AGNICO EAGLE

MEADOWBANK GOLD PROJECT

Groundwater Monitoring Plan

In Accordance with Water License 2AM-MEA1526

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

Version 10
July 2019

EXECUTIVE SUMMARY

The Groundwater Monitoring Plan herein presents the history of groundwater monitoring at Meadowbank mine since 2003, the 2018 extensive groundwater monitoring campaign and the groundwater monitoring program adapted for in-pit deposition operations that begun in July 2019. In addition, a review of methodologies and best practices under artic climate conditions is included for drilling, well installation and groundwater sampling.

The annual monitoring plan is a requirement for the Meadowbank Type A Water License No. 2AM-MEA1526 and is a continuation of previous Monitoring Plans.

The following activities were fulfilled in 2018:

- Four (4) new monitoring wells were installed in 2018 from May 29 to June 4, 2018, following technical advice and field services from an expert firm in the field of hydrogeology and geochemistry. The objective of the installation is to collect representative samples for water quality model updates. The locations of these new monitoring wells were chosen based on the current available information and because they are in the talik zone;
- The 2018 groundwater monitoring program included the eleven (11) monitoring stations, five (5) groundwater observation wells (MW-IPD-01 (s), MW-IPD-01 (d), MW-IPD-07, MW-IPD-09 and MW-16-01), three (3) dike seepages, one (1) pit sump, one (1) Storm management pond sump, and one (1) reclaim water.
- Two (2) groundwater sampling programs were carried out from July 5 to July 12, 2018 and September 6 to September 13, 2018 using low-flow sampling techniques for licensing requirements with duplicate, field blanks, and transport blanks.

Groundwater chemistry data is used to predict the quality of water accumulating in open pits, and to determine any effects of mining on groundwater quality, particularly with respect to tailings deposition.

Groundwater sampling is carried out twice a year. Analytical parameters will comply as per Schedule 1, Table 1, Group 2 of the Meadowbank Water License. Quality Assurance/Quality Control procedures will be implemented during each sampling event.

In 2018, the installation of three (3) new groundwater monitoring wells were installed. Strategic locations for the new well are based on groundwater numerical simulation results aiming to replicate the in-pit deposition site conditions. Moreover, to improve well designs and groundwater sample quality, best practices under arctic climate conditions continue to be investigated.

A groundwater monitoring report is submitted by Agnico Eagle Mines Limited to the Nunavut Water Board (NWB) and Nunavut Impact Review Board (NIRB) with each Annual Report. The report includes all data from the previous year's results as well as a historical record, dates and methods of sampling, and the assessment of salinity parameters and indicators of tailings reclaim water movement, with respect to total cyanide and dissolved copper

IMPLEMENTATION SCHEDULE

This Plan will be implemented immediately (2019) subject to any modifications proposed by the NWB as a result of the review and approval process.

DISTRIBUTION LIST

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DOCUMENT CONTROL

Version	Date (YMD)	Section	Revision
1	08/08/08		Comprehensive plan for Meadowbank Project
2	09/03/31	all	Comprehensive update of plan to include 2008 well installations
3	11/12/14		Update Executive Summary; insert Figure 1; update Table 1; addition of information on wells created in 2011; include well installation section;
4	14/01		Update Executive Summary; update Section 1.2 to reflect current wells; add Section 3.3 and 3.4 (seep and production drill hole sampling methods); update Section 5 (additional reporting on tailings-related parameters)
5	15/04	1.3 and 3.3 2.3	Sampling of pit wall seeps discontinued. Sampling of Goose Pit sump added. Updated with installation information for new well.
6	15/09	4.1 and 4.2	Updated list of analyse parameters. QAQC Section to include Trip and Field Blank Remove Goose Pit sump as monitoring station
7	17/03	Section 1.5, 3, 5 and 6	Add Section 5 and 6 and modify section 1.5 and 3
8	17/11	all	Comprehensive update
9	19/03	all	Comprehensive update and add 2018 groundwater monitoring report
10	19/07	all	Comprehensive update following In-Pit Disposal Approval

Version 10

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1. INTRODUCTION

The annual monitoring plan is a requirement for Meadowbank Type A Water License No. 2AM-MEA1526.

This document is the 10th version of the Groundwater Monitoring Plan for Meadowbank Mine. This version presents an update of the groundwater monitoring program described in Version 9 (Agnico, March 2019).

This version relates the historic of groundwater monitoring at Meadowbank mine since 2003, presents the extensive groundwater monitoring campaign achieved on site in 2018, and proposed a groundwater monitoring program adapted for in-pit deposition. Moreover, this document reviews methodology and best practices for drilling, well installation and groundwater sampling, especially under arctic climate conditions.

1.1 PURPOSE OF GROUNDWATER MONITORING

Groundwater data is used as a tool to predict the chemistry of water accumulating in open pits and to determine any effects of mining on groundwater quality, particularly with respect to tailings deposition activities. To this end, groundwater monitoring wells have been installed to sample groundwater in open talik areas, where unfrozen ground extends beneath large lakes. No groundwater monitoring wells is installed at the Vault Deposit, as the Vault Pit area is developed in permafrost.

Groundwater monitoring has traditionally been conducted using installed monitoring wells, but difficulties in obtaining representative samples by this method prompted the investigation of alternative methods from 2013 to 2016 based on technical advice from firms of experts. Nevertheless, groundwater samples are still collected in operable monitoring wells.

In 2017, the groundwater monitoring program was revisited, as suggested by Environment and Climate Change Canada (ECCC), to enhance the quality of the data collected for water quality model updates. Due to difficulties in maintaining and sampling monitoring wells, Agnico Eagle received technical advices and field services from a firm of experts to optimize low-flow sampling techniques as well as further sampling improvements and pursued opportunities for sampling groundwater from alternative methods as well as the existing wells. An extensive monitoring program took place in 2017 to collect representative samples across the mine site to infer the groundwater geochemistry and the potential chemical reaction between groundwater and surface water especially in relation to tailing migration. The groundwater investigation was repeated in 2018 with the addition of four (4) new monitoring wells (Appendix A of the 2018 Groundwater monitoring for wells location MW-IPD-01 (s), MW-IPD-01 (d), MW-IPD-07, MW-IPD-09).

The next phase for 2019 is to update the groundwater program to include interpretation of groundwater flow and groundwater sampling integrity as well as the 2018 sampling campaign.

1.2 TAILING STORAGE FACILITY EXPANSION AT MEADOWBANK

Since 2015, Agnico Eagle is evaluating diverse technical options to accommodate additional tailing storage facilities at Meadowbank. After a Multi-Account Assessment (MAA), the In-Pit Tailings Deposition (IPD) was selected as the preferred option to store tailings waste produced from Whale Tail Mine in addition to its current tailings storage facilities (TSF). IPD demonstrated superior performance capacities in the following categories: health and safety, quality of life, water, air, capital cost, technology, natural hazards, and adaptability (SNC-Lavalin, 2016; 2017a).

To ensure the environment protection and evaluate potential risks for tailing migration into groundwater, a feasibility study was conducted by SNC-Lavalin professionals in 2016-2017 (SNC-Lavalin, 2017a). The feasibility study included a complementary characterization of the geological structures and permafrost extent on site and the development of a detailed hydrogeological numerical 3D model. The numerical simulations were designed to represent the worst-case scenarios in terms of contaminant transport within the aquifers. Therefore, a groundwater monitoring program was designed in relation to the groundwater flow and contaminant transport simulation results. The hydrogeological model and solute transport simulations were updated during the detailed engineering study completed by SNC-Lavalin (2018) and following Natural Resources Canada (NRCan)'s recommendations addressed during In-Pit Tailings Deposition Project approval process.

1.3 GROUNDWATER MONITORING PROGRAM ADAPTED FOR IN-PIT TAILINGS DEPOSITION AT MEADOWBANK

Meadowbank groundwater monitoring program is adapted for the In-Pit tailings deposition (IPD). IPD started in July 2019 in Goose Pit, already mine out. Deposition will continue with an alternate filling of Portage Pit A and Pit E (SNC-Lavalin, 2017a). The installation of four (4) new groundwater monitoring wells in 2018 was proposed at strategic locations, based on groundwater numerical simulation results and 2017 borehole data. Methods to obtain representative groundwater samples and improve well designs under artic climate continue to be developed. The groundwater monitoring program will be updated as the project progresses. New information from the hydrogeological numerical model and from hydrogeological field data will be integrated throughout.

2. GROUNDWATER MONITORING PROGRAM

2.1 GROUNDWATER MONITORING PROGRAM 2003-2017

Groundwater data are used as a tool to predict the chemistry of water accumulating in open pits, and to determine any effects of mining on groundwater quality particularly with respect to tailings deposition activities. Important components surveyed are chloride concentrations, salinity and Total Dissolved Solid (TDS) calculated via conductivity measurements. Copper and cyanide are also monitored to trace potential effects of mining operations on groundwater quality. To this end, groundwater monitoring wells have been installed to sample groundwater in open talik areas, where unfrozen ground extends beneath large lakes. No groundwater monitoring wells are installed at the Vault Deposit, as the Vault Pit is developed in an area of permafrost.

Groundwater samples have traditionally been collected in monitoring wells. From 2003 to 2016, fourteen (14) monitoring wells were installed at Meadowbank mine. No groundwater well was installed in 2017. Throughout these years, thirty-four (34) groundwater samples, twenty-one (21) duplicates were collected from these wells. However, most of the monitoring wells became inoperable due to the challenging arctic conditions and permafrost environment at Meadowbank, and to this day, only one well remain operable.

In 2017, an extensive groundwater sampling program took place. The program aimed to improve the characterization of the baseline groundwater chemistry, identify potential sources of contaminants at the mine site, and identify potential interaction between surface and groundwater. The program included:

- Review of the sampling methodologies and the historical groundwater quality data;
- Testing and maintenance of the sampling equipment;
- Collection of surface and groundwater samples at specific locations and;
- Data compilation and basic interpretation of groundwater quality.

Well installation and groundwater collection have been a major challenge under artic conditions in permafrost environment. Some of the challenges were:

- Well damaged by frost action;
- Heat traces malfunctioning, therefore ice bridges forming in well annulus;
- Well damaged during site operations;
- Well obstructed with development material, once again due to frost action.

Despite multiple attempts to overcome these challenges, the collection of representative groundwater sampled was unsuccessful for most problematic wells. For example, saline solution was used to melt ice bridges formed in well annulus. The concentration of saline solution required to unplug the well could not be purged afterwards, the groundwater flow was not sufficient, and the amount of water needed to be purged out of the well unrealistic under permafrost conditions.

Since well installation and groundwater collection have been a tremendous challenge at Meadowbank, alternative methods to obtain representative groundwater samples were investigated from 2013 to 2016 (see 2012 Groundwater Monitoring Report and recommendations by Golder Associates). Alternative groundwater monitoring stations investigated includes: pit wall seepages, production drill holes, pit sumps, horizontal wells installed into pit walls, and temporary wells for pit dewatering.

From 2013 to 2016, six (6) groundwater samples were collected from horizontal wells installed in Pit E southeastern wall, one (1) sample from a temporary well for pit dewatering, two (2) samples from pit sumps during exploitation and one (1) production borehole.

Although production and pre-shear drill holes with sufficient flow rates only occurred on occasion, when sufficient groundwater flow was encountered, sampling was achieved. Moreover, a sample was collected from a temporary dewatering well (6 inches in diameter, 65 meters depth), installed in Pit E from July to August 2016, to reduce water table and ensure pit slope stability. Prior 2016, seepage from pit walls, commonly occurring at different locations, has indicated surface water rather than groundwater flow.

In 2017, only two (2) wells remain operable for groundwater sampling. Aside from the two wells, none of the previous monitoring stations were available for sampling in 2017. Due to the difficulties encountered in maintaining and sampling monitoring wells, Agnico Eagle contracted experts to obtain technical advice on optimizing low-flow sampling techniques. Moreover, further sampling improvements and pursued opportunities for sampling groundwater from alternative sources as well as the existing wells were carried out. An extensive monitoring field program took place in 2017. The objectives were to: 1) collect representative samples across the mine site; 2) understand groundwater background geochemical conditions and its potential interaction with surface water, especially in relation to tailing migration.

In 2018, only one (1) well (MW-16-01) from previous well installed remains operative and four (4) new wells were installed for groundwater sampling. Aside from the wells, only a station for reclaim water and dike seepage remain available from 2017 hydrogeological field investigation program. Due to the difficulties encountered in maintaining and sampling monitoring wells, Agnico Eagle continue to contract experts to obtain technical advice on optimizing low-flow sampling techniques and get further sampling improvements and pursued opportunities for sampling groundwater from alternative sources as well as the existing wells. An extensive monitoring program campaign took place in 2018 to collect representative samples across the mine site to understand the groundwater background geochemistry and the potential interaction between groundwater and surface water especially in relation to tailing water migration. Groundwater collected in 2018 from the four (4) newly installed well fits within the natural groundwater category established on 2017 results and can be use as threshold values to monitor groundwater quality in the future.

The locations of each former and existing groundwater wells and other types of groundwater monitoring stations are provided in Appendix A.

2.2 GROUNDWATER MONITORING PROGRAM ACHIEVED IN 2018

Two site visits were completed by a SNC-Lavalin professional in summer 2018. The objective of the first site visit was to provide on-site professional support to Agnico Eagle field technicians during the drilling and the installation of four (4) new monitoring wells. The objective of the subsequent visits was to provide on-site professional support to Agnico Eagle field technicians for the installation of dedicated sampling material into four new monitoring wells and to collect surface water and groundwater samples twice in 2018. A photographic report is presented on Appendix C showing the well installation. State of the art sampling techniques were performed and each sampling station, which were selected based on its contribution to the global understanding of groundwater quality. Twenty-one (21) water samples were collected in the vicinity of Goose Pit and Portage Pit A & E. The 2018 groundwater monitoring program aimed to:

- Achieve two groundwater sampling programs from July 5 to July 12, 2018 and September 6 to September 13, 2018 using low-flow sampling techniques for licensing requirements; and
- Compile and interpret the water quality data collected to document the potential interaction between surface water and groundwater, especially in relation to tailing migration.
- Improve the density and spatial distribution of groundwater monitoring stations and get representative samples;
- Achieve and repeat a complete groundwater sampling program as well as low-flow sampling techniques for licensing requirements;
- Collect groundwater chemical data required to understand the potential interaction between groundwater and surface water, especially in relation to tailing migration;
- Emit recommendations to improve the groundwater sampling program in the future.

Table 1 summarized the sample collected during the two site visits. In total, the 2018 groundwater monitoring program included the following eleven (11) monitoring stations, specifically five (5) groundwater observation wells (MW-IPD-01 (s), MW-IPD-01 (d), MW-IPD-07, MW-IPD-09 and MW-16-01), three (3) dike seepages, one (1) pit sump, one (1) Storm management pond sump, and one (1) reclaim water. A map illustrating the locations for each water sample is presented in Appendix A. The next section explains the context of each sampling station.

Table 1: Samples collected in 2018

Sample name	Type	Screen depth (m)	Pump depth (m)	July 2018	August 2018
MW-IPD-01(s)	Monitoring Well	51 – 69	60	X	X
MW-IPD-01(d)	Monitoring Well	163 – 181	175	X	X
MW-IPD-07	Monitoring Well	42 – 50	40	X	X
MW-IPD-09	Monitoring Well	62 – 80	70	X	X
MW-16-01	Monitoring Well	89 – 101	95	X	X
ST-S-5	Dike Seepage	-	-	X	X
ST-21	Reclaim Water	-	-	X	X
ST-8-North	Dike Seepage	-	-	X	X
ST-8-South	Dike Seepage	-	-	X	X
BG_Lagoon	Sump	-	-	X	X
SMP (Storm Management Pond)	Sump	-	-	X	-

2.3 MONITORING STATIONS AND SAMPLING METHODOLOGIES 2018

2.3.1 Monitoring well

In 2018, only one well was operable from previous year and four (4) news well installed in 2018. Installation details for operational monitoring wells are provided in Appendix C. Details for all other decommissioned wells are presented in the Groundwater Monitoring Report related to the year of installation. Formation of thick ice bridges in the annular space challenged the sampling of wells MW-08-02 in 2017 and was not sampled in 2018. Therefore, sampling protocols were different for the two wells and methodologies are described below.

2.3.1.1 MW-16-01

A portable double valve sampling pump (DVP) was installed at approximately 95 meters down in the well and in front of the screened interval. The well was purged to remove standing water inside the well and to induce a fresh groundwater flow from the rock formation by activating the DVP. The pump is activated by pushing compressed air into a ¼ inch Low Density Polyethylene (LDPE) tubing attached to the DVP. The in-situ physicochemical parameters are measured with a PCStestr 35 Oakton Probe that was calibrated prior usage. Purged water quality is monitored for pH, electrical conductivity, temperature, water clarity and colour (visual observation) during this operation. A minimum of 3 well volumes (volume of water between the in-well packer and bottom of screened interval) are to be removed prior sampling or until the monitored parameters stabilize (values remaining within 10% for three consecutive readings).

Groundwater sampling was carried out immediately after well purging with low-flow techniques. Groundwater samples were collected in the clean laboratory-supplied containers.

Groundwater was sampled following quality control procedure on sampling and analysis described in section 2.5 and detailed in Appendix D.

2.3.1.2 MW-08-02

Well MW-08-02, installed 191 m below ground, had an ice bridge from 30 m to 150 m. The ice blocking the well annulus was melted using a steamer and clean lake water. It took about 4 hours to melt 120 m of ice from the well. Following this procedure, the well remained free of ice for a maximum of 24 hours. To not damage any equipment, the well was purged using compressed air pushed through a tube lowered 150 m down the well for another 4 hours. Then, 12 hours were given to allow the well to recover to a static water level (30 m) before sampling. Afterwards, a 200 mL clean bailer was lowered 160 m below ground just above the screen interval to retrieve a representative groundwater sample. Groundwater sampling was carried out immediately after purging reading the in-situ parameters and sampling was carried out as mentioned in the previous section.

After interpreting the geochemical data, it can be stated that there is significant variability in some of the major elements to pursue the sampling of this well as is. Until the well can be free of ice for a period longer than 24 hours, to ensure a proper purge, there is no point trying to retrieve a groundwater samples from this well since it is never going to be truly representative of groundwater by using this methodology (steaming the well). This well was not sample in 2018 and will not be sampled in 2019.

2.3.1.3 IPD monitoring wells (MW-IPD-01(s)&(d), MW-IPD-07 and MW-IPD-09)

Four (4) monitoring wells were installed to complete the monitoring network and to adapt groundwater monitoring wells network to the in-pit tailings deposition project. Well screens were sealed with prepack bentonite composed of a 2-inch diameter stainless steel pipe and bentonite sleeve. Modified foam bridges were installed between the monitoring well screens and the bentonite sleeve to prevent the bentonite to seep downwards in the monitoring well screen interval. Lake water and environmentally safe drilling additives (DD2000) were used as drilling fluid. As recommended, no other additives, such as de-icing salt or calcium chloride that could impact the water chemistry, were used during drilling or installation.

The new monitoring wells were implemented considering the current state of knowledge and the monitoring wells were installed in talik areas. Heat traces cables were installed along the monitoring well pipes within the permafrost zones to prevent the riser pipe to be damages by the frost action. A double valve pump, tubing and a well head were dedicated to each monitoring well and installation equipment was inspected, replaced or calibrated when required and cleaned to prevent any contamination during sampling operations. Low flow technique with nitrogen was used for groundwater sampling.

Groundwater analytical results collected in 2018 from the four (4) newly installed well fit within the natural groundwater category established on 2017 results and can be use as threshold values to monitor groundwater quality in the future.

2.3.2 Dike seepage

The name "dike seepage" as a monitoring station applies to samples collected from dewatering wells (ST-8 North and ST-8 South), installed at the bedrock surface (6 m depth), to control East dike seepages. It also includes sumps created naturally by Central dike seepage (ST-S-5) or sump found between dikes near rock stockpiles (BG Lagoon). In most cases, samples are collected through a tap connected to a dewatering pump.

These sampling stations can be monitored though time, contribute to the understanding of groundwater quality at the mine and can be added to the long-term groundwater monitoring program.

2.3.3 Wall seepage

The name "wall seepage" as a monitoring station applies to groundwater collected on pit walls where water comes directly through the bedrock and where a small ¼ diameter LDPE tubing can be inserted into small fracture to prevent the sample to be in contact with the atmosphere. The groundwater runs through the tubing by gravity and physicochemical parameters are recorded and standard sampling procedures are followed.

These sampling stations can be monitored though time, contribute to the understanding of groundwater quality at the mine and can be added to the long-term groundwater monitoring program until the pit will be decommissioned. No wall seepages were sampled in 2018. Safety of field technicians is to be considered for the sampling of pit wall seepages and possible rock fall.

2.3.4 Pit sump

The name "Pit sump" as a monitoring station applies to groundwater collected at the bottom of a pit when groundwater filled a cavity during exploitation. After interpreting the geochemical data, it can be stated that there is too much ambiguity of the provenance of some elements found in this analysis to pursue the sampling of this well as is. Excavated ground is reworked and a lot of mine operations occur around the sumps such as drilling, blasting, and excavating. Moreover, the exact location of the sampling can never be reproduced year after year. For the mentioned reasons, pit sumps are not considered as representative groundwater samples and will not be integrated in further long-term monitoring program.

2.3.5 Deep Lake

The name "Deep Lake" as a monitoring station applies to water collected near lake bottom at its deepest point. Water was collected through a small ¼ inch diameter LDPE tubing, connected to a peristaltic pump. These samples were collected to verify the quality of groundwater at lake's bottom. Also, it aims to compare the different water geochemistry signatures originating from an open talik and a close talik, and to compare the data with the ones collected on site. These stations were monitored only once in 2017.

2.3.6 Geotechnical investigation holes

Field campaigns in summer 2017 at Meadowbank, included drilling of new boreholes susceptible to encounter groundwater. Attempt was made to collect a groundwater sample at borehole IPD-17-06. Although geotechnical holes are made under controlled conditions when compared to production holes, the inside diameter of metal casing are filled with grease, water is dirty and full of particles. After interpreting the physicochemical parameters for groundwater coming from geotechnical holes, and geochemical data from production holes and pre-shear holes, it can be stated that these holes are not a proper environment to retrieve representative groundwater samples. No further investigations were conducted in 2018 and they are neither considered relevant for further sampling program.

2.4 PHYSICOCHEMICAL AND GEOCHEMICAL PARAMETERS

2.4.1 Groundwater parameters required by the water license

For each sample, field parameters are recorded (pH, turbidity, salinity and electrical conductivity). Analytical parameters included the following (per Schedule 1, Table 1, Group 2 of the Meadowbank Water License):

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

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

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

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

2.4.2 Additional parameters

Each groundwater sample has a distinctive signature on the basis of its dissolved concentrations of chemical constituents. Geochemical interpretation of groundwater data can be very useful to support a conceptual model by improving the understanding of groundwater movements and processes along pathways as water composition varies. It can also help identifies zones where surface water is continually interacting with groundwater or only during permafrost thawing.

The geochemical composition of groundwater is defined by its main anions (HCO_3^-, SO_4^{2-}, Cl^-) and its main cations (Ca^{2+}, Na^+, Mg^{2+} K^+). Mass balance calculations for main ions dissolved in groundwater are a mandatory reliability check for any geochemical analysis (Hounslow, 1995). Mass balance calculations are useful to gain a first insight into water chemistry. From these calculations, groundwater chemical composition can be represented in Piper and Stiff diagrams, which facilitate its interpretation.

For the reasons presented above, additional parameters were also analyses: dissolved calcium, dissolved potassium, dissolved magnesium, dissolved sodium, fluorides, bromides, and ammonium-nitrogen. The following physicochemical in-situ parameters were also recorded on site: Oxydo-reduction Potential (ORP) and Dissolved Oxygen (DO).

2.5 QUALITY CONTROL ON SAMPLING AND ANALYSIS

2.5.1 Handling

The following procedures will be followed to provide data quality control:

- Measurement of field parameters at selected intervals until stable readings (within 10% of each other);
- Minimization of the exposure of the sampled water to the atmosphere;
- Use of compressed gas to evacuate water during sample collection;
- In-situ measurement of sensitive chemical parameters (pH, electrical conductivity, dissolved oxygen, alkalinity), where applicable; and
- Abiding by sample preservation methods (refrigeration and use of preservatives where needed), and specified holding times;
- Filtering for dissolved metal analysis with a 0.45 microns filter on site, when possible.

2.5.2 Duplicates, field and trip blank

A duplicate sample will be collected for one monitoring well per sampling event and submitted as a blind duplicate to the analytical laboratory. When both results are higher than five times the method detection limit (MDL), the relative percent difference (RPD) will be calculated as:

RPD = absolute difference in concentration/average concentration x 100

USEPA (1994) indicates that an RPD of 20% or less is acceptable. Where one or both results are less than five times the MDL, a margin of +/- MDL is acceptable.

One field and one trip blank will also be collected at each sampling campaign.

3. ADAPTED GW MONITORING PROGRAM FOR IPD

Since 2015, Agnico Eagle has been evaluating various technical options to store tailings from the mining of Whale Tail ore deposit. After a Multi-Account Assessment (MAA), the In-Pit Tailings Deposition (IPD) was selected as the preferred option to store tailings waste produced from Whale Tail Mine in addition to its current TSF (SNC-Lavalin, 2016; 2017a). Meadowbank Dike Review Board (the "MDRB") supported the use of early in-pit tailings disposal as an attractive alternative in addition to current practices at Meadowbank. Specifically, in-pit disposal of tailings has advantages with respect to health and safety, quality of life, water, air, capital cost, technology, natural hazards and adaptability. The MDRB accepted that in-pit disposal would be recognized as the best available technology.

The current monitoring well (MW) network is for operational needs, but it can be also used for long term monitoring (closure & post-closure). Before deposition, the monitoring well network should be used to increase the understanding of groundwater quality background at the site. Indeed, as long as the water level in the pits will not have completely return to the natural state (before dewatering), the pits will behave like hydraulic capture zones, preventing contaminant migration.IPD has begin in July 2019. IPD started in Goose Pit, already mined out, and will be followed by an alternate filling of Portage Pit A and Pit E (SNC-Lavalin, 2017a).

To ensure the environment protection and evaluate potential risks for tailing migration into groundwater, a feasibility study was conducted by SNC-Lavalin professionals in 2016-2017 (SNC-Lavalin, 2017a). The detailed engineering study completed by SNC-Lavalin (2018) included a complementary characterization of the geological structures and permafrost extent on site and the development of a detailed hydrogeological numerical 3D model.

The groundwater numerical model aimed at representing the hydrogeological conditions found at the mine site at the end of deposition to reproduce the groundwater flow and contaminant transport in talik zones located throughout the permafrost environment. The idea is to reproduce, in this context, realistic groundwater and contaminant transport within talik zones located throughout the permafrost environment. Considering that groundwater flow is strongly influenced by permafrost conditions, thermal cross-sections were modeled to assess the long-term impacts of in-pit tailing deposition on permafrost thawing around Goose Pit, Portage Pit A and Portage Pit E. Thermal modeling results were used to refined permafrost representation in the 3D model, for closure and post-closure period.

The numerical simulations were designed to represent the worst-case scenarios in terms of contaminant transport within the aquifers. Therefore, a groundwater monitoring program can be designed in relation to groundwater flow and contaminant transport simulation results.

In 2018, the latest version of the groundwater numerical model was used to forecast the post closure evolution of chloride concentrations at existing wells, including the four new wells installed in 2018. Breakthrough chloride concentration curves (predicted concentrations of chloride over time at a specific point of the 3D model) were extracted from the model at each monitoring well. Concentration increases over time showed that monitoring wells could intercept the contaminant plume from Pit A, Pit E and Goose Pit after closure over different period and at different concentrations.

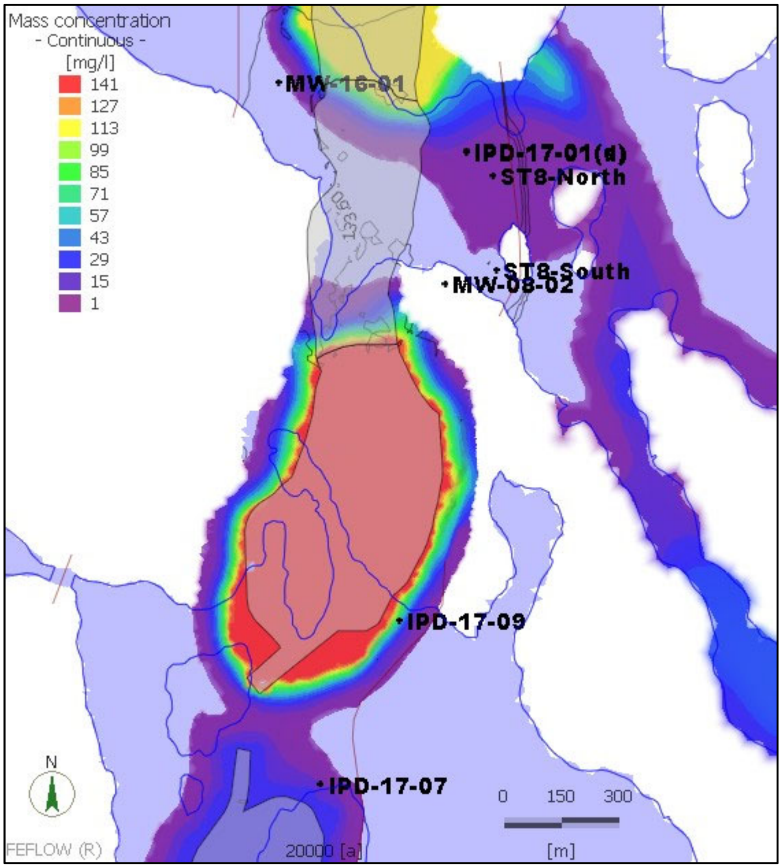

Figure 1 : Chloride transport simulation and existing monitoring wells network (excluding MW-08-02)

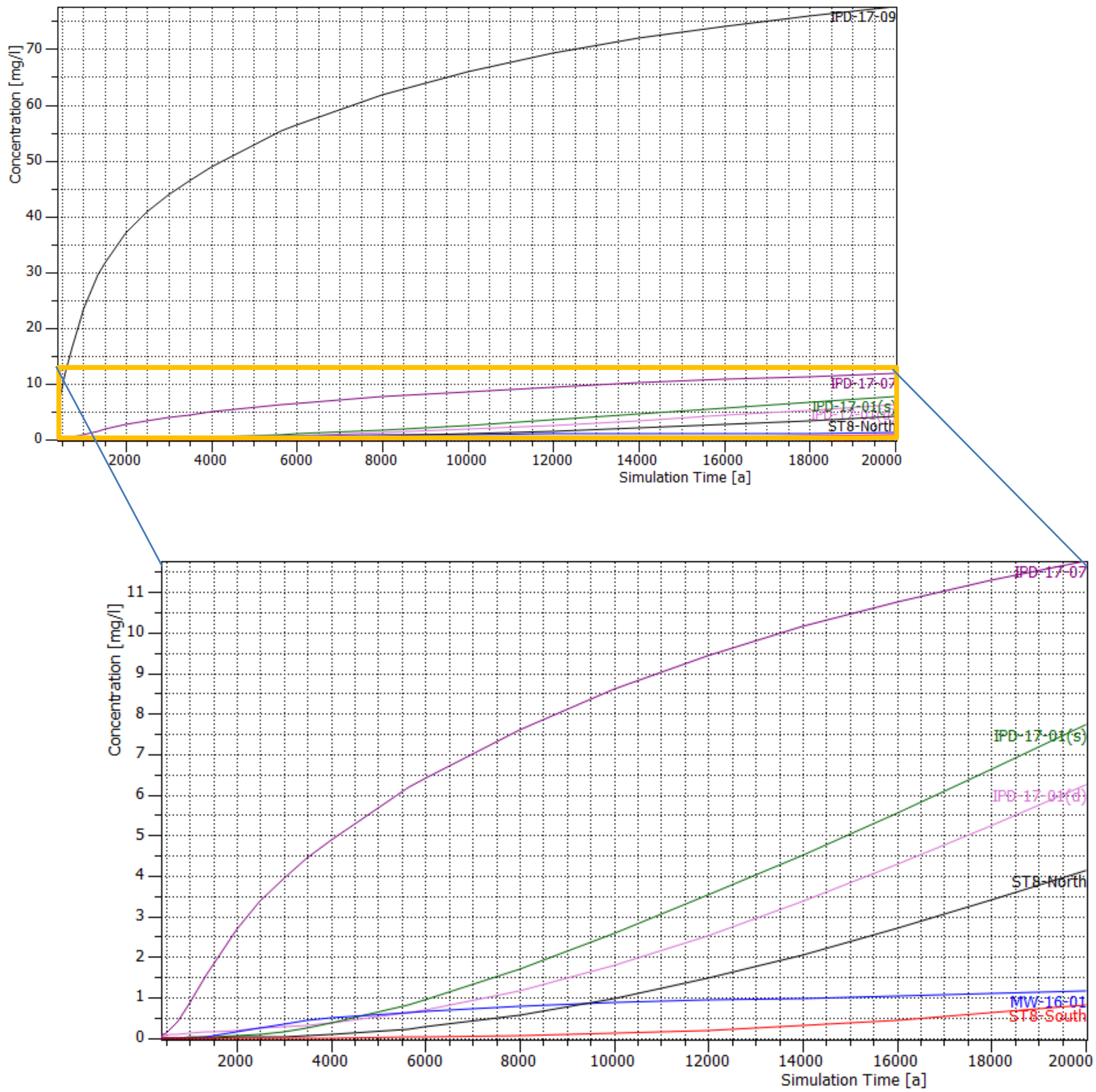

Figure 2: Breakthrough chloride concentration curves at existing monitoring wells

Table 2: Summary table of chloride concentration from breakthrough curves at existing monitoring wells

GW monitoring well	Location	Screen depth interval (m BGS)	Screen Elevation interval (masl)	Mid-screen Elevation (masl)	Interception Date of 1mg/L (Model Version4)	Conc. of chloride at t = 6000 y (mg/L)
IPD-17-01(d)	East flat	162,45 to 181,43	-32,36 to -51,34	-41.85	7,000	0.3
IPD-17-01(s)	East flat	50,84 to 69,82	79,25 to 60,27	69.76	6,000	1.0
IPD-17-07	Goose Pit	41,24 to 50,75	92,19 to 82,69	87.44	1,000	6.5
IPD-17-09	Pit E	61,86 to 81,84	71,36 to 52,38	61.87	0	57
MW-16-01	Central Dike	88,81 to 101,02	31,10 to 18,89	25	12,000	0.6
ST8-North	East flat	6	125	125	9,500	0.3
ST8-South	East flat	6	125	125	>20,000	0.1

The thermal modelling, hydrogeological modelling and contaminant transport simulations will be updated after in-pit tailings deposition and will be used as a predictive tool, along with field observations, to adapt the post-closure groundwater monitoring program (well locations, frequency, parameters) and if required, install additional monitoring wells in simulated groundwater flow paths. Breakthrough curves will be produced with the hydrogeological model to support the selection of monitoring wells screen location and depth.

Future groundwater monitoring program will be adapted for in-pit deposition at Meadowbank and the monitoring network will be used to confirm contaminant transport model prediction at closure and post-closure. Based on monitoring results, model calibration on transport parameters will be assessed at closure.

Additionally, physical and chemical laboratory analyses were performed on Whale Tail's tailings, intended to be deposited, to verify their properties and their potential for acid rock drainage (ARD) and release of chemicals (Golder, 2017). Finally, the updated groundwater monitoring program will be adapted to monitor the groundwater quality in the vicinity of pit shells with considerations of IPD operations. Moreover, methods to obtain representative groundwater samples and improve well designs under arctic climate continue to be developed. The groundwater monitoring program will be updated as the project progresses.

New information from the hydrogeological numerical model and from hydrogeological field data will be integrated throughout.

Groundwater samples were collected from the new wells preceding the first stages of in-pit deposition. The groundwater sampling data collected so far represent background geochemistry data prior to in-pit tailings deposition. The groundwater sampling program will continue to be carried out twice a year during in-pit tailings deposition operation using on-site monitoring wells and other monitoring stations. One sample per sampling event will be collected in duplicate and submitted blind (using different reference numbers) to the analytical laboratory. One transport blank and field blank will also be collected each year.

4. DRILLING, WELLS INSTALLATION AND GW SAMPLING IN DEEP PERMAFROST ENVIRONMENT: CHALENGES AND SOLUTIONS FOR BEST PRACTICES

The first objective of this section is to review the challenges encounter in deep permafrost environment during drilling, wells installation and groundwater monitoring. Based on current knowledge, the second objective is to propose better practices to successfully install long-lasting monitoring wells and retrieve representative groundwater samples at the Meadowbank mine site. Two tables synthetizing the information from different sources are presented. Table 2 documents the challenges encounter while drilling and installing wells. Some tested methods to resolve the enumerated problems are listed and promising solutions that could be attempt in the future are presented. Table 3 documents the challenges encounter during groundwater sampling.

Table 3: Protocol review for drilling and well design in permafrost setting

Borehole drilling and well design challenges	Tested methodology	Innovative solution (What could be done)
Drilling operation in permafrost.	• Advance the boreholes with standard HQ (Golder 2008 a) • Use heated water for drilling fluid (Golder 2008 a) • The fluid remaining in the borehole should have a target temperature of 60°C as water near boiling may freeze more quickly (Statler et al. 2010) • Borehole instrumentation should be on site and ready for installation once drilling is complete (Statler et al. 2010) • Drilling should proceed more slowly, providing the rock surrounding the borehole to warm up and allow a maximum time for installation of bottom hole assembly (Statler et al. 2010) • A bottom hole assembly is 15 m long and is used to isolate the bottom of the hole to allow sampling and monitoring (Statler et al. 2010) (includes pneumatic packer inflated with N_2 head over propylene glycol, a U tube sampling system with a	***Define permafrost and talik location prior or while drilling*** Temperature gauging should be conducted and logged during drilling operation. This information is key decision parameter for heat tracing cable length and elevation of purge and sampling pumps (Franz Environmental Inc. 2009) Pressure, salinity parameters should be taking in consideration to define talik/permafrost zones

	sample reservoir and a temperature sensor line (Freifeld et al. 2008) • Vertical well have less chances of failure. Inclination must be defined accordingly. • When installing bottom hole assembly, the sampling lines and heat tape should be wrapped with insulation to help prevent freezing • Heat tape should be installed with a safety factor i.e. if the highest thermal conductivity expected is 4 W/mK, plan 10 W/mK (Statler et al. 2010) • Heating cables must be attached on the downward side of the well (Franz 2009).	
Breakage of well pipes. Freezing of the standing water exposed to permafrost in the well causing breakage of well pipes or obstruction within the pipes	Use stainless steel instead of PVC. PVC centralizers were used to keep the well centered with boring but PVC centralizer may fail. Using two inflatable packers; one with the borehole annulus and another with the well pipe, to prevent talik water to rise in the permafrost section (Golder 2008). Inflate packers according to their purpose, note status of packers year after year to follow the same procedure and minimize damage potential (Franz 2009).	Use centralizer made of another material than PVC, the objective is to keep the well riser in the center of the borehole and prevent that the riser pipe assembly bends (Franz 2009).
Packer failure. Water bypass packers due to cold temperature-induced contraction of packer, loss of inflation	Ensure enough fuel in the generator so it can run continuously during purging so that the heating cable work all the time and both inside and outside packers should be inflated.	
Material damage through shipping.	Material shipped to the site must be properly package and should arrived	

Stainless steel tubing damage during shipping, cause leakage through casing	and be inspected well ahead of the time the material is needed to be used (Franz 2009).	
<u>Well installation.</u> Well installed from 2003 through 2014 failed for various reasons	Install pre-pack bentonite wells (Meeting minute on lessons learned at Meadowbank 2016) 1-1/2'' screen is installed in the hole with a 1-1/2 pipe. Prepack bentonite is installed above the screen to create the bentonite plug. Heat trace is tightly taped around the 1-1/2'' pipe during to installation to avoid the heat trace to touch each other and create a shortcut. Metal casing is installed and anchored in the bedrock in order to protect the well from material movement. No more grouting is used to fill the space between the casing and the pipe as it didn't prevent the hole MW-11-01 from collapsing. Packer was used in the past to replace the bentonite Proper well inclination should be considered for well installation and in the case of an incline well, heating cables must be attached on the downward side of the well (Franz 2009).	Verify if using U-sampler methodology with borehole assembly would be better over this

Table 4: Protocol review for sampling representative groundwater in permafrost setting

GW sampling challenges	Tested methodology	Innovative solution (What should be done)
Unrepresentative groundwater sample because of cross contamination. Groundwater sample contaminated by borehole drilling or well operation Mixing between resident groundwater and brines/drill fluid used for drilling restricts a proper interpretation of groundwater chemistry Potential contamination through borehole operations (drill bit, drill cuttings, packers), sampling equipment, sampling environment or during sample transportation		Contamination of samples with drilling brine should be minimized Use a tracer and analyses salinity of drill fluid. Tracer such as sodium fluorescein (Henkemans 2016) or perfluorocarbon tracer (PFT) with drill fluid (Pfiffner et al. 2008) to define the amount of contamination from drilling fluid from sampled groundwater. At the end of the borehole, block the drill string and perform a "wet" pull following borehole drilling to remove as much drilling fluid as possible from the borehole before it froze to the rock surface. To further clean the hole use a bailer (Statler et al. 2010; Pfiffner et al. 2008). Use a sampling system such as: U-Tube (Freifeld 2009) or Thermos bottle concept (Sutphin et al. 2006). Minimize contamination with proper sampling equipment i.e. cleaned pump, sanitized equipment dedicated to borehole, test equipment for contamination, use blank sample and transport blank to verify a potential contamination. Field samples must be immediately preserved using appropriate methods to retain competency for subsequent geochemical analyses (Wilkins et al. 2014).
Ice bridge formation within wells.	Heat tracer cables penetrating the permafrost zone were attached to the outside of the well pipe and were	

Borehole ice formation freezing of the standing water exposed to permafrost in the well also preclude the collection of more than one set of fluid samples from a given borehole due to post drilling formation.	activated at the sample collection time. Ensure generator run continuously to energized heat cables. Use a downhole camera if necessary to inspect well damage before proceeding to groundwater sampling.	
<u>Difficulties encounter while well purging and sampling</u> Melted the nylon line of the DVP pump system used to remove water from the well annulus above the casing packers Inoperable pump in the borehole annulus, therefore packers are of no use. Heat cable (energized to keep the well from freezing)	Required activation of the heating cables to melt the ice in the well prior sampling Use stainless steel tubing connected to the DVD pump rather than nylon	Temperature gauging should be conducted and logged during drilling operation. This will allow defining depth of permafrost and talik water location. This information is key decision parameter for heat tracing cable length and elevation of purge and sampling pumps (Franz Environmental Inc. 2009) Pump should be located within unfrozen water at all times is a key factor in avoiding problems due to freezing groundwater during purging/sampling (Franz 2009)
Line of the U-tube sampling system froze	Use an insulated hose encompassing both the sampling lines and the heat trace cable would have prevented the freezing (Statler et al. 2010; Friefeld et al. 2008).	

5. KEY POINTS AND RECOMMANDATIONS

- No new groundwater monitoring wells are planned to be installed in 2019. The groundwater monitoring program will be updated as the project progresses. New information from the hydrogeological numerical model and from hydrogeological field data will be integrated throughout. Moreover, methods to obtain representative groundwater samples and improve well designs under artic climate continue to be investigated.

- For the next field investigation, water used by the laboratory to fill the blank samples should be analyzed for the same parameters than the monitoring samples itself. If water used for the blank samples is clean (free of all parameters), then a source of contamination during transport should be identified by Agnico Eagle regarding the following parameters: carbon, nitrogen, cyanide and sulfate. Transport containers should be cleaned and selected accordingly. Moreover, transport blank should be kept in a refrigerator that is not used to store samples;

Only a few studies are available on deep permafrost environment. In most study, permafrost is defined by the temperature isotherm zero. However, pressure and salinity will influence the actual freezing point of water and therefore the presence or the absence of ice (Stotler et al. 2010; van Everdigen 1976). Pressure, salinity and the visual absence of ice in cores should be considered in the search for talik zones instead of just relying on temperature data.

- Important to define properly talik zones not only based on temperature gradient. Pressure and salinity will influence freezing temperature and the definition of permafrost/talik zone.

- Drilling methodology is the basis to a proper setting form representative groundwater sampling (many procedures have to be followed).

- Groundwater sample contamination can come from many sources, it is important to minimize and prevent the effect of sample contamination as much as possible (avoid drill/brine fluid, purge well as much as possible, clean purging and sampling equipment before use, installed well properly to avoid leakage of cross-contamination of fluid).

There is always a percentage of drill fluid left in the rock formation, so it is relevant to use a tracer to define the percentage of contamination (Pfiffner et al. 2008). Brine and drill fluid get pushed into fractures and former drill fluid stays in the rock formation and risk to contaminate groundwater samples. This would lead to erroneous groundwater salinity and TDS concentrations. When possible, it is suggested to use fresh heated water during the drilling. Cross-contamination between layers can occur as brine water from drilling won't freeze as readily as fresh water, heated fresh water would form an icy zone around the borehole and could be removed during the melting and purging procedures of the monitoring well. Some suggestions include the use of tracer with drilling fluid to define the degree of contamination of a groundwater sample, the usage of a U-sampler known for high purity samples for real-time and laboratory analysis, and a rigorous assessment of sample contamination including subsampling of material in contact with the borehole, drilling lubricant, drill cuttings, tools used for groundwater sampling, etc. The collection of blank samples during well and sampling operation is recommended.

After the drilling operation, if salt such as calcium chloride is used to prevent the borehole from freezing, it is suggested to measure the quantity of salt added to the borehole and that an extensive purge protocol related to the volume of salt added be done. Moreover, the conductivity of the groundwater remove from the well should be monitored during the purge to ensure removal of the salt added before sampling.

To improve the groundwater well installation and sampling program, Agnico Eagle will make additional efforts to apply the proposed innovative solutions and best practices when possible.

6. REPORTING

An annual groundwater monitoring report will be submitted by Agnico Eagle Mines Limited to the NWB and NIRB with the Meadowbank Annual Report of the following year. This report will include the following information:

- Installation logs for any new monitoring wells;
- Location in UTM coordinates of all groundwater monitoring locations;
- Description of the working condition of the existing wells;
- Date of groundwater sampling;
- Details of sampling methods;
- Analytical results including: field data, laboratory analytical data and QA/QC information;
- Comparative assessment of data obtained to date to input values used in the Water Quality Model for the site (relevant salinity parameters);
- Comparative assessment of parameters indicative of mine impacts to groundwater, with particular regard to tailings (total cyanide and dissolved copper);
- Historical trending of key parameters (such as chloride, sulfate, total cyanide, total copper, total iron and total arsenic) will be included in further groundwater monitoring reports; and,
- Actions taken regarding recommendations for the groundwater sampling program.

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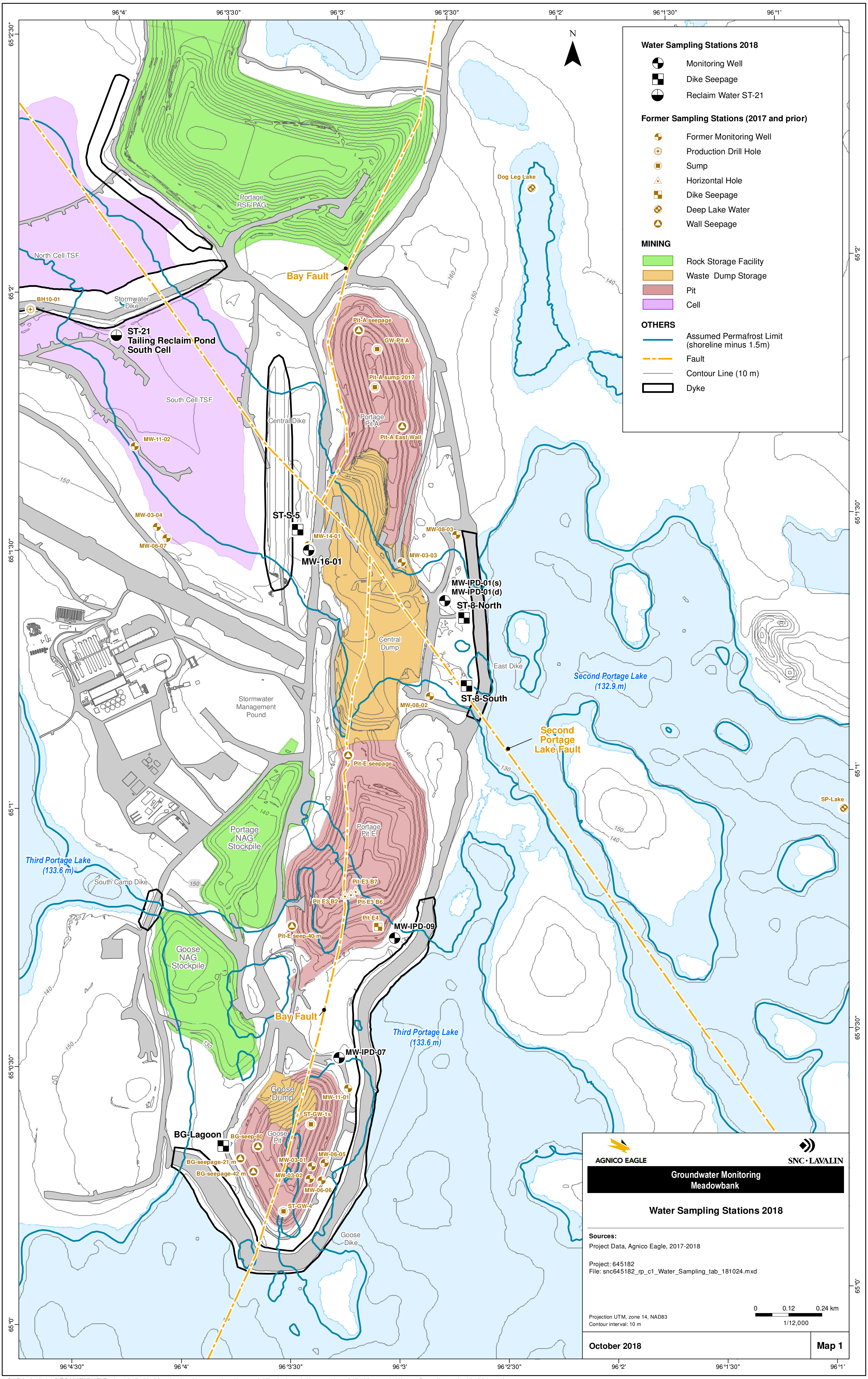
APPENDIX A

Groundwater Monitoring Stations at Meadowbank



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APPENDIX B

Photographic Report

P1: ORDERING AND RECEIVING EQUIPMENT FOR WELL INSTALLATION

Based on information received by M. Collard, (Agnico Eagle field technician and assigned to drilling supervision and monitoring well installation), all well riser pipes were inspected prior to drilling. Damaged threads on riser pipes were reworked and identified with pink and green color. These riser pipes were left aside and utilized as backup material if necessary.

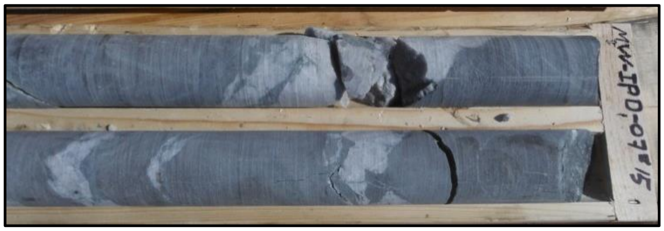
P2-P3: DRILLING OPERATIONS

Drilling installation at monitoring well MW-IDP-09.

Drilling installation at monitoring well MW-IDP-01(d).

Drilling installation at monitoring well MW-IDP-01(d). The overburden was drilled with a HWT casing (101,6 mm I.D) anchored into the bedrock before resuming the borehole with a nominal diameter of 96 mm (HQ). Drilling operation lasted between 1 and 4 days for each borehole.

P4-P8: DRILLING & CORING




Rock cores were drilled at the four new monitoring well sites. Rock cores were recovered for the entire vertical borehole length. The four pictures show the various stratigraphy and fractures types found across the boreholes.

Fractures and discontinuities are amongst the most important features for the comprehension of groundwater flow paths. Any indication in cores on how continuous a fracture plane is should be recorded. Features such as joints, fractures, joint filling and other discontinuity parameters should be recorded (Appendix 3a and 3b). Cores logging should be carried out accordingly.

P9: DRILLING & CORING

The front bedrock core sample shows a fracture infilled with calcite material.

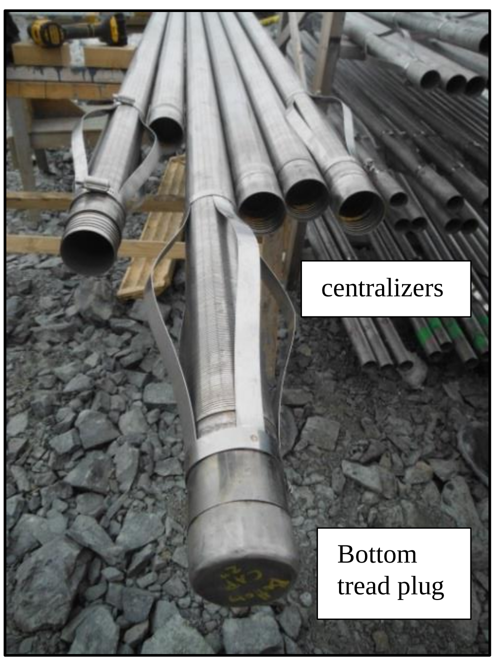
The back bedrock core sample shows alteration, fractures and veins.

Such features should be described in order to identify potential water bearing apertures.

P9-P10: HWT (101.6 mm (4 in) I.D.) FLUSH JOINT CASING INSTALLED IN OVERBURDEN

The two pictures show a monitoring well installation and a HWT casing. HWT casing was installed through the overburden into the bedrock to prevent the borehole from collapsing. On the right picture, the HWT casing stops below the ground level. HWT casing have to extend above ground level as on the left picture, to prevent surface water to enter the annulus space between the casing and the well.

P11-P12: WELL SCREEN AND BOTTOM TREAD PLUG



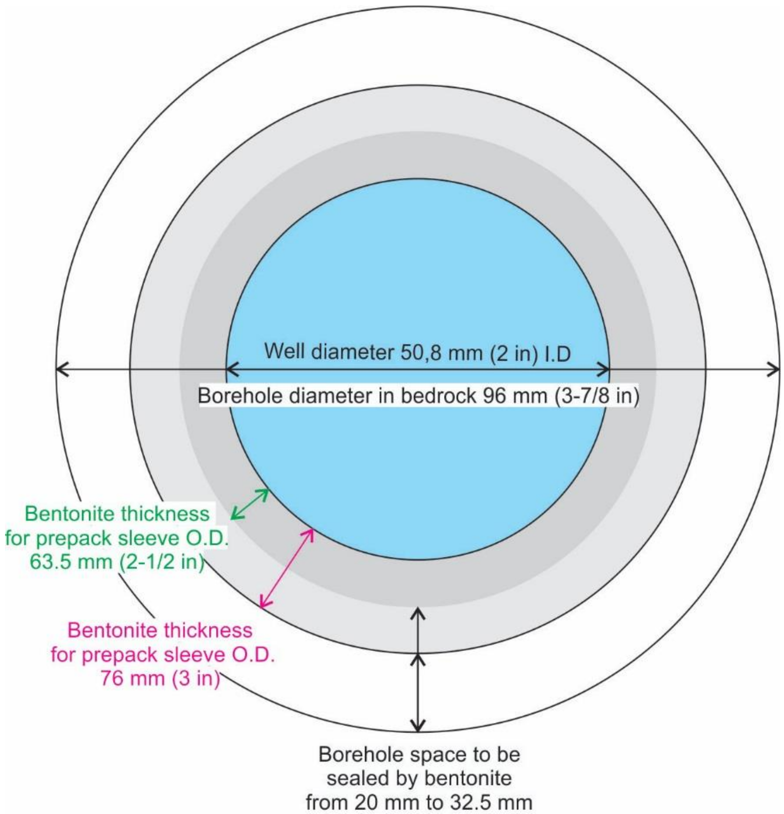
Prior to each monitoring well installation, well screens were inspected, prepared and numbered and set in their order of installation. The bottom plug was installed on the first screen (slot aperture is 0.254 mm (0.010 in). Pipe centralizers were installed every three length of pipes (9.14 m (30 feet).

P13-P16: FOAM BRIDGE ON A RISER

The pictures show a stainless steel riser pipe with a foam bridge. The foam bridge (88.9 mm (3-1/2 in) O.D.) on a 0,76 m (2,5 ft) long 2-inch (50.8 mm) diameter S.S. pipe was installed between the monitoring well screens and the bentonite sleeves to prevent the bentonite to seep downwards in the monitoring well screen interval. The foam bridge is 101.6 mm (4 in) long. Since the foam bridge risked to be damaged during installation, the Agnico Eagle technician added tape over the foam at monitoring well MW-IPD-01 (s).

The picture shows a prepack bentonite on a well riser pipe 50.8 mm (2 in) I.D. fitted above the foam bridge. For additional protection, the Agnico Eagle field technician added a geomembrane around the foam bridge. Holes were made on both side of the geomembrane to allow water to in the well to run through while the pipes were lowered into the borehole. This was done for monitoring well installations MW-IDP-01d, MW-IDP-07 and MW-IDP-09.

P17-P18: BENTONITE PREPACK VERIFICATION



The left drawing shows a scaled cross-section of the material installed in the borehole at the bentonite prepack level in the borehole (refer to Appendix 1 for monitoring well installation sketches). The right picture shows the prepack bentonite sleeve.

Prepack bentonite sections have the purpose to seal the annulus space between the borehole and the well riser pipe to isolate the well screens (refer to Appendix 1 for monitoring well installation sketches).

To verify the bentonite seal integrity, a dye tracer test is suggested. The dye tracer test can be conducted by adding a known volume and concentration of dye tracer in the monitoring well annulus (between the HWT casing and the well casing). If colored water is pumped out of the well while sampling, it could be concluded that the prepack bentonite is sealing the well screen properly.

P19-P20: WELL RISER VERIFICATION

Above the bentonite sections, well risers pipe have a diameter of 38.1 mm (1-1/2 in) I.D.. The smaller diameter riser pipes were required to accommodate the heat trace cables installed within permafrost zone (0-40 m from ground level).

A connector is added to fit the 2 in (O.D.) riser pipe with the 1-1/2 in riser pipes.

Before installation, all well riser pipes were numbered and centralizers were installed at every three pipes.

Before the installation, ice stuck in the fitting of the well riser pipes was melted and all the pipes were verified a last time to ensure proper installation.

P21-P22: WELL SCREEN INSTALLATION

A pipe clamp was used to hold the heavy well equipment while additional riser pipes were added and screwed on. However, the pipe clamp slightly compressed the pipes. For further well installations, adapted tools (clamps) are proposed to prevent permanent damage to well equipment.

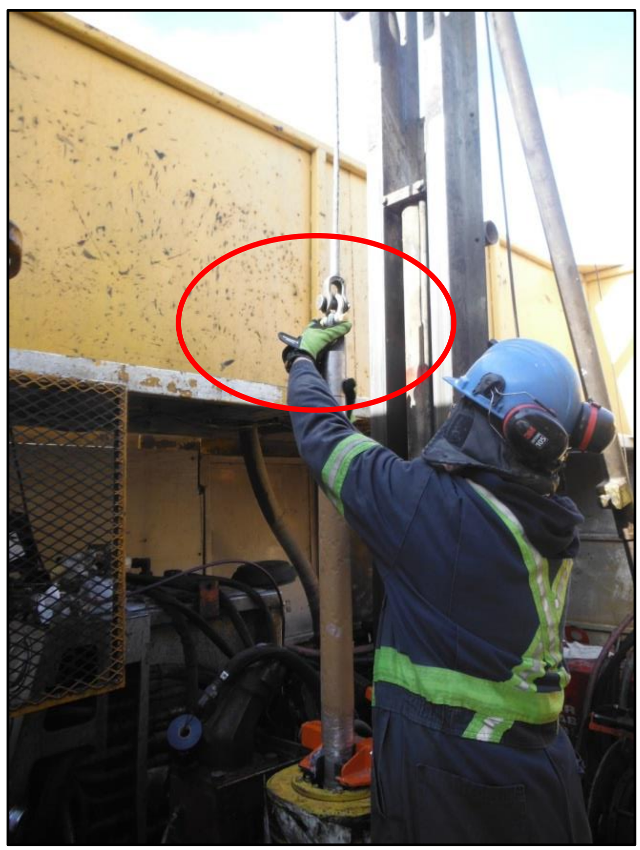
P23-P24: BENTONITE PREPACK INSTALLATION

Driller assistant was standing below the drill head, in the pit, to orientate the riser pipes into the borehole.

Foam bridge and bentonite prepack installations.

P25-P26: PREPACK BENTONITE INSTALLATION

A steel hoisting plug was screwed onto the well riser to lower down the monitoring well material into the borehole.



P27-P28: WELL RISER PIPE INSTALLATION

After the bentonite sleeves were installed, a crossover connector was added to fit 1-1/2 in (I.D.) well riser pipes. A centralizer was installed on the first riser pipe.

P29-P32: HEAT TRACE INSTALLATION

Heat trace cables were installed around the 38.1 mm (1-1/2 in) I.D. well riser pipes. Heat trace cables are taped along the well riser pipes and installed meticulously around well centralizers. Heat trace cables are installed within the permafrost intervals to prevent ice bridges to form in the monitoring well.

P33-P35: WELL SET UP

The two pictures show a monitoring well installation and HWT casing anchor in bedrock. The left picture shows MW-IDP-07 well installed on June 2, 2018. On the right, MW-IDP-01(s) well was installed on May 28, 2018 the day before SNC professional arrival. The monitoring well installation of MW-IDP-01(s) took three hours. At MW-IDP-01s, a sea can was installed and heat trace cables were connected to an electrical panel. Heat trace cables were functional and the sea can was installed.

Heat trace cables are connected to a permanent electrical box for MW-IDP-01s and MW-IDP-01d. For MW-IDP-07 and MW-IDP-09, heat trace cables are connected temporarily on a light tower, working with fuel generator.

P36-P37: WELL HEAD INSTALLATION AND TESTING

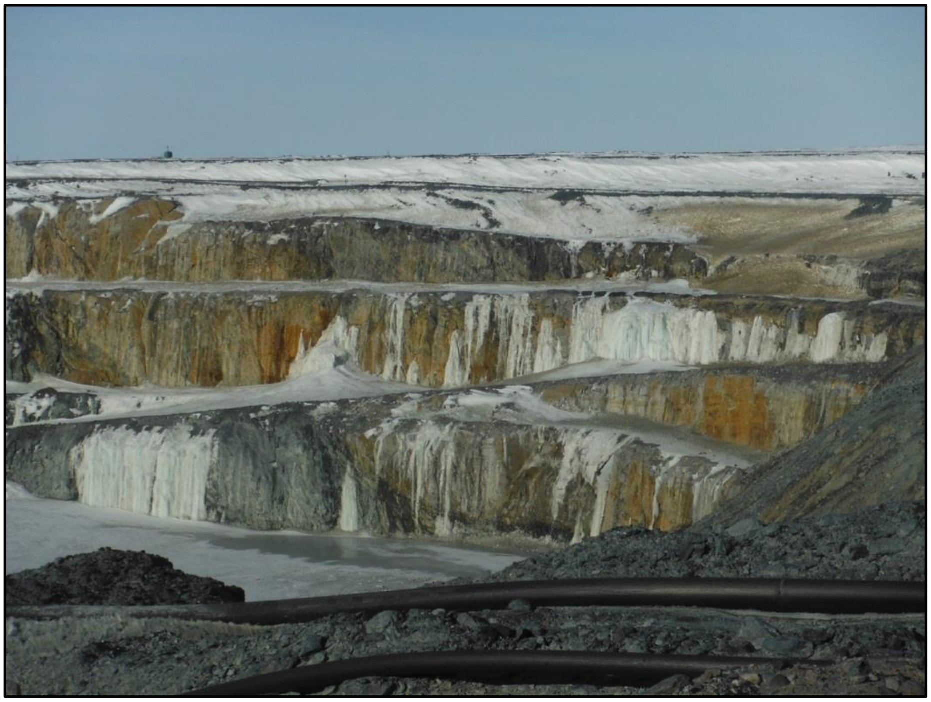
One well head was installed and tested at MW-16-01. The dedicated well head and pump set up are aiming to ease groundwater sampling and prevent groundwater sample cross-contamination.

All fittings were tested to verify no material was missing in prevision of the next groundwater sampling campaign planned for July 5th to 13th 2018.

Heat trace cables were installed below the well head to avoid melting of the well head. It is important to drain the water line properly, for the portion of the well not covered by heat trace cable, to avoid any water freezing and line damage.

Once the well head is closed, all sampling material is protected again cross-contamination (dust, grease, etc.) and is ready for the next sampling event.

P38-P39: WINTER INVESTIGATION OF PIT WALL SEEPAGE

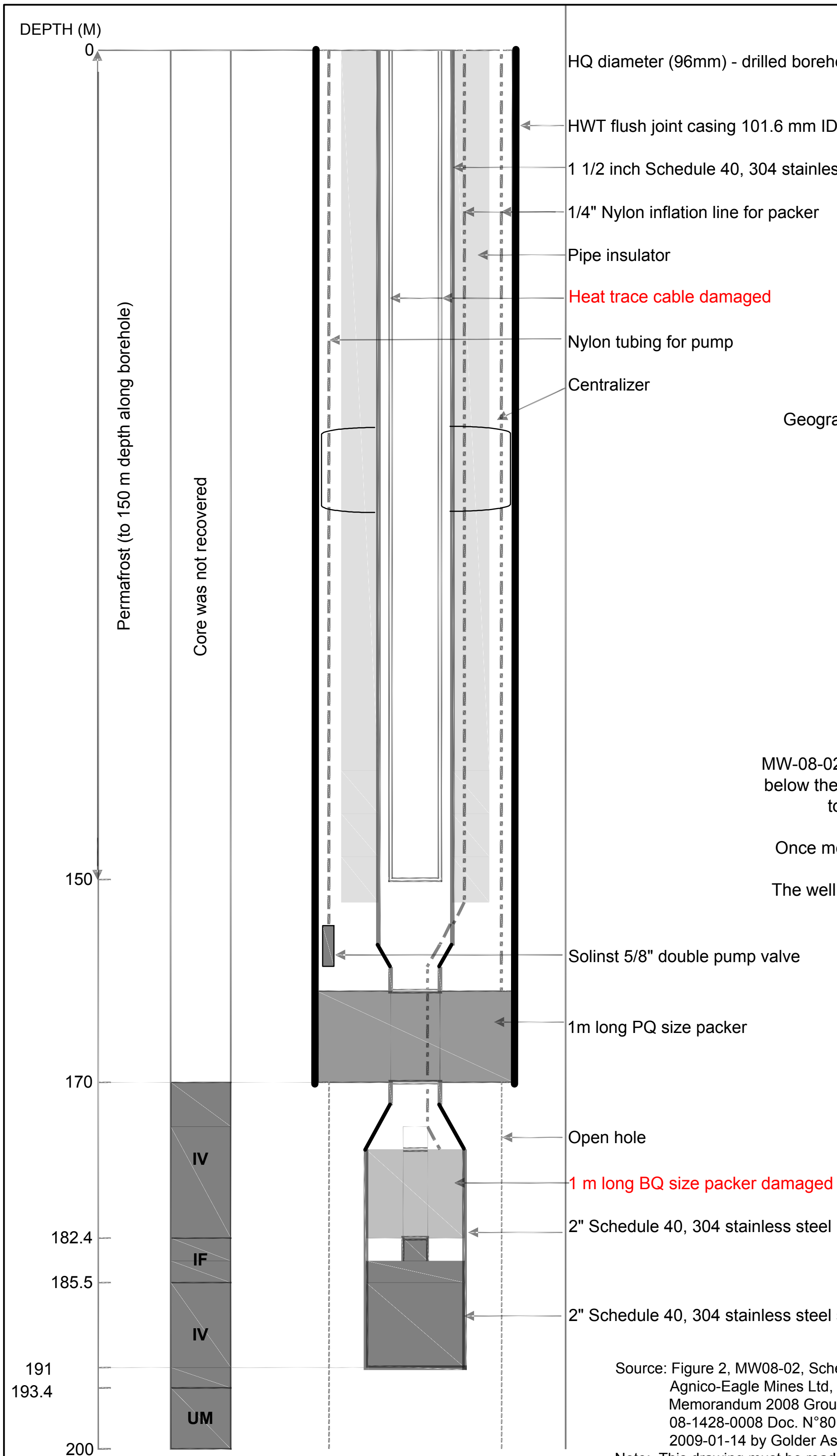


Goose Pit view looking southwest. All wall faces show frozen ice sheets at seepage areas.

View of Portage Pit E, looking west. In comparison to Goose Pit, Portage Pit E water on wall is not frozen. It will be interesting to continue sampling these Pit E walls during the next campaign, as this area was not accessible last year.

APPENDIX C

Well MW 16-01 and MW-08-02 Construction



PIEZOMETER COMPLETION DETAIL

Location: Meadowbank
Date installed: November 2016
Inclination: 70°
Geographic coordinate system: UTM NAD83 ZONE 14
Easting: 638750.9
Northing: 7214427.3

LITHOLOGIC UNIT LEGEND

IV Intermediate Volcanics
IF Iron Formation
UM Ultramafic

TECHNICAL NOTE

Heat traces are damaged.
MW-08-02 annulus is obstructed by ice from 30 m to 150 m below the ground surface. It takes a minimum of four hours to melt the ice with a steamer and 500 feet of hose (SNC-Lavalin: 2017-07-17).
Once melted, it takes about 12 hours for static water level to get back to 30 m (SNC-Lavalin:2017-07-18).
The well remains free of ice for a period of about 24 hours (SNC-Lavalin:2017-07-18).

Source: Figure 2, MW08-02, Schematic Borehole Log and Monitoring Well Instrumentation, Agnico-Eagle Mines Ltd, Meadowbank Division from Appendix C4 Technical, Memorandum 2008 Groundwater Quality Monitoring Program, Meadowbank Mine, 08-1428-0008 Doc. N°801 Ver. 0 ; Drawing N° 08-1428-0008/7000 realized the 2009-01-14 by Golder Associates.
Note: This drawing must be read in conjunction with the accompanying report.

SNC·LAVALIN

PROJECT : AE Meadowbank Groundwater Monitoring

CLIENT : AGNICO EAGLE

TITLE : MW08-02 Schematic Borehole Log and Monitoring Well Instrumentation

N°	DESCRIPTION	DATE
00	For consultation	2017-11-02

DRAWN : É. Cazeneuve
VERIFIED : L. Tremblay

SCALE:	DATE :	FILE:	NO:
-	2017-11-02	645182	02

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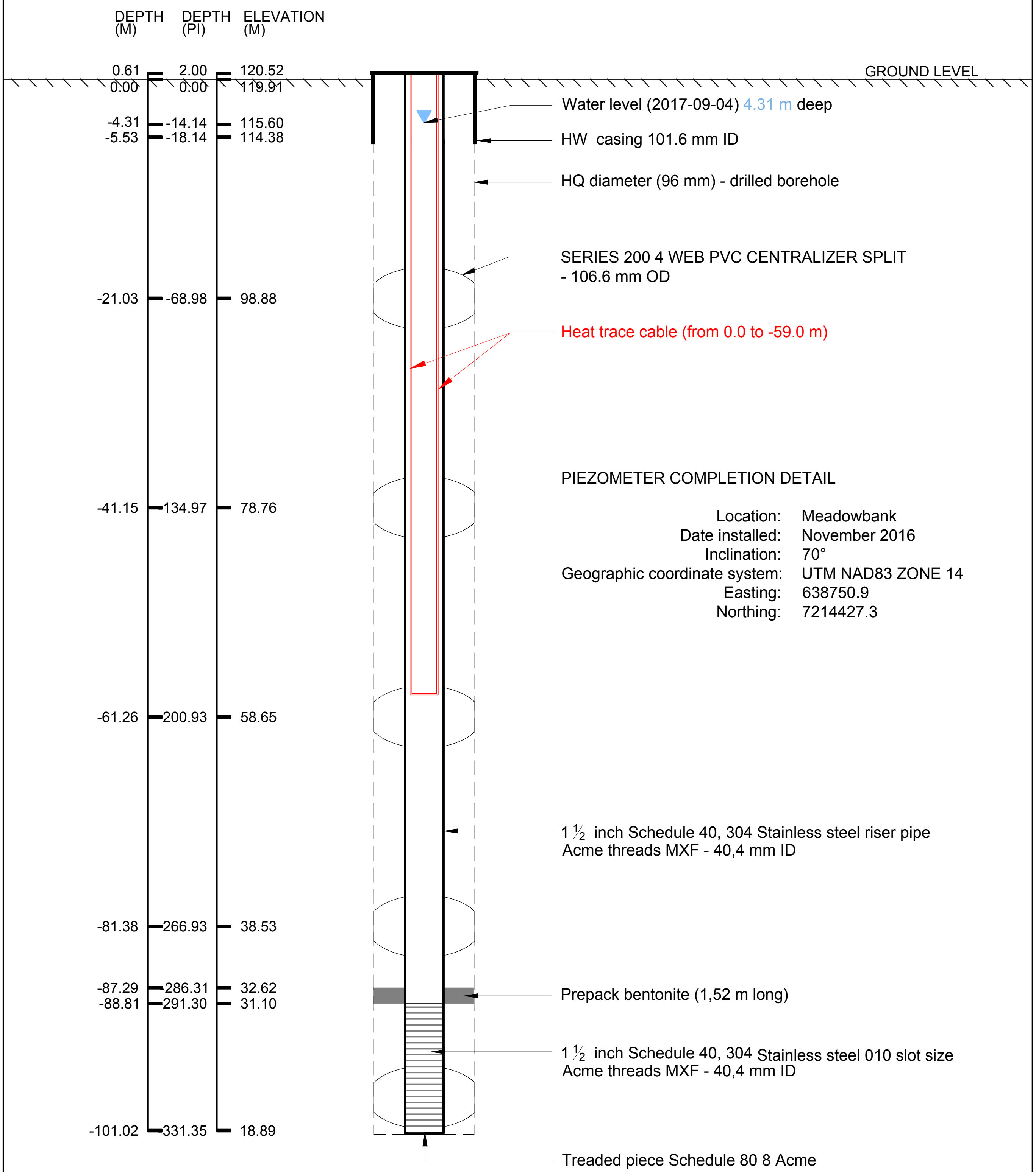
FORMAT 8,5x11



Note : This drawing must be read in conjunction with the accompanying report.

SNC·LAVALIN

CLIENT : AGNICO EAGLE

PROJECT : AE Meadowbank Groundwater Monitoring

TITLE : MW-16-01 Schematic Monitoring Well Instrumentation

DRAWN : É. Cazeneuve

VERIFIED : L. Tremblay

N°	DESCRIPTION	DATE
00	For consultation	2017-11-02

SCALE:	DATE :	FILE:	NO:
1Y : 10X	2017-11-02	645182	01

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APPENDIX D

Standard Operating Procedure for Sampling of Groundwater Monitoring Wells

Purpose:

› Conduct a groundwater (GW) monitoring program to investigate mining impacts on local GW. This is in accordance with both Meadowbank NWB and NIRB permits.

› Standardize methodologies

Groundwater Sampling SOP:

GW sampling consists of measuring field parameters and collecting GW samples within the designated bottles, twice a year, at the same period of the year (early July and early September).

Wells to sample:

Well name	x	y	Screens depth (m)	Pump depth (m)
MW-16-01	638750.9	7214427.3	89-101	95
MW-IPD-01 (s)	639240.3	7214249.9	51-69	60
MW-IPD-01 (d)	639240.0	7214245.0	163-181	175
MW-IPD-07	638859.6	7212597.2	42-50	40
MW-IPD-09	639065.2	7213024.5	62-80	70

A week before sampling check for:

- Heat trace cables functionality (can't be check at MW-IPD-01 (d) since heat trace cables start 2 m below ground, so the lines won't feel warm);
- Make sure the light tower generator are running at MW-IPD-07 and MW-IPD-09
- Make sure the nitrogen tanks are in place and secured

Light tower generator at MW-IPD-07 and MW-IPD-09 to keep the heat trace cables working

Material required for sampling:

- Nitrogen tanks (JDE number 134720) already installed at each sampling station
- Solinst double valve pump (already in the monitoring well), two spare pumps are in the cooler
- Nitrogen regulator
- Solinst Control unit 464 ECU 250 psi
- Black drive line and supply line
- Clean pails
- Graduated measuring cups
- Calibrated multi-parameter probe and a flow through cell (to prevent the water sample to be in contact with oxygen): temperature, specific conductivity, pH, oxydoreduction potential, dissolved oxygen, total dissolved solid, salinity, turbidity;
- Water level probe
- Sampling bottles (see list below)
- Syringe and adapted 0,45 micron filters
- Nitrile gloves
- Permanent marker

Sampling bottle check list:

- 1 * 1 L clear plastic bottle with no preservative
- 1 * 250 ml clear plastic bottle with no preservative
- 1 * 125 ml clear plastic bottle with H_2SO_4
- 2 * 125 ml clear plastic bottle with nitric acid (HNO_3)
- 1 *125 ml clear plastic bottle with NaOH
- 1 * 125 ml clear plastic bottle with NaOH - SGS laboratory bottle
- 1 * 125 ml clear plastic bottle with HCl

Well name	Pressure left in the nitrogen tank	Gas used for each sampling even	Comment
	psi	psi	
MW-IDP-01s	1600	200	-
MW-IDP-01d	200	800	Need a new nitrogen tank
MW-IDP-07	2200	150	-
MW-IDP-09	2000	150	-
MW-16-01	1000	500	Need a new nitrogen tank soon

Sampling procedures

Prior sampling the water in the monitoring well

1- Remove well head cap
2- Remove the red plug on well head
3- Lower the small water level probe into the hole where the red cap was located and measure the water level from the well head hole level
4- Place the ¼ inch waterra line on the well head

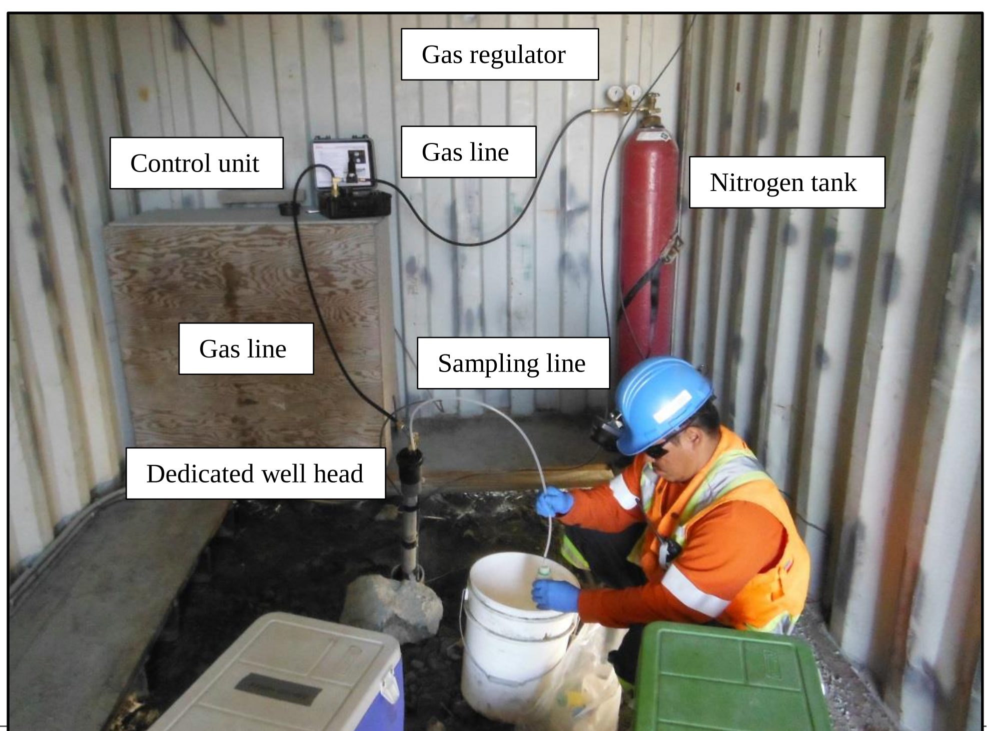
Well name	Water level at plastic well head level	HWT casing above ground level	Well casing above ground level	casing above ground level with PVC and well head addition
	m	m	m	m
MW-IDP-01 (s)	18,19	0,17	0,29	0,75
MW-IDP-01 (d)	18,07	0,00	0,28	0,35
MW-IDP-07	1,79	0,06	0,19	0,45
MW-IDP-09	2,36	0,00	0,26	0,45
MW-16-01	5,30	0,17	?	0,745

Setting up the nitrogen tank and the gas line

5- Screw on the nitrogen regulator on the nitrogen tank and tighten lightly with a 1 1/8in wrench ((ideally not an adjustable wrench since it will damage the bolt)
6- Connect the supply line into the regulator to "air in" on the control box
7- Connect the drive line from the air out on the control box to the well head

This end goes into the nitrogen

Manual Control Button
Air Out
Air In
Regulator
Pressure Gauge
Battery Enclosure



Gas regulator
Control unit
Gas line
Nitrogen tank
Gas line
Sampling line
Dedicated well head

8- **Open** to its maximum position (turning towards the left side) the handle/valve located on the gas pressure regulator at the maximum (the close position would send the maximum nitrogen pressure to the air line and we want to avoid that). The valve should feel loose, not tighten;

9- **Slowly open** (1/4 turn to the left) the valve located on the nitrogen tank. You should be able to read the pressure left in the nitrogen tank on the pressure gage located on the right side of the regulator;

10- **Slowly closed** (a tiny bit, less than 1/8 turn to the right) the valve located on the gas pressure regulator until the gauge on the left side indicated 150 psi. **NEVER EXCEED 250 psi** or you are going to blow up the controller box**.**

11- On the control box press RUN than select the menu on AUTO mode for Preset Flow Rate.

12- This should take 1 minute before the water is flowing.

Well name	Pressure set on control unit box (flow rate set to medium)	Flow setting on controller unit	GW flow rate measured while pumping	Comments
	psi		mL/min	
MW-IDP-01s	50	medium	100	
MW-IDP-01d	110	medium	50	
MW-IDP-07	40	medium	200	Rate too fast, water level was decreasing
MW-IDP-09	50	high	165	
MW-16-01	50	high	100	

13- While the water is purging from the monitoring well measure the flow rate with a measuring cup and a timer. The ideal flow rate is equal or below 100 ml/min. Keep measuring and recording the water level. If the water level is not stable and diminishes it means that you are pumping the water from the well and not from the bedrock formation and you want to avoid that. You want to keep a flow rate that will keep your water level stable.
14- Let it run for 45 minutes, measure and record physicochemical parameters and record every 15 minutes.
15- Sample the water from the well when you have more than 3 consecutive readings that are:
    a. pH is within 0.1 or 0.2 of a standard unit;
    b. temperature is within 0.2 °C or 3%;
    c. specific conductance is within 5% for values equal to or less than 100 microsiemens and 3% for values greater than 100 microsiemens;
    d. DO (dissolved oxygen) is within 10%;
    e. Eh/ORP (oxido-reduction potential) is within 10 millivolts;
    f. Turbidity is within 10% for values greater than 1 NTU but less than 100 NTU;
16- To filter the sample for the dissolved metal analysis, use a larger filter and hold it to ¼ diameter LDPH tubing (respect the flow direction indicated by an arrow) or fill the syringe directly with the water coming out of the ¼ diameter LDPH tubing, install a small filter on the syringe and fill the dissolved metal bottles.
17- Remove the filter and fill all the other bottles.
18- See instruction to set up personalised drive and vent ranges.

https://www.solinst.com/products/groundwater-samplers/464-pneumatic-pump-control-units/electronic-control-unit-datasheet/

Optimizing Pumping Pressure

To collect a representative sample, especially when monitoring for volatiles, it is important to avoid the drive gas to enter the pump and aerate the sample water during a drive period. This means, you need to carefully calculate the appropriate pumping pressure to be applied. To do so, it is important to measure the depth of the static water level.

The pumping pressure needed is calculated due that it takes about 1 psi of pressure to raise 2.3 ft. of water plus 10 psi fo line loss. To calculate the pumping pressure needed in psi, take depth to static level in feet, and multiply by 0.43 psi/ft. (1 psi /2.3 feet = 0.43 psi/ft.). E.g., if depth to static water level is 50 ft., the pumping pressure needed is calculated by the following:

50 ft. to static level x 0.43 psi/ft. + 10 psi = 32 psi needed.

Refer to Solinst Website for more instruction: https://www.solinst.com/products/groundwater-samplers/408-double-valve-pumps/technical-bulletins/getting-best-quality-samples-double-valve-pump.php

APPENDIX E

Template Sheet for Groundwater Monitoring Sampling

Groundwater sampling

Field note

simple ID ____________________

Crew: ____________________ Date: __________ Time: __________

Odor/color ____

Observations: ____

water level : ____________________ Pression tank at start: ____________________

Is there sediment in water?: Yes No Pression tank at end: ____________________

Heat line heating?: Yes No Speed on the black box: ____________________

Water Flow rate : ____________________

FIELD MEASUREMENTS

Time	Temperature	Specific Conductivity	Dissolved Oxygen	pH	Turbidity	ORP	Salinity	TDS	Water Level
units:	°C	µS/cm	mg/L		NTU	mV	PSU	mg/L	cm

Groundwater sampling

REMINDER : Stop taking value when 3 samples or within the range listed below

pH is within 0.1 or 0.2	D.O. (dissolved oxygen) is within 10%
Turbidity is within 10 % for values greater than 1 NTU but less than 100 NTU	
Temperatur is within 0.2 °C OR 3 %	Eh/ORP (oxidoreduction potential is within 10 millivolts
Specific conductance is within 5% for values equal to or less than 100 microsiemens and 3% for values greater than 100 microsiemens	

BOTTLE CHECKLIST

1 * 1 L clear plastic bottle with no preservative
1 * 250 ml clear plastic bottle with no preservative
1 * 125 ml clear plastic bottle with H_2SO_4
2 * 125 ml clear plastic bottle with nitric acisid (HNO_3)
1 *125 ml clear plastic bottle with NaOH
1 * 125 ml clear plastic bottle with NaOH - SGS laboratory botle
1 * 125 ml clear plastic bottle with HCl

Field Notes: Don't forget to write down the total of volume purged