**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; $m^3$/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 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 $m^3$/day in 2030 to approximately 1,170 $m^3$/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 $m^3$/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 $m^3$/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 $m^3$/day inflow at the start of reflooding to -25 $m^3$/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] ($m^3$/day) | Inflow TDS Concentration [2] (mg/L) | Portion of Inflow from Attenuation Pond (%) | Portion of Inflow from South Basin of Whale Tail Lake (%) | 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/Outflow[1] ($m^3$/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; $m^3$/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] ($m^3$/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:
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; $m^3$/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 $m^3$/day in Year 1 to 1.4 $m^3$/day after 200 years. The long-term predicted pit lake discharge to the sub-permafrost groundwater flow system is predicted to be 1.2 $m^3$/day, which is 20% less than the long-term pit lake discharge in the FEIS Addendum (1.5 $m^3$/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 ($3 \times 10^{-9}$ m/s) based on packer testing data, the approximate area of the pit (0.5 $km^2$), 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 $m^3$/day. This value is in good agreement with the predicted value from the model after 300 years (1.2 $m^3$/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 $m^3$/day, which is 30% lower than the predicted discharge in the FEIS Addendum (0.7 $m^3$/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 $m^3$/day in 2019 to 1,340 $m^3$/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 2025[2]. The groundwater inflow to the Underground is predicted to increase from 20 $m^3$/day in 2020 to 180 $m^3$/day in 2023 and then decrease to 130 $m^3$/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 $m^3$/day in 2019 to 1,350 $m^3$/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 2025[1]. The groundwater inflow to the Underground is predicted to increase from 60 $m^3$/day in 2020 to 4200 $m^3$/day in 2023 and then decrease to 340 $m^3$/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 $m^3$/day in 2030 to approximately 1160 $m^3$/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 $m^3$/day in 2030 to approximately 1,170 $m^3$/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 $m^3$/day and 0.5 $m^3$/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 you current requirements. If you have any questions or require further assistance, please do not hesitate to contact the undersigned.


Jennifer Levenick, MSc
*Associate, Senior Hydrogeologist*

Don Chorley, MSc, PGeo.
*Senior Hydrogeology Specialist*

JL/DC/jr

https://goldenassociates.sharepoint.com/sites/103027/technical work/02_hydrog-modelling/01_report/rev0/18108905-291-tm-updated-hydrogmodel_rev0.docx

## 9.0 REFERENCES

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.

Golder (Golder Associates Ltd.). 2016. Westbay System Installation Summary – Whale Tail Pit Project, Nunavut. Dated July 7, 2016 (Reference 1649355-003-TM-Rev0-4000).

Golder. 2017. Hydrogeological and Permafrost Field Investigations, Amaruq Project 2017 Factual Report. Dated 31 July 2017. (Reference 1649355-008-R-Rev0-5000).

Golder. 2018. Hydrogeological Assessment and Modelling, Whale Tail Pit – Expansion Project. Dated November 2018. (Reference 1769310-213-RPT-Rev0).

Golder. 2019a. 2018 Westbay Groundwater Monitoring Investigation. Dated 8 February 2019 (Reference 1769310-244-TM-Rev0).

Golder. 2019b. Winter 2018 Hydrogeological Field Program – Amaruq Project, Nunavut. Dated 25 March 2019. (Reference 18113037-002-TM-Rev0-3000).

Golder. 2019c. Whale Tail Lake Thermal Assessment. Dated April 2019 (Reference 18108905-276-RPT-Rev0).

Golder. 2019d. Whale Tail Pit – Expansion Project 2019 Mean Annual Water Balance Update. Dated May 2019

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 ($km^2$) site located on Inuit Owned Land approximately 150 kilometres (km) north of the hamlet of Baker Lake and approximately 50 km northwest of 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.

**Golder Associates Ltd.**
1931 Robertson Road Ottawa, Ontario, K2H 5B7 Canada T: +1 613 592 9600 +1 613 592 9601

**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 brine[1]. 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.

$$(1) \qquad Dilute\ Brine\ Factor_{Port\ i} = \frac{Field\ Conductivity_{Port\ i}}{Brine\ Conductivity_{calculated}}$$

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).

$$(2) \qquad Dilute\ Brine_{Port\ i} = Laboratory\ Result_{Brine} \times Dilution\ Brine\ Factor_{Port\ i}$$

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.

$$(3) \qquad Groundwater\ Quality_{calculated} = Laboratory\ Result - \frac{Proportion\ of\ Drill\ Brine \times Dilute\ Brine\ Chemistry}{Proportion\ of\ Formation\ Water}$$

[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 (ºC) |
|---|---|---|---|---|---|---|---|---|---|
| | 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 x$10^{-8}$ to 3 x $10^{-8}$ 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 x $10^{-9}$ 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 x$10^{-8}$ to 3 x $10^{-8}$ ) and the now refined hydraulic conductivity (1 x $10^{-9}$ 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 x $10^{-9}$ to 3 x $10^{-8}$ m/s), and the measured downward gradient (0.008), the data would indicate long-term groundwater flux would be approximately 0.3 $m^3$/day to 11 $m^3$/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 $m^3$/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 $^oC$, 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 crypogeg (Port 6) could have a heterogenous 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:

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

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.

Golder Associates Ltd. has relied in good faith on all information provided and does not accept responsibility for any deficiency, misstatements, or inaccuracies contained in the technical memorandum as a result of omissions, misinterpretation, or fraudulent acts of the persons contacted or errors or omissions in the reviewed documentation.

The services performed, as described in this technical memorandum, were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

Any use which a third party makes of this technical memorandum, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Golder Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this technical memorandum.

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.

**Golder Associates Ltd.**

REGISTERED PROFESSIONAL GEOLOGIST
08-02-2019
V.J. BERTRAND
LICENSEE
NWT/NU

Dale Holtze, M.Sc.
*Hydrogeologist*

Valerie Bertrand, M.A.Sc., P.Geo. (NT, NU)
*Associate, Senior Geochemist*

Jennifer Levenick, M.Sc.
*Senior Hydrogeologist*

PERMIT TO PRACTICE
GOLDER ASSOCIATES LTD.
Signature
Date 2019-02-08
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

DH/VJB/JL/jr
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

Agnico Eagle (Agnico Eagle Mines Limited). 2018. Whale Tail Pit Management Plans - AEM RESPONSES TO ECCC & CIRNAC Reply - Waste Rock Management Plan, Water Management Plan, Water Quality and Flow Monitoring Plan. November 23 2018.

Golder (Golder Associates Ltd.). 2016a. Groundwater Quality Investigation, Amaruq, Nunavut. Technical Memorandum 1649355-080 prepared for Agnico Eagle Mines Ltd. November 15, 2016.

Golder. 2016b. Westbay System Installation Summary – Whale Tail Pit Project, Nunavut. Technical Memorandum 1649355-033-TM-Rev0-4000 prepared for Agnico Eagle Mines Ltd. July 7, 2016.

Golder. 2016c. Hydrogeological Model Pre-Mining, During Mining, and Closure. Submitted as Volume 6, Appendix 6-B in the Whale Tail Pit and Haul Road Final Environmental Impact Statement. June 2016.

Golder. 2016d. Hydrogeology Baseline Report – Whale Tail Project. Submitted as Volume 6, Appendix 6-A in the Whale Tail Pit and Haul Road Final Environmental Impact Statement. June 2016.

Golder. 2018a. Hydrogeological Assessment and Modelling, Whale Tail Pit – Expansion Project. Submitted to Agnico Eagle Mines Limited. Ref. 1789310-213-RPT-Rev0. November 2018.

Golder. 2018b. Whale Tail Pit Project, Hydrodynamic Modelling of Whale Tail Pit Lake. Submitted to Agnico Eagle Mines Limited. Ref. 1789310-181-TM-Rev0. June 26, 2018.

Golder. 2018c. Whale Tail Pit Post-Closure Hydrogeological Assessment for the Whale Tail Open Pit. Dated 27 June 2018.

Maidment, D.R. 1992. Handbook of Hydrology. McGraw-Hill, New York, USA

NIRB (Nunavut Impact Review Board). 2018. Whale Tail Pit Project, NIRB Project Certificate No.: 008. Issued March 15, 2018.

Rusydi, A. 2017. Correlation between conductivity and total dissolved solids in various types of water: A review. Global Colloquium on GeoSciences and Engineering 2017. IOP Conf. Series: Earth and Environmental Science 118 (2018) 012019. IOP Publishing. Pp. 1-6.

# 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 | mininum | maximum | minimum | maximum |
| Average Field measured parameters | | | | | | | | | | | | | |
| Fluoroscein | 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 |

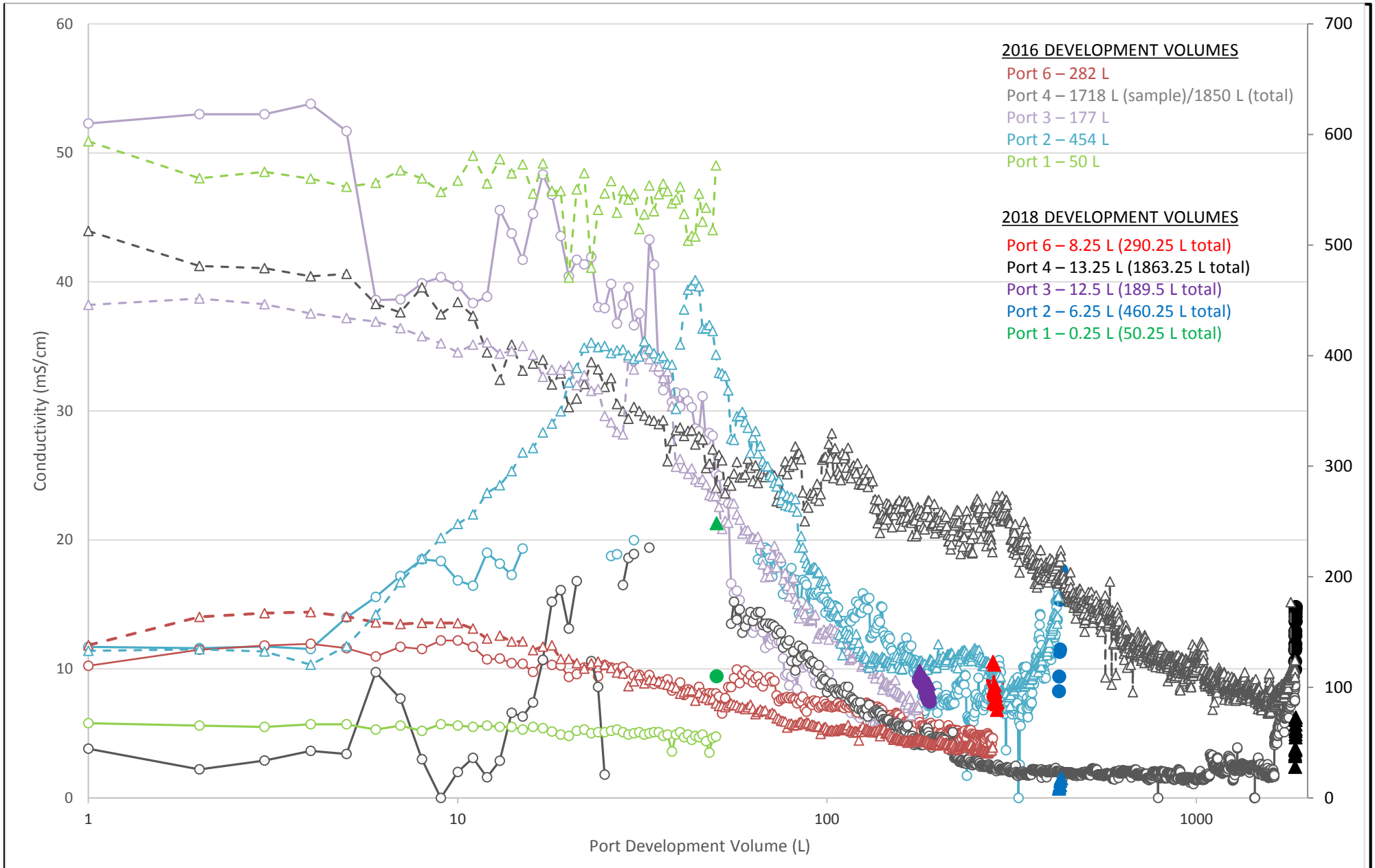
# Table 5
## Rock Formation Groundwater Quality Corrected to Remove Residual Drilling Water
## Whale Tail Lake Talik
## Whale Tail Project, Nunavut

| 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 | mininum | 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 | | Zone 6 | Zone 66 | | Method | | Zone 4 | Zone 44 | | Zone 3 | Zone 33 | |
| Paramètres | Detection Limit | Units | | | | Detection Limit | Units | | | | | | |
| **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)




Notes:
2016 conductivity
2016 fluorescein
2018 conductivity
2018 fluorescein
Volumes reported at time of sample collection and/or end of development (Port 1, Port 4 - 1855 L only)

2016 Data: Port 6, Port 4, Port 3, Port 2 and Port 1
2018 Data: **Port 6**, **Port 4**, **Port 3**, **Port 2** and **Port 1**

GOLDER

CLIENT
AGNICO EAGLE MINES LIMITED

CONSULTANT

| | |
|---|---|
| YYYY-MM-DD | 2019-02-08 |
| PREPARED | DH |
| DESIGN | -- |
| REVIEW | VJB |
| APPROVED | VJB |

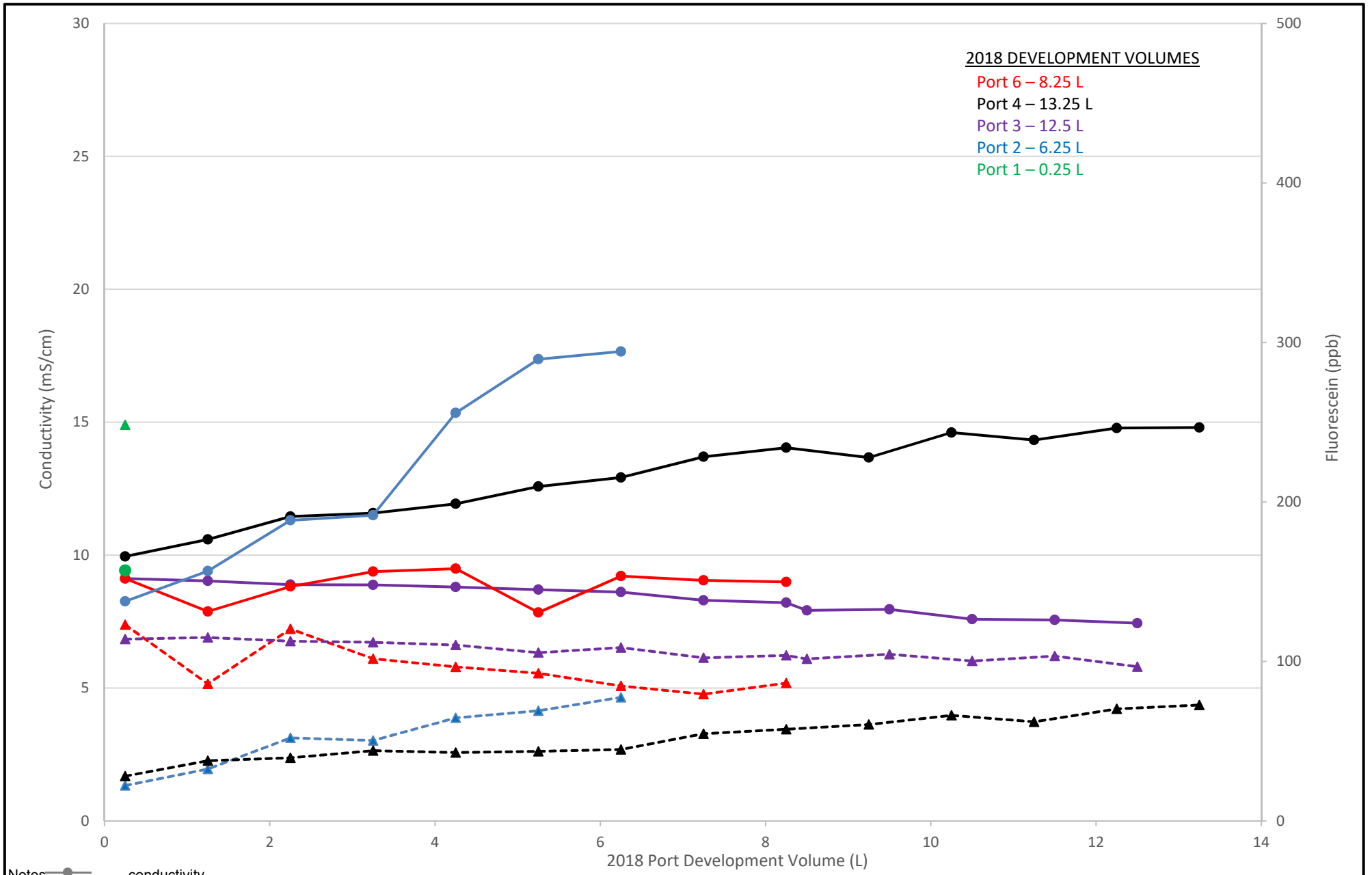
PROJECT
2018 WESTBAY SYSTEM GROUNDWATER MONITORING INVESTIGATION

TITLE
2016 AND 2018 DEVELOPMENT RECORD

PROJECT No. 1789310-244

Rev.

FIGURE 1




Notes: conductivity
fluorescein
Volumes reported at time of sample collection and/or end of development (for Port 1)

Colours **Port 6**, **Port 4**, **Port 3**, **Port 2** and Port 1

CLIENT
AGNICO EAGLE MINES LIMITED

CONSULTANT
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2019-02-08 |
| PREPARED | DH |
| DESIGN | -- |
| REVIEW | VJB |
| APPROVED | VJB |

PROJECT
2018 WESTBAY SYSTEM GROUNDWATER MONITORING INVESTIGATION

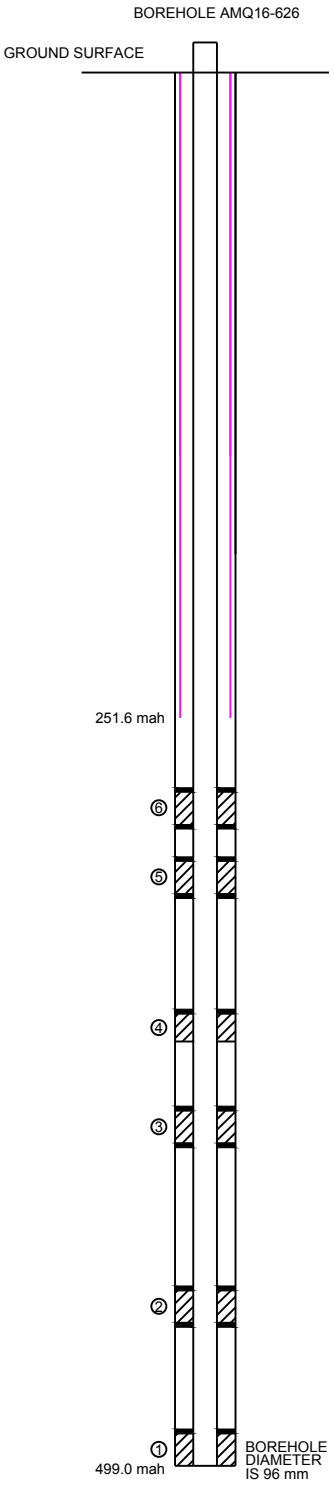
TITLE
2018 DEVELOPMENT RECORD

PROJECT No. 1789310-244 Rev.

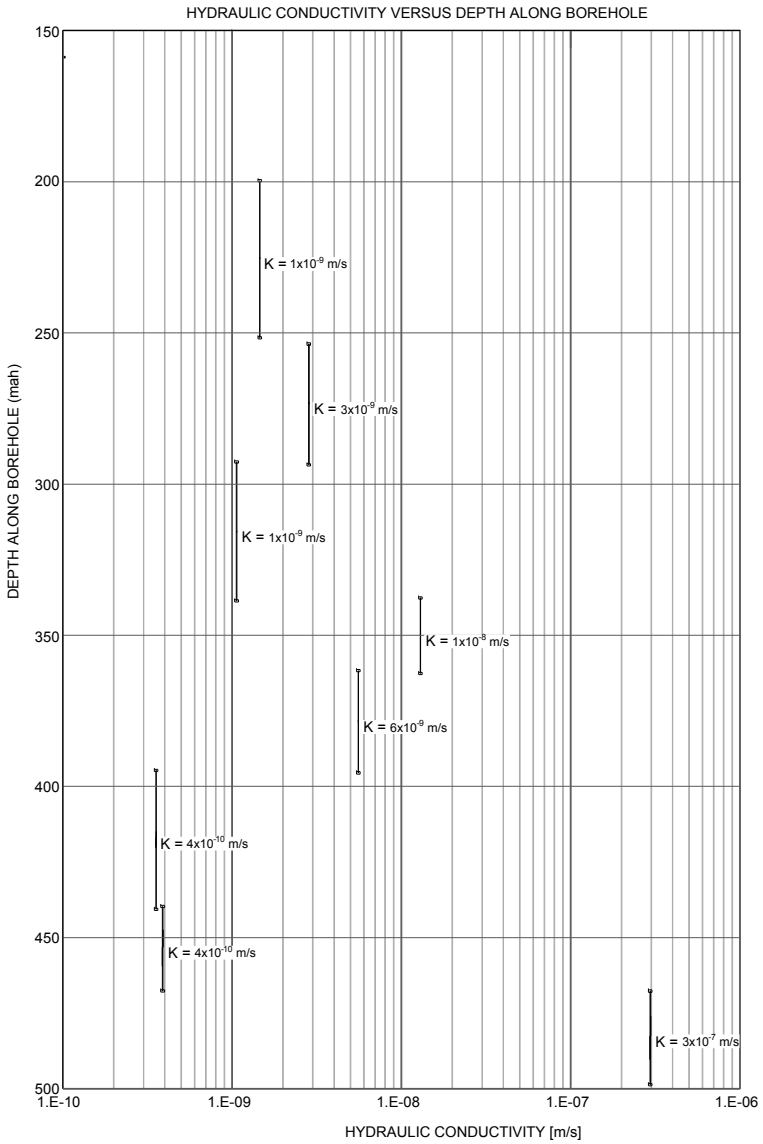
FIGURE 2

**APPENDIX A**

# AMQ160626 Westbay System Installation Details




| 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

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

## NOTES

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

**NOT TO SCALE**
**SCHEMATIC ONLY**

| REV | DATE | REVISION DESCRIPTION | DES | CADD | CHK | RVW |
|---|---|---|---|---|---|---|
| 0 | 2016-07-06 | ISSUED FOR FINAL | JJ | PP | DV | DC |
| A | 2016-05-27 | ISSUED FOR REVIEW | JJ | PP | | |

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\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 | 0.208 | 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

Westbay Instruments

# MOSDAX Calibration Report 2: EMS - 1764 Module 323

Full Scale: 2000 (psia)

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

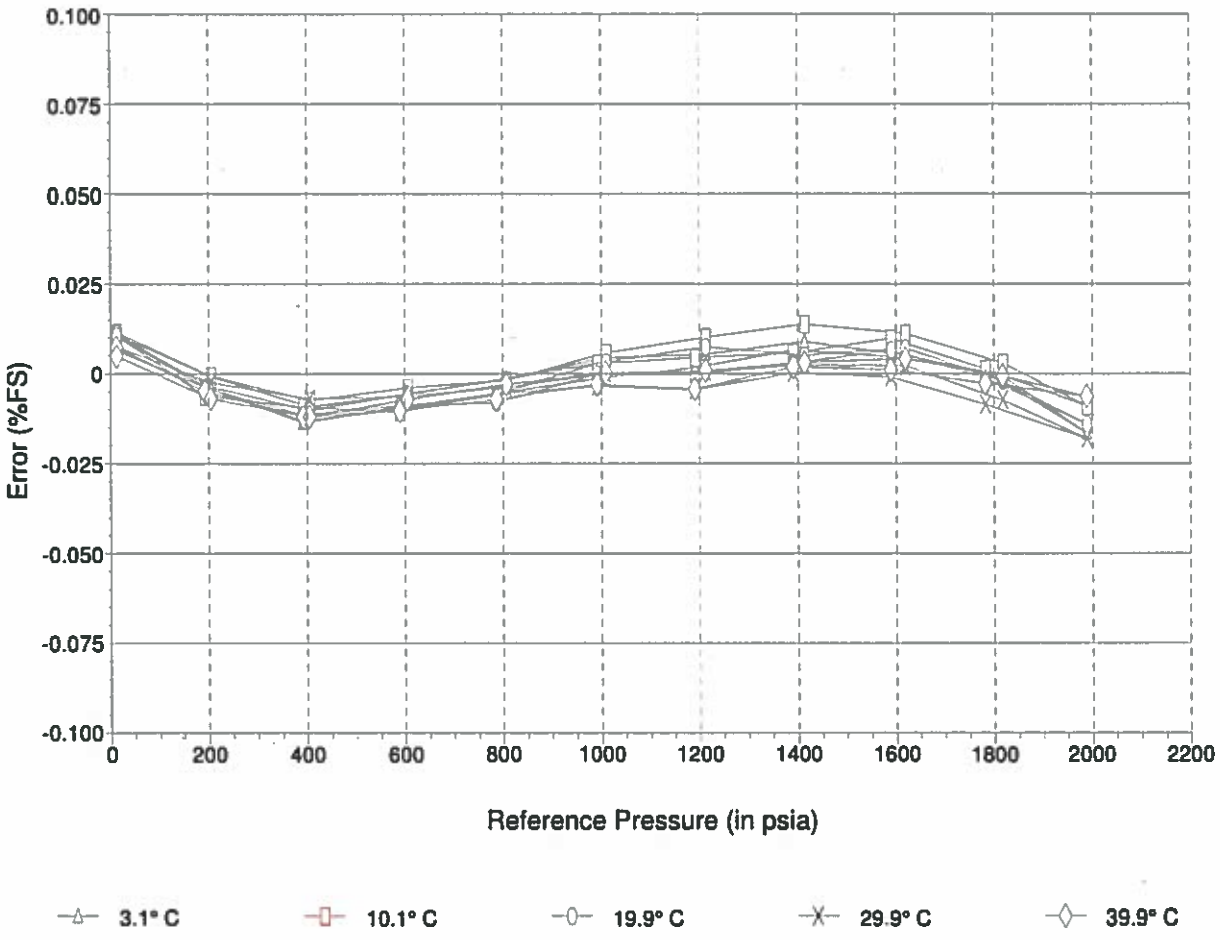
Pressure Reference: Paroscientific Model 42K-101 S/N 59937

Range: 2K PSI

Date of last reference to traceable standard: Oct 5 2017

## Plot of Error vs. Reference Pressure

EMS - 1764 Module 323




Comments

Issued by

Westbay Instruments

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

Full Scale: 2000 (psia)

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

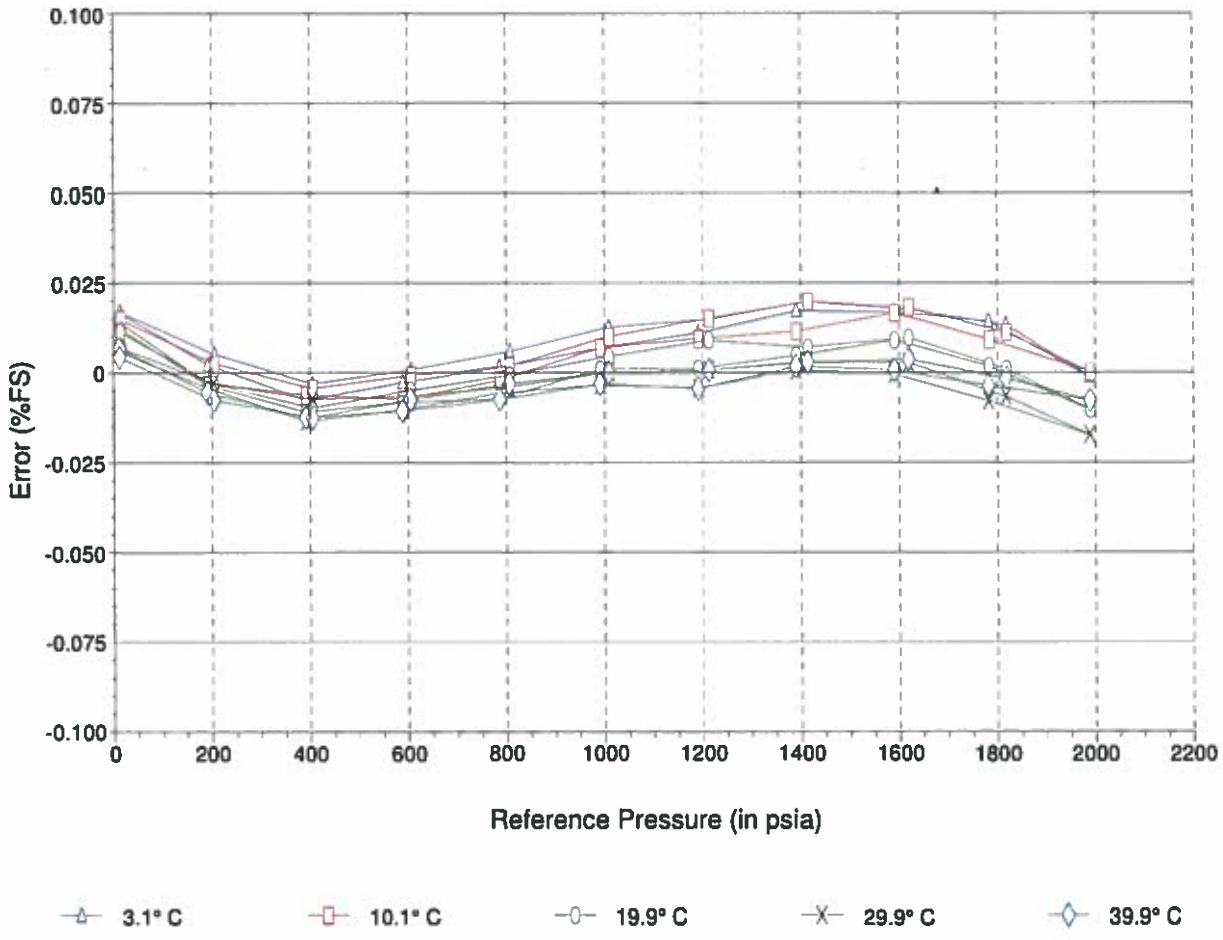
Pressure Reference: Paroscientific Model 42K-101 S/N 59937

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

Westbay Instruments

# 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 |

Issued by

Westbay Instruments

# 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

| Ref Pres (psia) | Error (psia) | (% FS) |
|---|---|---|
| 14.846 | -0.142 | -0.007 |
| 192.843 | -0.001 | 0.000 |
| 393.849 | 0.122 | 0.006 |
| 587.948 | -0.023 | -0.001 |
| 791.882 | -0.022 | -0.001 |
| 990.911 | -0.057 | -0.003 |
| 1190.327 | -0.189 | -0.009 |
| 1390.264 | -0.181 | -0.009 |
| 1589.406 | -0.082 | -0.004 |
| 1781.525 | 0.044 | 0.002 |
| 1989.515 | 0.123 | 0.006 |
| 1818.398 | 0.071 | 0.004 |
| 1619.022 | -0.012 | -0.001 |
| 1412.880 | -0.003 | 0.000 |
| 1211.907 | -0.038 | -0.002 |
| 1009.806 | 0.075 | 0.004 |
| 808.334 | 0.096 | 0.005 |
| 606.956 | 0.169 | 0.008 |
| 406.373 | 0.123 | 0.006 |
| 205.741 | 0.110 | 0.006 |
| 14.848 | -0.083 | -0.004 |

EMS - 2652 Jun 02 07:51:36 2018
Range 2 Temp 10.3° C

| Ref Pres (psia) | Error (psia) | (% FS) |
|---|---|---|
| 14.855 | -0.105 | -0.005 |
| 192.231 | -0.010 | -0.001 |
| 393.607 | 0.068 | 0.003 |
| 593.420 | 0.070 | 0.003 |
| 792.296 | 0.087 | 0.004 |
| 991.833 | 0.075 | 0.004 |
| 1191.049 | -0.061 | -0.003 |
| 1390.953 | -0.006 | 0.000 |
| 1589.174 | 0.014 | 0.001 |
| 1781.549 | 0.156 | 0.008 |
| 1989.230 | 0.324 | 0.016 |
| 1818.861 | 0.206 | 0.010 |
| 1618.518 | 0.147 | 0.007 |
| 1415.894 | 0.075 | 0.004 |
| 1212.127 | 0.094 | 0.005 |
| 1010.514 | 0.213 | 0.011 |
| 808.014 | 0.218 | 0.011 |
| 606.949 | 0.179 | 0.009 |
| 406.191 | 0.137 | 0.007 |
| 206.072 | 0.110 | 0.005 |
| 14.863 | -0.040 | -0.002 |

EMS - 2652 Jun 02 03:10:20 2018
Range 3 Temp 20.1° C

| Ref Pres (psia) | Error (psia) | (% FS) |
|---|---|---|
| 14.842 | -0.118 | -0.006 |
| 194.509 | -0.104 | -0.005 |
| 390.935 | 0.064 | 0.003 |
| 592.897 | 0.002 | 0.000 |
| 791.655 | 0.062 | 0.003 |
| 991.348 | 0.019 | 0.001 |
| 1190.921 | -0.121 | -0.006 |
| 1390.842 | -0.037 | -0.002 |
| 1589.397 | -0.028 | -0.001 |
| 1781.207 | 0.088 | 0.004 |
| 1989.355 | 0.295 | 0.015 |
| 1816.258 | 0.129 | 0.006 |
| 1618.089 | 0.091 | 0.005 |
| 1413.069 | 0.081 | 0.004 |
| 1212.924 | 0.023 | 0.001 |
| 1009.965 | 0.189 | 0.009 |
| 807.813 | 0.215 | 0.011 |
| 606.634 | 0.213 | 0.011 |
| 407.189 | 0.192 | 0.010 |
| 205.699 | 0.162 | 0.008 |
| 14.852 | -0.051 | -0.003 |

EMS - 2652 Jun 01 22:31:07 2018
Range 4 Temp 30.0° C

| Ref Pres (psia) | Error (psia) | (% FS) |
|---|---|---|
| 14.847 | -0.019 | -0.001 |
| 194.042 | -0.002 | 0.000 |
| 393.209 | 0.097 | 0.005 |
| 593.265 | 0.087 | 0.004 |
| 792.056 | 0.052 | 0.003 |
| 991.614 | 0.043 | 0.002 |
| 1189.236 | -0.151 | -0.008 |
| 1389.839 | -0.128 | -0.006 |
| 1588.713 | -0.048 | -0.002 |
| 1788.124 | 0.061 | 0.003 |
| 1989.624 | 0.201 | 0.010 |
| 1817.189 | 0.140 | 0.007 |
| 1616.308 | 0.001 | 0.000 |
| 1412.900 | 0.022 | 0.001 |
| 1212.611 | 0.060 | 0.003 |
| 1009.750 | 0.246 | 0.012 |
| 808.478 | 0.183 | 0.009 |
| 606.817 | 0.225 | 0.011 |
| 406.966 | 0.233 | 0.012 |
| 205.745 | 0.163 | 0.008 |
| 14.853 | -0.013 | -0.001 |

EMS - 2652 Jun 01 17:53:01 2018
Range 5 Temp 39.8° C

| Ref Pres (psia) | Error (psia) | (% FS) |
|---|---|---|
| 14.838 | -0.006 | 0.000 |
| 194.229 | 0.072 | 0.004 |
| 393.823 | 0.095 | 0.005 |
| 592.922 | 0.099 | 0.005 |
| 792.743 | 0.066 | 0.003 |
| 991.261 | 0.057 | 0.003 |
| 1190.280 | -0.056 | -0.003 |
| 1389.590 | -0.057 | -0.003 |
| 1588.437 | 0.020 | 0.001 |
| 1789.309 | 0.187 | 0.009 |
| 1989.755 | 0.368 | 0.018 |
| 1818.126 | 0.224 | 0.011 |
| 1615.388 | 0.129 | 0.006 |
| 1413.930 | 0.177 | 0.009 |
| 1208.395 | 0.080 | 0.004 |
| 1009.785 | 0.309 | 0.015 |
| 808.128 | 0.308 | 0.015 |
| 606.791 | 0.317 | 0.016 |
| 407.604 | 0.144 | 0.007 |
| 206.494 | 0.092 | 0.005 |
| 14.839 | -0.005 | 0.000 |

Issued by



Westbay Instruments

# MOSDAX Calibration Report 2: EMS - 2652 Module 3008

Full Scale: 2000 (psia)

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

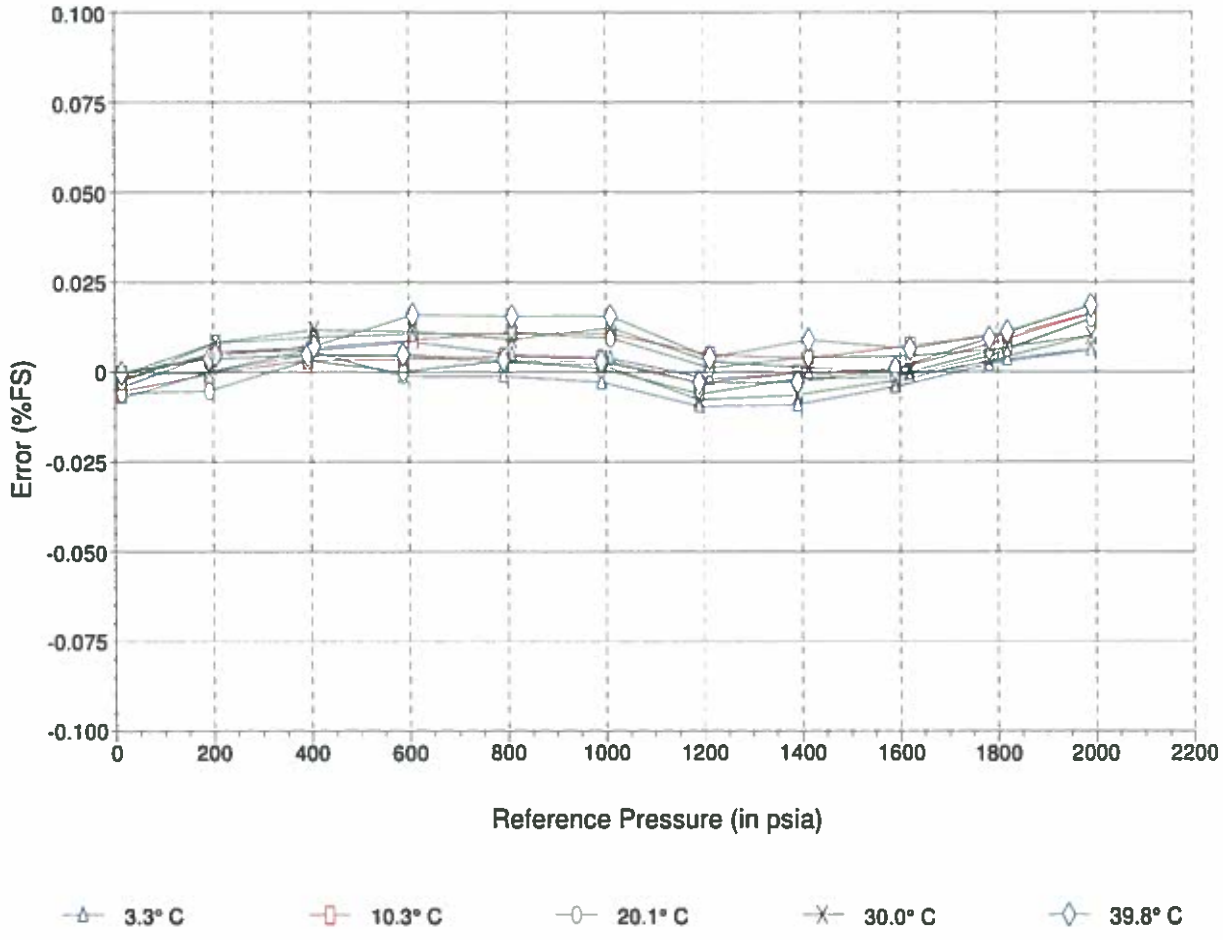
Pressure Reference: Paroscientific Model 42K-101 S/N 59937

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



Westbay Instruments

# 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

| Ref Pres (psia) | Error (psia) | (% FS) |
|---|---|---|
| 14.846 | 0.013 | 0.001 |
| 192.843 | 0.170 | 0.008 |
| 393.849 | 0.313 | 0.016 |
| 587.948 | 0.190 | 0.009 |
| 791.882 | 0.218 | 0.011 |
| 990.911 | 0.211 | 0.011 |
| 1190.327 | 0.110 | 0.005 |
| 1390.264 | 0.152 | 0.008 |
| 1589.406 | 0.286 | 0.014 |
| 1781.525 | 0.449 | 0.022 |
| 1989.515 | 0.569 | 0.028 |
| 1818.398 | 0.484 | 0.024 |
| 1619.022 | 0.362 | 0.018 |
| 1412.880 | 0.333 | 0.017 |
| 1211.907 | 0.264 | 0.013 |
| 1009.806 | 0.346 | 0.017 |
| 808.334 | 0.338 | 0.017 |
| 606.956 | 0.385 | 0.019 |
| 406.373 | 0.315 | 0.016 |
| 205.741 | 0.282 | 0.014 |
| 14.848 | 0.072 | 0.004 |

EMS - 2652 Jun 02 07:51:36 2018
Range 2 Temp 10.3° C

| Ref Pres (psia) | Error (psia) | (% FS) |
|---|---|---|
| 14.855 | 0.042 | 0.002 |
| 192.231 | 0.155 | 0.008 |
| 393.607 | 0.255 | 0.013 |
| 593.420 | 0.277 | 0.014 |
| 792.296 | 0.315 | 0.016 |
| 991.833 | 0.321 | 0.016 |
| 1191.049 | 0.204 | 0.010 |
| 1390.953 | 0.279 | 0.014 |
| 1589.174 | 0.318 | 0.016 |
| 1781.549 | 0.476 | 0.024 |
| 1989.230 | 0.662 | 0.033 |
| 1818.861 | 0.530 | 0.027 |
| 1618.518 | 0.453 | 0.023 |
| 1415.894 | 0.362 | 0.018 |
| 1212.127 | 0.362 | 0.018 |
| 1010.514 | 0.462 | 0.023 |
| 808.014 | 0.447 | 0.022 |
| 606.949 | 0.388 | 0.019 |
| 406.191 | 0.325 | 0.016 |
| 206.072 | 0.277 | 0.014 |
| 14.863 | 0.107 | 0.005 |

EMS - 2652 Jun 02 03:10:20 2018
Range 3 Temp 20.1° C

| Ref Pres (psia) | Error (psia) | (% FS) |
|---|---|---|
| 14.842 | 0.032 | 0.002 |
| 194.509 | 0.061 | 0.003 |
| 390.935 | 0.244 | 0.012 |
| 592.897 | 0.196 | 0.010 |
| 791.655 | 0.268 | 0.013 |
| 991.348 | 0.236 | 0.012 |
| 1190.921 | 0.105 | 0.005 |
| 1390.842 | 0.196 | 0.010 |
| 1589.397 | 0.211 | 0.011 |
| 1781.207 | 0.331 | 0.017 |
| 1989.355 | 0.540 | 0.027 |
| 1816.258 | 0.372 | 0.019 |
| 1618.089 | 0.330 | 0.017 |
| 1413.069 | 0.314 | 0.016 |
| 1212.924 | 0.250 | 0.013 |
| 1009.965 | 0.407 | 0.020 |
| 807.813 | 0.422 | 0.021 |
| 606.634 | 0.408 | 0.020 |
| 407.189 | 0.373 | 0.019 |
| 205.699 | 0.328 | 0.016 |
| 14.852 | 0.098 | 0.005 |

EMS - 2652 Jun 01 22:31:07 2018
Range 4 Temp 30.0° C

| Ref Pres (psia) | Error (psia) | (% FS) |
|---|---|---|
| 14.847 | 0.148 | 0.007 |
| 194.042 | 0.167 | 0.008 |
| 393.209 | 0.270 | 0.013 |
| 593.265 | 0.263 | 0.013 |
| 792.056 | 0.233 | 0.012 |
| 991.614 | 0.229 | 0.011 |
| 1189.236 | 0.040 | 0.002 |
| 1389.839 | 0.070 | 0.003 |
| 1588.713 | 0.156 | 0.008 |
| 1788.124 | 0.271 | 0.014 |
| 1989.624 | 0.418 | 0.021 |
| 1817.189 | 0.351 | 0.018 |
| 1616.308 | 0.205 | 0.010 |
| 1412.900 | 0.220 | 0.011 |
| 1212.611 | 0.252 | 0.013 |
| 1009.750 | 0.432 | 0.022 |
| 808.478 | 0.364 | 0.018 |
| 606.817 | 0.403 | 0.020 |
| 406.966 | 0.406 | 0.020 |
| 205.745 | 0.332 | 0.017 |
| 14.853 | 0.154 | 0.008 |

EMS - 2652 Jun 01 17:53:01 2018
Range 5 Temp 39.8° C

| Ref Pres (psia) | Error (psia) | (% FS) |
|---|---|---|
| 14.838 | 0.193 | 0.010 |
| 194.229 | 0.252 | 0.013 |
| 393.823 | 0.259 | 0.013 |
| 592.922 | 0.253 | 0.013 |
| 792.743 | 0.216 | 0.011 |
| 991.261 | 0.209 | 0.010 |
| 1190.280 | 0.104 | 0.005 |
| 1389.590 | 0.117 | 0.006 |
| 1588.437 | 0.215 | 0.011 |
| 1789.309 | 0.410 | 0.020 |
| 1989.755 | 0.624 | 0.031 |
| 1818.126 | 0.450 | 0.023 |
| 1615.388 | 0.327 | 0.016 |
| 1413.930 | 0.354 | 0.018 |
| 1208.395 | 0.241 | 0.012 |
| 1009.785 | 0.462 | 0.023 |
| 808.128 | 0.458 | 0.023 |
| 606.791 | 0.471 | 0.024 |
| 407.604 | 0.307 | 0.015 |
| 206.494 | 0.271 | 0.014 |
| 14.839 | 0.194 | 0.010 |

Issued by



Westbay Instruments

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

Full Scale: 2000 (psia)

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

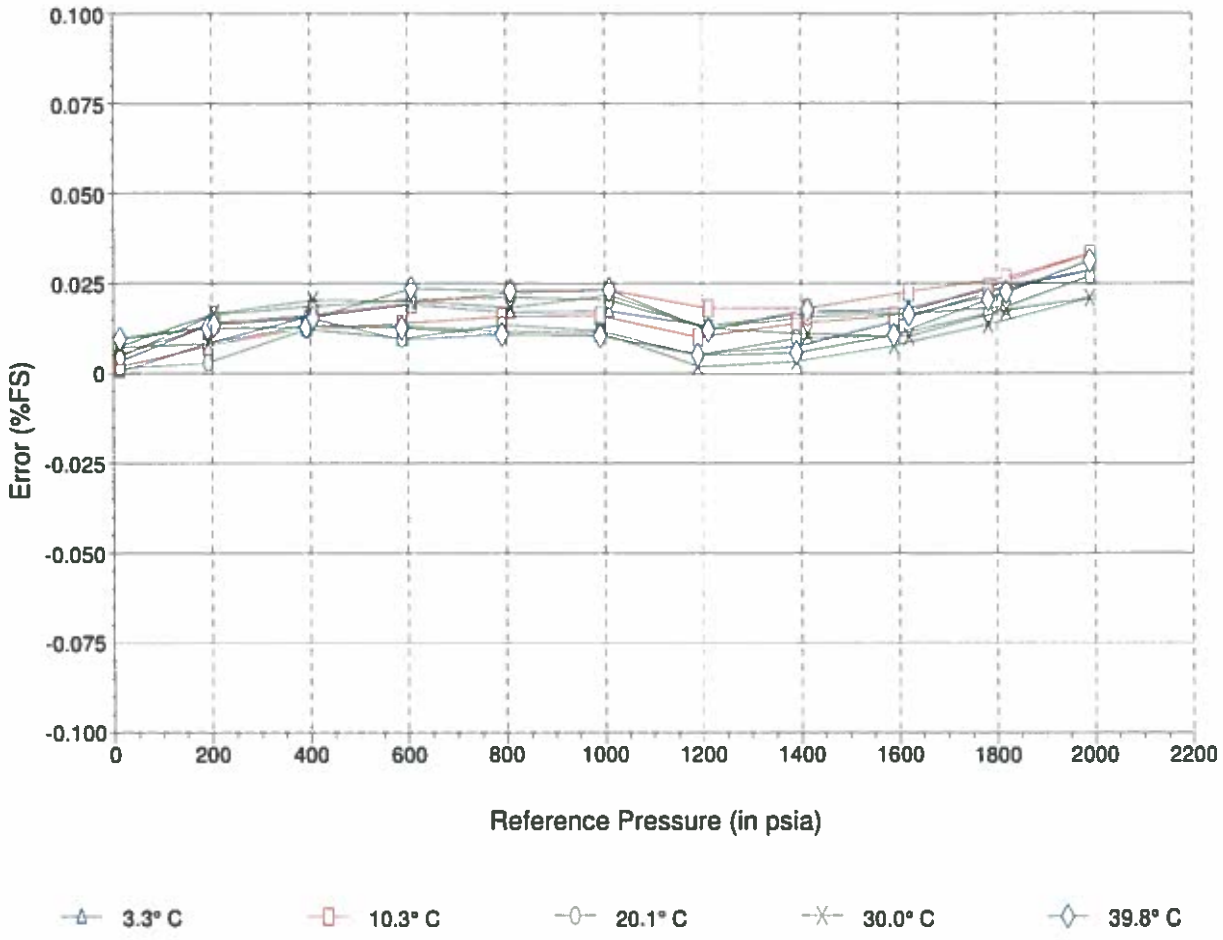
Pressure Reference: Paroscientific Model 42K-101 S/N 59937

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



Westbay Instruments

**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

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L2197641-1 | L2197641-2 | L2197641-3 | L2197641-4 | L2197641-5 |
|---|---|---|---|---|---|---|
| | Description | GW | GW | GW | GW | GW |
| | Sampled Date | 10-NOV-18 | 10-NOV-18 | 11-NOV-18 | 11-NOV-18 | 12-NOV-18 |
| | Sampled Time | 17:30 | 17:30 | 17:30 | 17:30 | 17:30 |
| | Client ID | ZONE 2 | ZONE 22 | ZONE 4 | ZONE 44 | 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** | L2197641-6 | | | | |
| | **Description** | GW | | | | |
| | **Sampled Date** | 12-NOV-18 | | | | |
| | **Sampled Time** | 17:30 | | | | |
| | **Client ID** | ZONE 33 | | | | |
| **Grouping** | **Analyte** | | | | | |
| **SEAWATER** | | | | | | |
| **Physical Tests** | Hardness (as CaCO3) (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

| Grouping | Analyte | 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 |
|---|---|---|---|---|---|---|
| | **Sample ID / Description / Sampled Date / Sampled Time / Client ID** | | | | | |
| **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** | L2197641-6 | | | | |
| | **Description** | GW | | | | |
| | **Sampled Date** | 12-NOV-18 | | | | |
| | **Sampled Time** | 17:30 | | | | |
| | **Client ID** | 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

| Grouping | Analyte | 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 |
|---|---|---|---|---|---|---|
| | **Sample ID** / **Description** / **Sampled Date** / **Sampled Time** / **Client ID** | | | | | |
| **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** | L2197641-6 | | | | |
| | **Description** | GW | | | | |
| | **Sampled Date** | 12-NOV-18 | | | | |
| | **Sampled Time** | 17:30 | | | | |
| | **Client ID** | 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

| Grouping | Analyte | 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 |
|---|---|---|---|---|---|---|
| **Sample ID / Description / Sampled Date / Sampled Time / Client ID** | | | | | | |
| **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 DLDS | 5910 DLDS | 5220 DLDS | 4530 DLDS | 2700 DLDS |
| | 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 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Phosphorus (P)-Total (mg/L) | 0.0120 DLDS | 0.0132 DLDS | 0.0067 DLDS | 0.0059 DLDS | 0.0061 DLDS |
| | Sulfate (SO4) (mg/L) | <15 | <15 | <15 | <15 | <15 |

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

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L2197641-6 | | | | |
| | **Description** | GW | | | | |
| | **Sampled Date** | 12-NOV-18 | | | | |
| | **Sampled Time** | 17:30 | | | | |
| | **Client ID** | ZONE 33 | | | | |
| **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 wwt - 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.*

# Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2197641-COFC

COC Number: 17 - 720417

Page of

| Report To | Contact and company name below will appear on the final report | Report Format / Distribution | Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply) |
|---|---|---|---|
| Company: | Golder Associates Ltd. | Select Report Format: [X] PDF [X] EXCEL [ ] EDD (DIGITAL) | Regular [R] [X] Standard TAT if received by 3 pm - business days - no surcharges apply |
| Contact: | Dale Holtze | Quality Control (QC) Report with Report [ ] YES [ ] NO | PRIORITY (Business Days): 4 day [P4-20%] [ ]; 3 day [P3-25%] [ ]; 2 day [P2-50%] [ ] — EMERGENCY: 1 Business day [E-100%] [ ]; Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)] [ ] |
| Phone: | 613-592-9600 | [ ] Compare Results to Criteria on Report - provide details below if box checked | |
| | Company address below will appear on the final report | Select Distribution: [ ] EMAIL [ ] MAIL [ ] FAX | Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm |
| Street: | 1931 Robertson Road | Email 1 or Fax: dholtze@golder.com | For tests that can not be performed according to the service level selected, you will be contacted. |
| City/Province: | Ottawa, ON | Email 2: valerie-bertrand@golder.com | |
| Postal Code: | K2H 5B7 | Email 3: | |
| Invoice To | Same as Report To [X] YES [ ] NO | Invoice Distribution | Analysis Request |
| | Copy of Invoice with Report [ ] YES [ ] NO | Select Invoice Distribution: [X] EMAIL [ ] MAIL [ ] FAX | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below |
| Company: | | Email 1 or Fax: dholtze@golder.com | |
| Contact: | | Email 2: | |

| Project Information | | Oil and Gas Required Fields (client use) | |
|---|---|---|---|
| ALS Account # / Quote #: | Q70883 | AFE/Cost Center: | PO#: |
| Job #: | 1789310 | Major/Minor Code: | Routing Code: |
| PO / AFE: | | Requisitioner: | |
| LSD: | | Location: | |
| ALS Lab Work Order # (lab use only): | | ALS Contact: Joanne Lee | Sampler: P. Holtze |

| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | total metals | dissolved metals | total P | major ions | TDS, TSS | SAMPLES ON HOLD | Sample is hazardous (please provide further details) | NUMBER OF CONTAINERS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Zone 2 | 10-Nov-18 | 17:30 | GW | X | X | X | X | X | | | 6 |
| | Zone 22 | 10-Nov-18 | 17:30 | | | | | | | | | |
| | Zone 4 | 11-Nov-18 | 17:30 | | | | | | | | | |
| | Zone 44 | 11-Nov-18 | 17:30 | | | | | | | | | |
| | Zone 3 | 12-Nov-18 | 17:30 | | | | | | | | | |
| | Zone 33 | 12-Nov-18 | 17:30 | | | | | | | | | |

| Drinking Water (DW) Samples[1] (client use) | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | SAMPLE CONDITION AS RECEIVED (lab use only) |
|---|---|---|
| Are samples taken from a Regulated DW System? [ ] YES [X] NO | Elevated salt concentrations likely (Brine) EC Zone 2+22 ~ 17.37 mS/cm Zone 4+44 ~ 14.8 mS/cm Zone 3+33 ~ 7.5 mS/cm | Frozen [ ] SIF Observations Yes [ ] No [ ] |
| Are samples for human consumption/ use? [ ] YES [X] NO | | Ice Packs [X] Ice Cubes [ ] Custody seal intact Yes [X] No [ ] |
| | | Cooling Initiated [ ] |
| | | INITIAL COOLER TEMPERATURES °C: FINAL COOLER TEMPERATURES °C: 7 |

| SHIPMENT RELEASE (client use) | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | |
|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Received by: AA JC | Date: Nov 16/18 | Time: 830AM |
| Dale Holtze | 2018-11-13 | 8:00 | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JULY 2017 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

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

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | L2198327-1 | L2198327-2 | L2198327-3 | L2198327-4 | |
|---|---|---|---|---|---|
| Description | Groundwater | Groundwater | Groundwater | Groundwater | |
| Sampled Date | 13-NOV-18 | 13-NOV-18 | 13-NOV-18 | 13-NOV-18 | |
| Sampled Time | 17:00 | 17:00 | 15:00 | 15:30 | |
| Client ID | ZONE 6 | ZONE 66 | EB | 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 | L2198327-1 | L2198327-2 | L2198327-3 | L2198327-4 | |
|---|---|---|---|---|---|
| Description | Groundwater | Groundwater | Groundwater | Groundwater | |
| Sampled Date | 13-NOV-18 | 13-NOV-18 | 13-NOV-18 | 13-NOV-18 | |
| Sampled Time | 17:00 | 17:00 | 15:00 | 15:30 | |
| Client ID | ZONE 6 | ZONE 66 | EB | 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 | L2198327-1 | L2198327-2 | L2198327-3 | L2198327-4 | |
|---|---|---|---|---|---|
| Description | Groundwater | Groundwater | Groundwater | Groundwater | |
| Sampled Date | 13-NOV-18 | 13-NOV-18 | 13-NOV-18 | 13-NOV-18 | |
| Sampled Time | 17:00 | 17:00 | 15:00 | 15:30 | |
| Client ID | ZONE 6 | ZONE 66 | EB | 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

| Grouping | Analyte | 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 | |
|---|---|---|---|---|---|---|
| **Sample ID** | | | | | | |
| **Description** | | | | | | |
| **Sampled Date** | | | | | | |
| **Sampled Time** | | | | | | |
| **Client ID** | | | | | | |
| **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 DLDS | 3060 DLDS | <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 | <0.050 | <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 wwt - 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.*

L2198327-COFC

# Chain of Custody / Analytical Request Form

**Canada Toll Free: 1 800 668 9878**

www.alsglobal.com

COC # 18-1789310

Page 1 of 1

| Report To | | | | Report Format / Distribution | | | | Service Requested (Rush for routine analysis subject to availability) |
|---|---|---|---|---|---|---|---|---|
| Company: | GOLDER ASSOCIATES LTD | | | ☑ Standard | ☐ Other | | | ◉ Regular (Standard Turnaround Times - Business Days) |
| Contact: | Dale Holtze | | | ☑ PDF | ☑ Excel | ☐ Digital | ☐ Fax | ○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT |
| Address: | 1931 Robertson Road | | | Email 1: | dholtze@golder.com | | | ○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT |
| | Ottawa, ON K2H 5B7 | | | Email 2: | valerie_bertrand@golder.com | | | ○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT |
| Phone: | 613-592-9600 | Fax: | 613-592-9601 | Email 3: | | | | **Analysis Request** |
| **Invoice To** | Same as Report ? | ☑ Yes | ☐ No | **Client / Project Information** | | | | Please indicate below Filtered, Preserved or both (F, P, F/P) |
| Hardcopy of Invoice with Report? | | ☐ Yes | ☐ No | Job #: | 1789310 | | | F / P |
| Company: | | | | PO / AFE: | | | | |
| Contact: | | | | LSD: | | | | |
| Address: | | | | | | | | |
| Phone: | | Fax: | | Quote #: | Q70883 | | | |
| Lab Work Order # (lab use only) | | | | **ALS Contact:** | Joanne Lee | **Sampler:** | Dale Holtze | |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | DISSOLVED METALS | TOTAL METALS | TOTAL PHOSPHORUS | MAJOR IONS, TDS, TSS | pH | EC | NH3 | Anions | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Zone 6 | 13-Nov-18 | 17:00 | Groundwater | | | | | | | | | 4 |
| | Zone 66 | 13-Nov-18 | 17:00 | Groundwater | | | | | | | | | 4 |
| | EB | 13-Nov-18 | 15:00 | Water | | | | | | | | | 4 |
| | TB | 13-Nov-18 | 15:30 | Water | | | | | | | | | 3 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

2 DAY RUSH

Routine 5 days

**Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details**

SAMPLES 'ZONE 6' AND 'ZONE 66' HAVE ELEVATED TDS/CONDUCTIVTY. FIELD MEASURED CONDUCTIVITY RANGES BETWEEN 9 AND 9.1 mS/cm.

**Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.**

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date (dd-mmm-yy) | Time (hh-mm) | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| Dale Holtze | 14-Nov-18 | 8:00 | PAVL | NOV 19 | 08:30 | 9.8 °C | | | | |

**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
Échantillon : Brine Fluid
Nom du préleveur : N/D
Type d'échantillon : Eau surface
Réseau:

Date de prélèvement : 17 avril 2016
Heure de prélèvement : N/D
Date de réception : 19 avril 2016

**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.





900, 5ième avenue
Val d'Or (Québec)
J9P 1B9
Téléphone : (819) 874-0350
Fax / Téléc: (819) 874-0360
E-mail: valdor@multilab-direct.com
Site web: www.multilab-direct.com

Multilab Val-d'Or

# 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 (HCO3) | 27 mg CaCO3/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 CaCO3/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 |
| Molybdene (Mo) | <0.0005 mg/L | Sous-traitance\Multilab Direct | 20 avril 2016 |
| NH3 (NH3 non-ionisé) | 1.52 mg N/L | Sous-traitance\Multilab Direct | 20 avril 2016 |
| NH4 | 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 (NO3) | 0.54 mg N/L | Sous-traitance\Multilab Direct | 19 avril 2016 |
| Nitrites (NO2) | 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 |



900, 5ième avenue
Val d'Or (Québec)
J9P 1B9
Téléphone : (819) 874-0350
Fax / Téléc: (819) 874-0360
E-mail: valdor@multilab-direct.com
Site web: www.multilab-direct.com



F-02-06
Version 3ième: 26/10/2005

Multilab Val-d'Or

# 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 |
|---|---|---|---|
| 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 CaCO3/L | M-TIT-1.0 | 20 avril 2016 |
| Sulfate (SO4) | <0.6 mg SO4/L | Sous-traitance\Multilab Direct | 12 mai 2016 |

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



900, 5ième avenue
Val d'Or (Québec)
J9P 1B9
Téléphone : (819) 874-0350
Fax / Téléc: (819) 874-0360
E-mail: valdor@multilab-direct.com
Site web: www.multilab-direct.com



F-02-06
Version 3ième: 26/10/2005

Multilab Val-d'Or

# 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 (HCO3) | 2 | mg CaCO3/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 CaCO3/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 |
| Molybdene (Mo) | 0.0005 | mg/L | Sous-traitance | Oui |
| NH3 (NH3 non-ionisé) | 0.01 | mg N/L | Sous-traitance | - |
| NH4 | 0.01 | mg N/L | Sous-traitance | - |
| Nickel (Ni) | 0.0005 | mg/L | Sous-traitance | Oui |
| Nitrates (NO3) | 0.01 | mg N/L | Sous-traitance | Oui |
| Nitrites (NO2) | 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 |





900, 5ième avenue
Val d'Or (Québec)
J9P 1B9
Téléphone : (819) 874-0350
Fax / Téléc: (819) 874-0360
E-mail: valdor@multilab-direct.com
Site web: www.multilab-direct.com

# 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 CaCO3/L | M-TIT-1.0 | |
| Sulfate (SO4) | 0.6 | mg SO4/L | Sous-traitance | Oui |





900, 5ième avenue
Val d'Or (Québec)
J9P 1B9
Téléphone : (819) 874-0350
Fax / Téléc: (819) 874-0360
E-mail: valdor@multilab-direct.com
Site web: www.multilab-direct.com

Multilab Val-d'Or

# 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 |





900, 5ième avenue
Val d'Or (Québec)
J9P 1B9
Téléphone : (819) 874-0350
Fax / Téléc: (819) 874-0360
E-mail: valdor@multilab-direct.com
Site web: www.multilab-direct.com

Multilab Val-d'Or

# 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 |





900, 5ième avenue
Val d'Or (Québec)
J9P 1B9
Téléphone : (819) 874-0350
Fax / Téléc: (819) 874-0360
E-mail: valdor@multilab-direct.com
Site web: www.multilab-direct.com

Multilab Val-d'Or

# 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 |
| Molybdene (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 (NO3) mg N/L | Blanc | <0.01 |
| Nitrites (NO2) mg N/L | Blanc | <0.01 |
| | Nom Standard | DMR-0175-2016-NO2 |
| | Valeur obtenue | 1.97 |
| | Justesse | 97.5% |





900, 5ième avenue
Val d'Or (Québec)
J9P 1B9
Téléphone : (819) 874-0350
Fax / Téléc: (819) 874-0360
E-mail: valdor@multilab-direct.com
Site web: www.multilab-direct.com

Multilab Val-d'Or

# 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 |





900, 5ième avenue
Val d'Or (Québec)
J9P 1B9
Téléphone : (819) 874-0350
Fax / Téléc: (819) 874-0360
E-mail: valdor@multilab-direct.com
Site web: www.multilab-direct.com

Multilab Val-d'Or

# 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 | Tl-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 |



900, 5ième avenue
Val d'Or (Québec)
J9P 1B9
Téléphone : (819) 874-0350
Fax / Téléc: (819) 874-0360
E-mail: valdor@multilab-direct.com
Site web: www.multilab-direct.com



F-02-06
Version 3ième: 26/10/2005

# 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 |





900, 5ième avenue
Val d'Or (Québec)
J9P 1B9
Téléphone : (819) 874-0350
Fax / Téléc: (819) 874-0360
E-mail: valdor@multilab-direct.com
Site web: www.multilab-direct.com

# 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/m$^3$ 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 7x10$^{-12}$ and 7x 10$^{-11}$ m/s. It is however recommended to assume a hydraulic conductivity of less than 1 x 10$^{-10}$ 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) | | | | | |
| AMQ18-1925 | 1 | 419.5 | 699.0 | 279.5 | 375.9[c] | 626.4 | 250.5 | SI | SI | $2 \times 10^{-9}$ | $8 \times 10^{-12}$ | $<1 \times 10^{-10}$ |
| | 2 | 500.4 | 699.0 | 198.6 | 448.4 | 626.4 | 178.0 | SI | SI | $7 \times 10^{-9}$ | $4 \times 10^{-11}$ | $<1 \times 10^{-10}$ |
| | 3 | 599.4 | 699.0 | 99.6 | 537.1 | 626.4 | 89.3 | SI, SW | SI | $7 \times 10^{-9}$ | $7 \times 10^{-11}$ | $<1 \times 10^{-10}$ |
| | 4 | 419.5 | 699.0 | 279.5 | 375.9 | 626.4 | 250.5 | SI, SW | SI | $2 \times 10^{-9}$ | $7 \times 10^{-12}$ | $<1 \times 10^{-10}$ |

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 mah. 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 $x10^{-10}$ 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*

PERMIT TO PRACTICE
GOLDER ASSOCIATES LTD.
Signature
Date 25MAR2019.
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL GEOLOGIST
March 25, 20
D.W. CHORLEY
LICENSEE
NWT/NU

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

AC/MD/DC/ah

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

https://golderassociates.sharepoint.com/sites/100859/deliverables/issued/18113037-002-tm-rev0-3000/01 text/18113037-002-tm-rev0-3000-2018 amaruq hydrogeo_25mar 2019.docx

## 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

Golder Associates Ltd. (Golder) has prepared this document in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this document. No warranty, express or implied, is made.

This document, including all text, data, tables, plans, figures, drawings and other documents contained herein, has been prepared by Golder for the sole benefit of Agnico Eagle Mines Limited. It represents Golder's professional judgement based on the knowledge and information available at the time of completion. Golder is not responsible for any unauthorized use or modification of this document. All third parties relying on this document do so at their own risk.

The factual data, interpretations, suggestions, recommendations and opinions expressed in this document pertain to the specific project, site conditions, design objective, development and purpose described to Golder by Agnico Eagle Mines Limited, and are not applicable to any other project or site location. In order to properly understand the factual data, interpretations, suggestions, recommendations and opinions expressed in this document, reference must be made to the entire document.

This document, including all text, data, tables, plans, figures, drawings and other documents contained herein, as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder. Agnico Eagle Mines Limited may make copies of the document in such quantities as are reasonably necessary for those parties conducting business specifically related to the subject of this document or in support of or in response to regulatory inquiries and proceedings. Electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore no party can rely solely on the electronic media versions of this document.