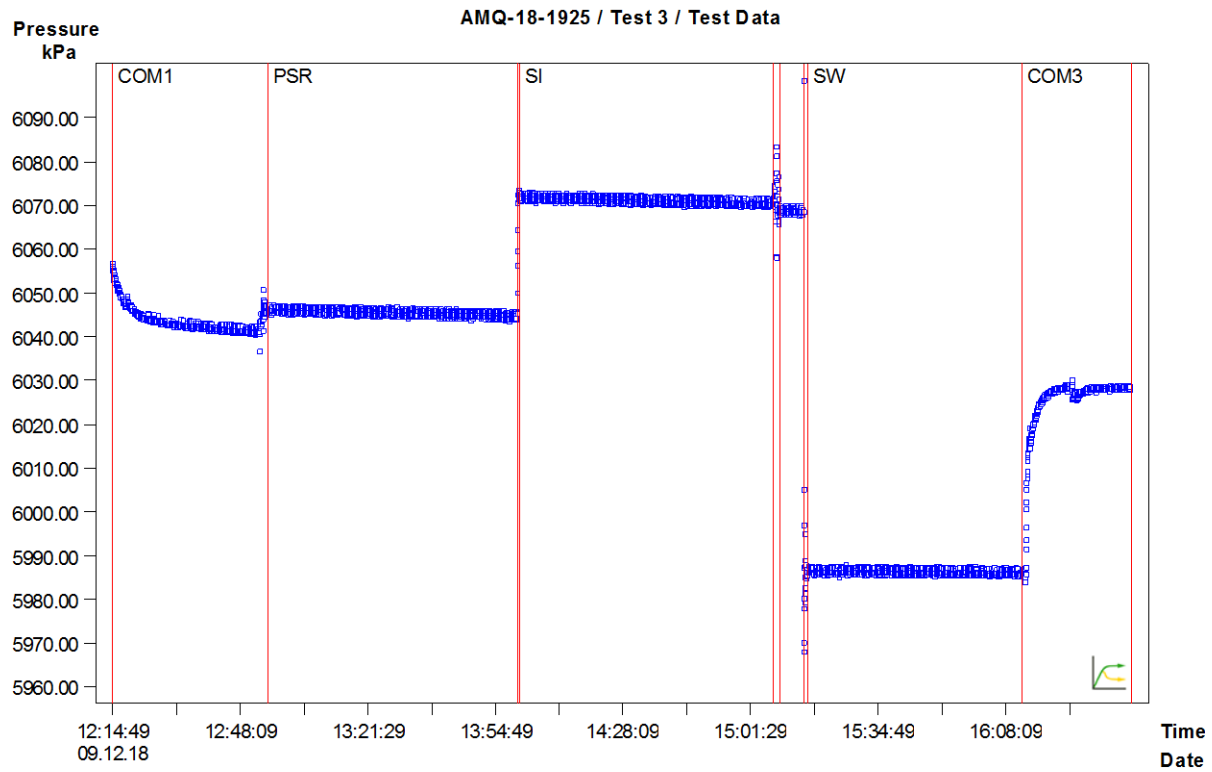


Figure 1: Pressure response and sequence definition

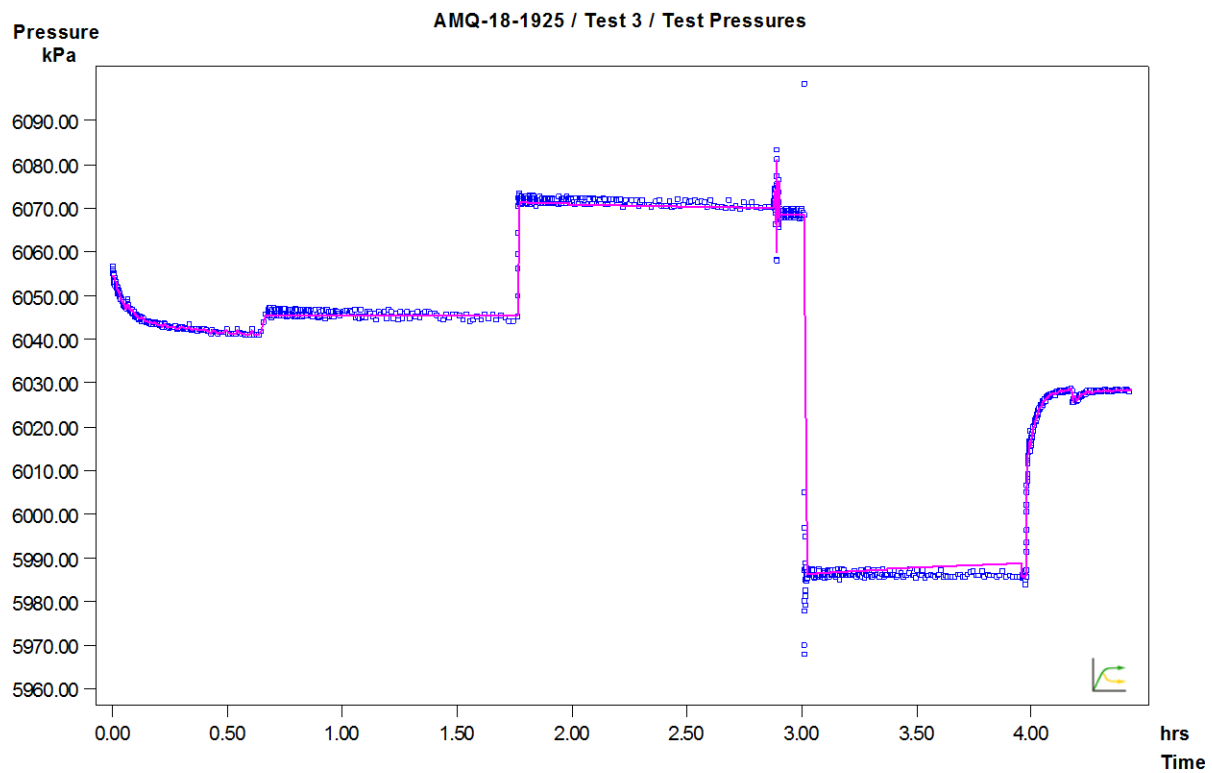


Figure 2: Pressure response (blue) and simulation (pink) cartesian plot

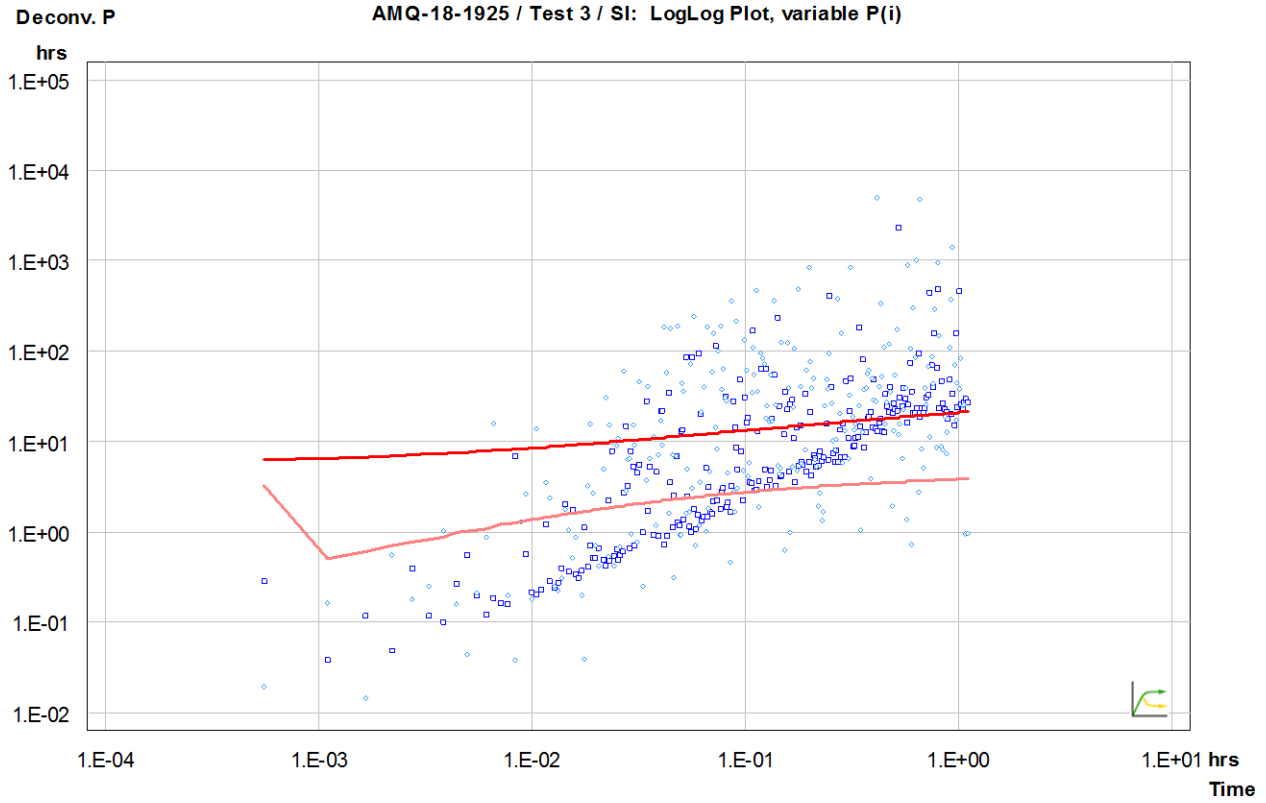


Figure 3: Deconvolved pressure response (dark blue), derivative (light blue) and simulation (red): Log-Log diagnostic plot, SI sequence

HYDROBENCH REPORT

Project 2018 Hydrogeology Program
Site Amaruq Project Site
Source Well AMQ-18-1925
Test Name Test 4
Test Date/Time
Interval top: 419.50 m bottom: 699.00 m
Description Testing: AC
Analysis: AC
Review: JDJ

Basic Data

Test Interval 279.50 m
Porosity 0.10
Well Radius 0.038 m Tubing Radius 0.023 m
Inclination 24.0 deg
Test Volume 1261.276 l
Well Type Source

Fluid Properties

Viscosity 0.001 Pa*s
Density 1195.0 kg/m³
Compressibility 2.0e-09 1/Pa

Sequence Definition

Name	Category	t(o) [hrs]	P(o) [kPa]	P(i) [kPa]	Rate [l/min]	C [m ³ /Pa]
COM1	Variable Pressure	0.00000	4017.01			1.6e-07
PSR	Recovery	1.54056	4035.07			1.6e-07
SI-INIT	dP-Event	2.19222	4034.50	-96.6 *		1.6e-07
SI	Slug	2.20556	4131.15	4034.5		1.6e-07
SW-INIT	dP-Event	3.00722	4129.94	101.2 *		1.6e-07
SW	Slug	3.05389	4028.74	4129.9		1.6e-07
PSR2	Recovery	3.56389	4028.94			1.6e-07
COM2	Variable Pressure	4.06611	4029.07			1.6e-07

Analysis Results

Analysis "SI"

Static Pressure: 4034.44 kPa

Shell Parameters:

Name	Transmissivity [m ² /s]	Storativity [-]	Radius [m]	Flow Dimension [-]
Shell 1	2.1e-09	5.5e-04	--	2.0

Sequence Parameters:

Name	Wellbore Storage [m ³ /Pa]	Skin [-]
COM1	1.6e-07	0.0
PSR	1.6e-07	0.0
SI-INIT	1.6e-07	0.0
SI	1.6e-07	0.0
SW-INIT	1.6e-07	0.0
SW	1.6e-07	0.0
PSR2	1.6e-07	0.0
COM2	1.6e-07	0.0

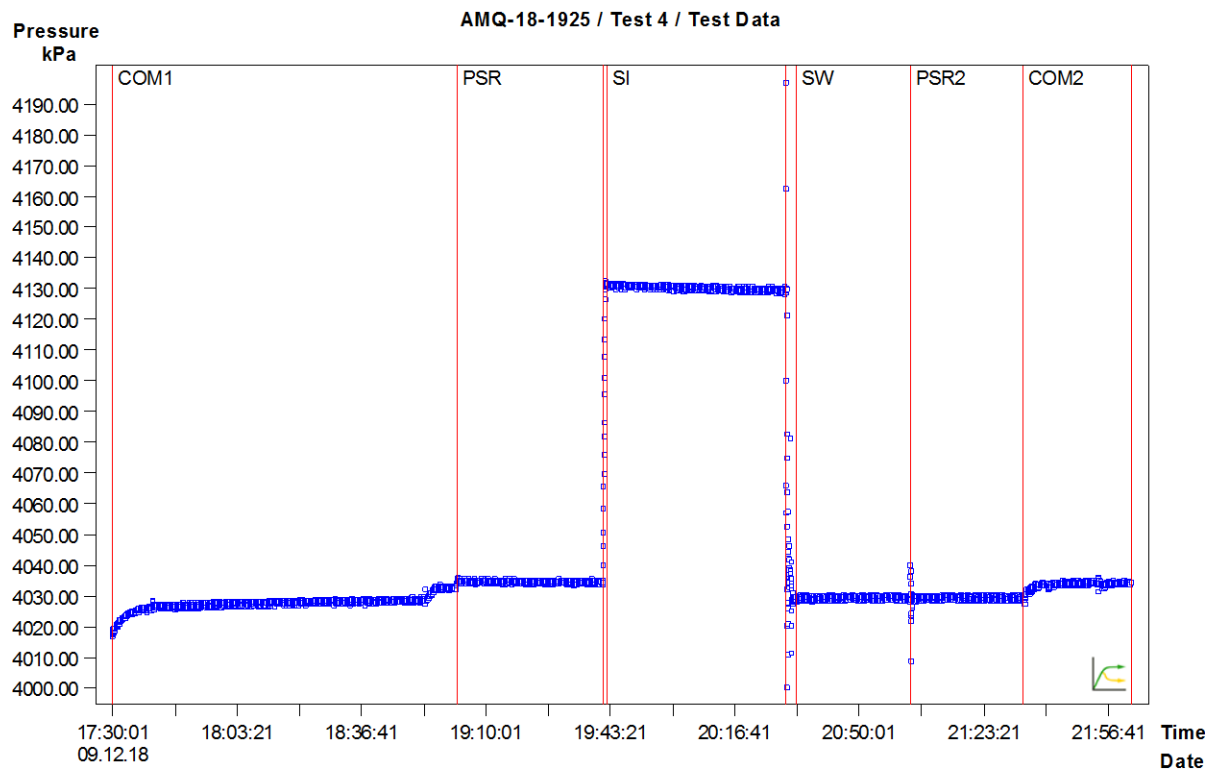


Figure 1: Pressure response and sequence definition

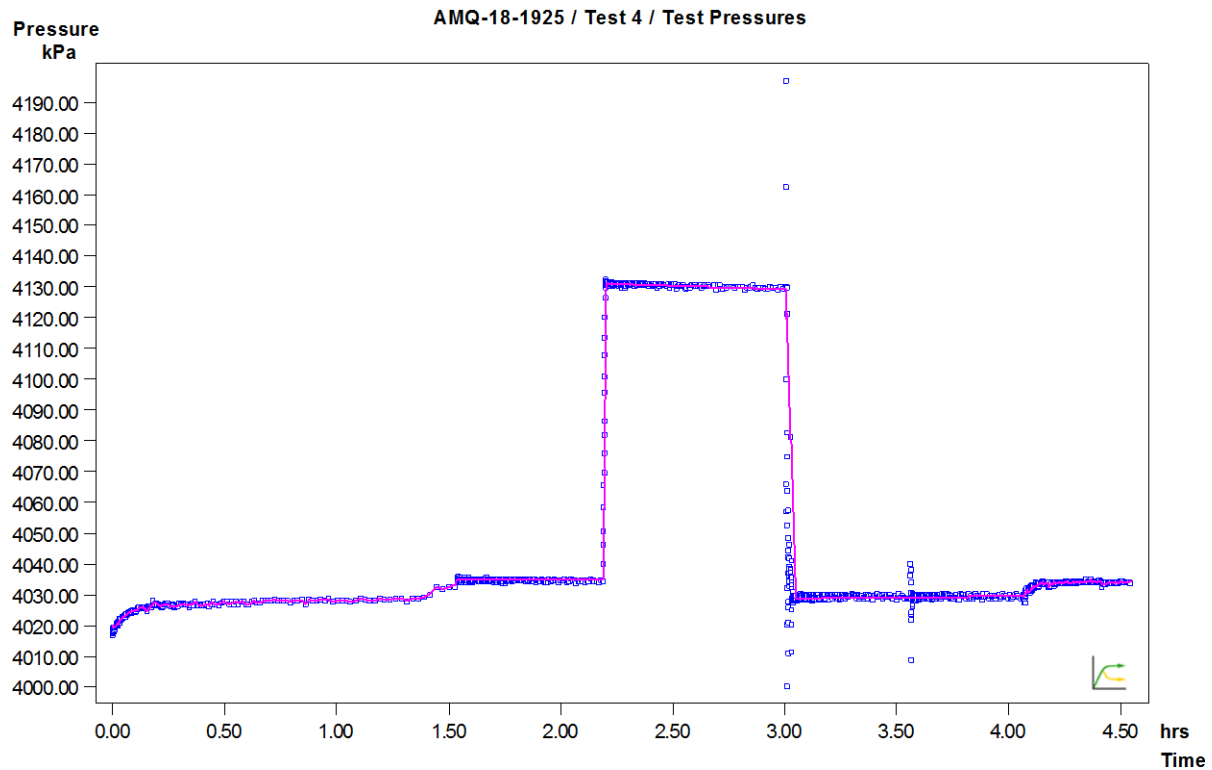


Figure 2: Pressure response (blue) and simulation (pink) cartesian plot

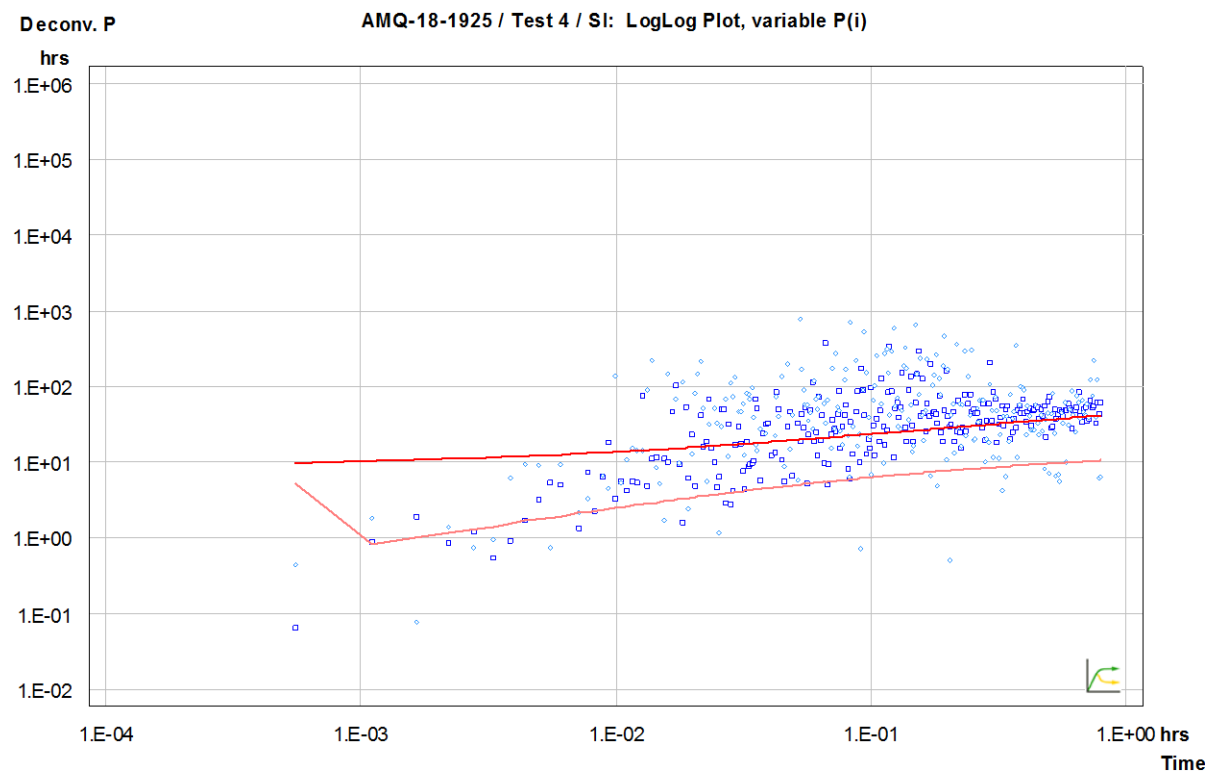


Figure 3: Deconvolved pressure response (dark blue), derivative (light blue) and simulation (red): Log-Log diagnostic plot, SI sequence