# Design Report for CP6 and CP6 Berm
# Meliadine Project, Nunavut

PRESENTED TO

**Agnico Eagle Mines Limited**

JANUARY 24, 2020
ISSUED FOR USE
FILE: ENG.EARC03140-06
AGNICO EAGLE DOCUMENT NUMBER: 6526-695-100-REP-001

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# EXECUTIVE SUMMARY

Agnico Eagle Mines Limited (Agnico Eagle) is operating the Meliadine Gold Mine. The mine is located approximately 25 km north from Rankin Inlet, and 80 km southwest from Chesterfield Inlet in the Kivalliq Region of Nunavut.

Agnico Eagle obtained the Type "A" Water Licence (No. 2AM-MEL1631) for the project on April 1, 2016 and started the mine production in early 2019. As a part of the proposed mine infrastructure development plan, Agnico Eagle is planning to construct a water collection pond (CP6) and associated thermal protection berm (CP6 Berm) in March 2020. Tetra Tech Canada Inc. (Tetra Tech) was retained by Agnico Eagle to carry out the detailed design of CP6 and CP6 Berm to facilitate the water management during operation and closure.

CP6 will collect runoff water from the proposed Waste Rock Storage Facility 3 (WRSF3) and serve as temporary water storage during operation. The proposed berm (CP6 Berm) at the downstream side of CP6 will provide thermal protection to maintain the underlying permafrost. The water collected in CP6 will be pumped to the primary water collection pond (CP1) for treatment prior to discharging to the outside receiving environment.

The design of CP6 and CP6 Berm is based on the following criteria and key considerations:

- CP6 is designed to store 3/7 of 1 in 100 wet precipitation year freshet. The water collected in CP6 will be actively pumped to CP1 from the fourth day of spring freshet and the water in CP6 will be completely pumped out within seven days. The design minimum operating water pumping rate is 11,000 $m^3$/day for the CP6 pumping system.
- The maximum operating water elevation in CP6 under Inflow Design Flood (IDF) is set to be at least 2.0 m lower than the lowest natural outlet elevation of CP6 (the lowest original ground surface elevation along the perimeter of CP6) to reduce the potential seepage from CP6 into the surrounding ground.
- The berm is designed to aggrade or preserve permafrost in the original ground below the center of the berm to a top permafrost elevation of at least 2.0 m higher than the maximum operating water elevation in CP6 under Inflow Design Flood (IDF). The permafrost will reduce the potential seepage through the berm foundation into the downstream receiving environment (i.e., Lake H2).
- Minimal water will be stored in CP6 after the spring freshet water is pumped out, so that the runoff from an extreme rainfall event can be temporarily stored in CP6.
- CP6 should become nearly empty before the CP6 pumping station is shut down by the end of the water pumping season (around end of October) each year until closure of the mine.

This report summarizes the site conditions and design basis and presents the detailed design, Issued for Construction drawings, and construction material specification. This report is also indented to meet the requirements of Part D Items 1 and 2 of the Type "A" Water License (No. 2AM-MEL1631).

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# ACRONYMS & ABBREVIATIONS

| Acronyms/Abbreviations | Definition |
|---|---|
| AEP | Annual Exceedance Probability |
| CDA | Canadian Dam Association |
| CP | Collection Pond |
| GTC | Ground Temperature Cable |
| IDF | Inflow Design Flood |
| km | Kilometers |
| masl | Metres Above Sea Level |
| ML | Metal Leaching |
| MMER | Metal Mining Effluent Regulations |
| NPAG | Non-Potentially Acid Generating |
| PGA | Peak Ground Acceleration |
| PMP | Probable Maximum Precipitation |
| ppt | Parts Per Thousand |
| QA/QC | Quality Assurance and Quality Control |
| TDS | Total Dissolved Solids |
| WRSF | Waste Rock Storage Facility |

## LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Agnico Eagle Mines Limited. and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Agnico Eagle Mines Limited, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on Use of this Document attached in the Appendix D or Contractual Terms and Conditions executed by both parties.

# 1.0 INTRODUCTION

Agnico Eagle Mines Limited (Agnico Eagle) is operating the Meliadine Gold Mine. The mine is located approximately 25 km north from Rankin Inlet, Nunavut. Situated on the western shore of Hudson Bay, the project site is located on the peninsula between the east, south, and west basins of Meliadine Lake (63°01'23.8"N, 92°13'6.42"W). A general location plan for the project is shown in Figure 1.

Agnico Eagle obtained the Type "A" Water Licence (No. 2AM-MEL1631) for the project on April 1, 2016 and started the mine production in early 2019. As a part of the proposed mine infrastructure development plan, Agnico Eagle is planning to construct a water collection pond (CP6) and associated thermal protection berm (CP6 Berm) in March 2020. Tetra Tech Canada Inc. (Tetra Tech) was retained by Agnico Eagle to carry out the detailed design of CP6 and CP6 Berm to facilitate the water management during operation and closure.

The proposed locations of CP6 and CP6 Berm are shown on Figure 2. CP6 will collect runoff water from the proposed Waste Rock Storage Facility 3 (WRSF3) and serve as temporary water storage during operation. The proposed berm (CP6 Berm) at the downstream side of CP6 will provide thermal protection to maintain the underlying permafrost. The water collected in CP6 will be pumped to the primary water collection pond (CP1) for treatment prior to discharging to the outside receiving environment.

This report summarizes the site conditions and design basis and presents the detailed design, Issued for Construction drawings, and construction material specifications for CP6 and CP6 Berm. This report is also indented to meet the requirements of Part D Items 1 and 2 of the Type "A" Water License (No. 2AM-MEL1631).

# 2.0 GENERAL SITE CONDITIONS

## 2.1 Climate and Meteorology

The Project site lies within the Southern Arctic Climatic Region where daylight reaches a minimum of 4 hours per day in winter and a maximum of 20 hours per day in summer. The nearest weather station is Rankin Inlet A (Station 2303401), located approximately 25 km south of the Project site and has been operating since 1954.

The monthly mean air temperature is typically above 0°C for the months of June to September, and is below 0°C between October and May. July is typically the warmest month and January the coldest. Winters are typically long and cold, while summers are short and cool. Spring and autumn are short. The mean annual temperature for the period of record from 1981 to 2010 was -10.5°C.

The annual average total precipitation at the mine site is 405 mm/year and falls almost equally as snow and rainfall (Golder 2013a). Average annual evaporation for small waterbodies in the Project area is estimated to be 323 mm between June and September. The average annual loss of snowpack to sublimation and snow redistribution is estimated to vary between 46% and 52% of the total precipitation for the winter period and occurs between October and May (Golder 2013a).

The region is known for high winds, which are due in part to the broad, flat, uninterrupted expanses offered to moving air masses. The wind blows from the north and north-northwest direction more than 30% of the time. The mean values for wind speed show that the north-northwest, together with north and northwest winds, have the highest speeds and tend to be the strongest. Mean monthly wind speeds are typically between 19 km/hour and 27 km/hour.

The climate in the Project region is projected to be warmer for the 2020s, 2050s, and 2080s time horizons when compared to the observed historic values (Agnico Eagle and Golder 2014). Precipitation shows an increase compared to historical values, but the majority of projections are not significantly different from the annual recorded precipitation values.

## 2.2 Topography and Lakes

The dominant terrain in the Project area comprises glacial landforms such as drumlins (glacial till), eskers (gravel and sand), and lakes. A series of low relief ridges are composed of glacial deposits, oriented in a northwest-southeast direction, which control the regional surface drainage patterns. The property is about 60 metres above sea level (masl) in low-lying topography with numerous lakes.

The surveyed lake surface elevations in the Project area range from about 51 masl at Meliadine Lake to about 74 masl for local small perched lakes. Lakes formed by glaciofluvial processes or glacial processes, are common throughout the Project area. Most of the perched lakes at the Project site are relatively shallow (less than 2 m water depth). Late-winter ice thicknesses on freshwater lakes in the Project area range between 1.0 m and 2.3 m with an average thickness of 1.7 m. Ice covers usually appear by the end of October and are completely formed in early November. The spring freshet typically begins in mid-June and is complete by early July (Golder 2012a).

## 2.3 Permafrost

The Project site is located within the Southern Arctic terrestrial eco-zone, one of the coldest and driest regions of Canada, in a zone of continuous permafrost. Continuous permafrost to depths of between 360 m to 495 m is expected based on historical and recent ground temperature data from thermistors installed near Tiriganiaq, F-Zone, and Discovery deposits (Golder 2012b). The measured ground temperature data indicates that the active layer is 1.0 m to 3.0 m in areas of shallow soils and areas away from the influence of lakes. It is anticipated that the active layer adjacent to lakes or below a body of moving water such as a stream could be deeper. The typical permafrost ground temperatures at the depths of zero annual amplitude (typically at a depth of below 15 m) are in the range of -5.0°C to -7.5°C in the areas away from lakes and streams. The geothermal gradient ranges from 0.012°C/m to 0.02°C/m (Golder 2012b).

## 2.4 Groundwater

In areas of continuous permafrost, there are generally two groundwater flow regimes: a shallow groundwater flow regime located in the active layer near the ground surface, and a deep groundwater flow regime located beneath permafrost. From late spring to early autumn, when temperatures are above 0°C, the active layer thaws. Within the active layer, the water table is expected to be a subdued replica of topography, and is expected to parallel the topographic surface. The Project area groundwater in the active layer flows to local depressions and ponds that drain to larger lakes.

The permafrost in the rock in the Project area would be virtually impermeable to groundwater flow. The shallow groundwater flow regime, therefore, has little to no hydraulic connection with the deep groundwater regime. A numerical hydrogeological model for the deep groundwater flow regime was developed (Golder 2013b). The results of the hydrogeological model have indicated that the rock at the Project site below the base of the permafrost or in taliks is generally of low hydraulic conductivity, on the order of $3 \times 10^{-9}$ m/s (Golder 2013c).

To a lesser degree, groundwater beneath the permafrost is influenced by density differences due to the upward diffusion of deep-seated brines (density-driven flow). In the Canadian Shield, concentrations of Total Dissolved

Solids (TDS) in groundwater increase with depth, primarily in response to upward diffusion of deep-seated brines. Salinity can induce a freezing point depression, creating a cryopeg in permafrost where water can be unfrozen even though the temperature is below 0°C. At the Project site, the freezing point depression was calculated to be equivalent to -3.3°C (Golder 2012b). The portion of the permafrost, where groundwater may be partially or wholly unfrozen due to the freezing point depression, has been estimated to be at a depth of 350 m to 375 m (Golder 2012b).

## 2.5 General Subsurface Conditions

A number of site investigation programs were carried out at the Project site in 1998, 1999, 2007, 2009, 2011, 2012, 2013, 2014, 2015, 2016, and 2017.

In general, the near surface stratigraphy comprises a veneer of organic material, underlain by non-cohesive soils (i.e., silty sand and sandy silt) with cobbles and boulders. The overburden thickness ranges between 1.5 m and 17.8 m and is underlain by greywacke, medium to strong with some fracturing and frost jacking of the upper bedrock surface. A layer of ice-rich overburden (silt or sand) has been observed in some of the boreholes drilled. Overburden soils with excess ice (Vc, Vs, Vx, and Vr) were observed in most of the boreholes. Massive icy beds up to 1.25 m thick were also encountered. The estimated percentage (by volume) of the excess visible ice ranged from 2% to more than 50% in the overburden soils. Soil porewater salinity tests (EBA 2013) indicated that the overburden soils have a porewater salinity of 4 to 12 parts per thousand (ppt).

## 2.6 Seismic Zone

The Project site is situated in an area of low seismic risk. The peak ground acceleration (PGA) for the area was estimated from the 2015 National Building Code of Canada seismic hazard website (http://earthquakesscanada.nrcan.gc.ca). The estimated PGA is 0.022 g for a 5% in 50-year probability of exceedance (0.001 per annum or 1 in 1,000 year return) and 0.037 g for a 2% in 50-year probability of exceedance (0.000404 per annum or 1 in 2,475 year return) for the area.

## 2.7 Other Relevant Data

The raw land survey data, a 1-m contour digital map of the ground surface and 0.5 m contour lake bathymetric data for selected lakes at the Project site were provided to Tetra Tech by Agnico Eagle. New survey data for selected areas including the proposed CP6 and CP6 Berm areas were recently provided to Tetra Tech and were incorporated into the original digital map for the design of CP6 and CP6 Berm.

# 3.0 DESIGN BASIS

## 3.1 CP6 Operation Plan

The overall site wide water management plan was described in Meliadine Gold Project Water Management Plan (Agnico Eagle 2019a). Under the current water management plan, a water collection pond (CP6) is required before the spring freshet of 2020 to collect the surface runoff water from the proposed WRSF3 area. A summary of the CP6 operation plan is presented as follows:

- CP6 will be used to collect the runoff water from the WRSF3 catchment and serve as a temporary water storage pond. A water pumping system will be installed in CP6 to pump the CP6 water to CP1.
- During the annual spring freshet (conservatively assumed to be a duration of seven days), the first three days of spring freshet water can be stored in CP6 in order to prepare the pumping system. The water collected in CP6 will be actively pumped to CP1 from the fourth day of spring freshet and the water in CP6 will be completely pumped out within seven days.
- Minimal water will be stored in CP6 after the spring freshet water is pumped out, so that the runoff from an extreme rainfall event can be temporarily stored in CP6.
- CP6 should become nearly empty before the CP6 pumping station is shut down by the end of the water pumping season (around end of October) each year until closure of the mine.
- No water will be discharged from CP6 directly to the outside downstream receiving environment during operation.
- The design minimum operating water pumping rate for the CP6 pumping system is 11,000 $m^3$/day.

## 3.2 Lake Dewatering and Construction and Operation Schedules

The proposed CP6 is located within a previous natural lake H19, which was dewatered in the fall of 2019. Based on the information provided by Agnico Eagle, the following construction and operation schedules are assumed for the design of the pond and berm:

- Start construction on March 1, 2020;
- Complete construction by March 15, 2020;
- Start operation of CP6 in the spring freshet of 2020; and
- After the final closure of the mine, CP6 Berm will be breached and CP6 will no longer serve as a water collection pond after mine closure.

## 3.3 Precipitation, Surface Runoff, and Lake Surface Evaporation

Surface runoff parameters for a mean precipitation year and a 1/100 wet precipitation year are presented in Table 1 and Table 2, respectively. The values in Tables 1 and 2 were adopted from the feasibility study (Tetra Tech EBA 2014). Some of the parameters in these tables are used in estimating the volumes of the runoff/run-on water from natural precipitation into the pond.

**Table 1: Various Parameters for Surface Runoff Estimation for a Mean Precipitation Year**

| Item | Value |
|---|---|
| Total adjusted annual precipitation for a mean precipitation year | 412 mm |
| Total adjusted annual rainfall for a mean precipitation year | 210 mm |
| Total adjusted annual water equivalent snowfall for a mean precipitation year | 202 mm |
| Total estimated snow sublimation | 99 mm |
| Estimated snow melt water equivalent in spring freshet | 103 mm |
| 24-hour duration rainfall with a 1 in 2 years of return period | 33 mm |

## Table 1: Various Parameters for Surface Runoff Estimation for a Mean Precipitation Year

| Item | Value |
|---|---|
| Monthly rainfall distribution | 16% in June, 21.2% in July<br>30.8% in August, 24.5% in September<br>7.5% in October |
| Annual net runoff on natural on-land surface for a mean precipitation year | 215 mm (127 mm in June, 22 mm in July,<br>32 mm in August, 26 mm in September, and<br>8 mm in October) |
| Estimated monthly lake (non-saline water) surface evaporation | 60 mm in June, 125 mm in July<br>96 mm in August, 42 mm in September |
| Annual net runoff on lake surface for a mean precipitation year | -10 mm (76 mm in June, -80 mm in July,<br>-31 mm in August, 9 mm in September, and<br>16 mm in October) |
| Estimated monthly natural land surface evapotranspiration | 6 mm in June, 14 mm in July<br>11 mm in August, 5 mm in September |
| Annual net runoff on disturbed land surface for a mean precipitation year | 251 mm (133 mm in June, 36 mm in July,<br>43 mm in August, 31 mm in September, and<br>8 mm in October) |

## Table 2: Various Parameters for Surface Runoff Estimation for a 1 in 100 Extreme Wet Year and Extreme Rainfall

| Item | Value |
|---|---|
| Total adjusted annual precipitation for a 1 in 100 wet precipitation year | 594 mm |
| Total adjusted annual rainfall for a 1 in 100 wet precipitation year | 324 mm |
| Total adjusted annual water equivalent snowfall for a 1 in 100 wet precipitation year | 270 mm |
| Total estimated snow sublimation | 99 mm |
| Estimated snow melt water equivalent in spring freshet for a 1 in 100 wet precipitation year | 171 mm [(a)] |
| Monthly rainfall distribution | 16% in June, 21.2% in July<br>30.8% in August, 24.5% in September<br>7.5% in October |
| Annual net runoff on natural on-land surface for a 1 in 100 wet precipitation year | 430 mm (213 mm in June, 55 mm in July, 80 mm in August,<br>63 mm in September, and 19 mm in October) |
| Estimated monthly lake surface (non-saline water) evaporation | 60 mm in June, 125 mm in July 96 mm in August,<br>42 mm in September |
| Annual net runoff on lake surface for a 1 in 100 wet precipitation year | 172 mm (163 mm in June, -56 mm in July, 4 mm in August,<br>37 mm in September, and 24 mm in October) |
| Estimated monthly natural land surface evapotranspiration | 6 mm in June, 14 mm in July, 11 mm in August,<br>5 mm in September |
| Annual net runoff on disturbed land surface for a 1 in 100 wet precipitation year | 466 mm (219 mm in June, 69 mm in July, 91 mm in August,<br>68 mm in September, and 19 mm in October) |
| 24-hour duration extreme rainfall with a 1 in 100 years of return period | 65 mm |
| 24-hour duration extreme rainfall with a 1 in 1,000 years of return period | 77 mm |

### Table 2: Various Parameters for Surface Runoff Estimation for a 1 in 100 Extreme Wet Year and Extreme Rainfall

| Item | Value |
|---|---|
| 24-hour duration PMP (probable maximum precipitation) | 259 mm |
| Runoff coefficient for extreme rainfall | 1.0 |

Note: [(a)]Used for CP6 design.

## 3.4 Geotechnical Conditions in CP6 and CP6 Berm Areas

A total of 13 boreholes were drilled within the proposed CP6 and CP6 Berm areas during the 2016 and 2019 geotechnical site investigation programs (Tetra Tech EBA 2016 and Agnico Eagle 2019b). The locations of drilled boreholes are presented on Figure 3.

The four boreholes (BH16-04 to BH16-07) were drilled using an SH-48 diamond drill rig with a triple tube coring system in later March 2016. All overburden and bedrock cores were recovered using an HQ core barrel (61.1 mm inner diameter) and conventional diamond drilling techniques. The nine boreholes (GT19-01 to GT19-07, TH-CP6-01, and TH-CP6-02) were drilled using exploratory percussion drilling techniques in November 2019, which provided depths to the bedrock surface at the borehole locations. Table 3 summarizes the ground conditions in the boreholes in the CP6 and CP6 Berm areas. Borehole logs for BH16-04 to BH16-07 are attached in Appendix A.

Eight single-bead GTCs (four in each of GT19-02 and GT19-03) were installed during the 2019 site investigation program. The readings from the installed GTCs indicated that the ground temperatures at depths (i.e., 13.6 m to 15.2 m below the original ground) were -3.2°C in GT19-03 and -4.9°C in GT19-02 on January 1, 2020 (Agnico Eagle 2020).

### Table 3: Geotechnical Ground Condition around CP6 and CP6 Berm

| Borehole No. | Organic Layer Thickness (m) | Major Overburden Soil Types | Ice Conditions | Depth to Bedrock (m) | Bedrock Conditions |
|---|---|---|---|---|---|
| BH16-04 | 0.24 | Cobbles and Boulders; Gravelly Sand; Sand and Gravel; Silty Sand | Up to 10% Vx, Vs,Vc | 8.5 | Fresh; Competent rock |
| BH16-05 | 1.07 | Sand and Gravel; Sand; Gravel and Sand; Boulders | Up to 50% Vx, Vs; 0.10 m Ice | 4.9 | Fresh to slightly weathered; Competent rock |
| BH16-06 | 0.06 | Sand and Gravel; Sand; Sand and Silt | Up to 15% Vx, Vs | 2.9 | Slightly to moderately weathered; Competent rock |
| BH16-07 | 0.06 | Sand and Silt; Ice and Sand; Gravel and Sand | Up to 20% Vx, Vs; 0.10 m Ice and Sand | 6.4 | Fresh; Competent rock |
| GT19-01 | | | | 1.7 | |
| GT19-02 | | | | 6.7 | |
| GT19-03 | | | | 2.9 | |

**Table 3: Geotechnical Ground Condition around CP6 and CP6 Berm**

| Borehole No. | Organic Layer Thickness (m) | Major Overburden Soil Types | Ice Conditions | Depth to Bedrock (m) | Bedrock Conditions |
|---|---|---|---|---|---|
| GT19-04 | | | | 5.6 | |
| GT19-05 | | | | 2.4 | |
| GT19-06 | | | | 2.9 | |
| GT19-07 | | | | 6.1 | |
| TH-CP6-01 | | | | 4.9 | |
| TH-CP6-02 | | | | 4.4 | |

## 3.5 Geochemical Characteristics of Overburden and Rock

A baseline geochemical characterization program for the project was initiated in 2008 and consisted of static and kinetic testing methods to assess the chemical composition of the mine waste and overburden, its potential to generate acid rock drainage and its potential for metal leaching (ML) upon exposure to ambient conditions.

Golder (2012c) documented the waste geochemical characterization programs carried out from 1998 to 2011 for the project. The key findings included the following:

- The waste rock from the Tiriganiaq deposit area is considered to be non-potentially acid generating (NPAG) and has a low potential for ML. Kinetic tests at various scales indicate that drainage water quality will meet Metal Mining Effluent Regulations (MMER) monthly mean effluent limits.
- The overburden at the site will be NPAG, and that leachate concentrations are generally lower than waste rock and will meet MMER monthly mean effluent limits. Waste rock and overburden have compatible geochemical characteristics such that these materials can be managed together in the same disposal facilities.

Therefore, the waste rock from the mine development, fill materials sourced from the rock, and overburden materials are considered to be NPAG and have low potential of ML.

# 4.0 DESIGN OF CP6 AND CP6 BERM

## 4.1 Design Objectives and Considerations

The CP6 and CP6 Berm design criteria were adopted to meet the following overall objectives:

- Comply with the Canadian Dam Safety Guidelines (CDA 2007 with 2013 revision), if applicable;
- Canadian Foundation Engineering Manual, 4th Edition (CGS 2006);
- Minimize seepage through the berm while optimizing the construction efficiency;
- Maximize the use of available construction materials from the pond excavation;

- Utilize permafrost as an effective seepage barrier;
- Facilitate an effective/safe construction plan and an effective closure plan; and
- Other applicable regulation (i.e., Water Licence- No. 2AM-MEL1631), codes, guidelines, and standards.

Besides the overall objectives stated above, the following specific design objectives are also considered for the pond and berm design:

- The maximum operating water elevation in CP6 under Inflow Design Flood (IDF) is set to be at least 2.0 m lower than the lowest natural outlet elevation of CP6 (the lowest original ground surface elevation along the perimeter of CP6) to reduce the potential seepage from CP6 into the surrounding ground.
- The berm is designed to aggrade or preserve permafrost in the original ground below the center of the berm to a top permafrost elevation of at least 2.0 m higher than the maximum operating water elevation in CP6 under IDF. The permafrost will reduce the potential seepage through the berm foundation into the downstream receiving environment (i.e., Lake H2).

## 4.2 Berm Classification and Consequence of Failure

CDA (2007) presents recommendations on the consequence of failure for water retaining structures. The consequences of failure are evaluated in terms of loss of life, environmental and cultural values, and infrastructure and economics. Five consequence categories are used in CDA (2007), including Low, Significant, High, Very High, and Extreme.

CP6 Berm is designed to be a thermal protection berm with no water ponding against both the berm upstream and downstream slopes. Therefore, strictly speaking, CP6 Berm cannot be classified as a “dam” based on the definition in CDA (2007). Nevertheless, as a general design guideline, CP6 Berm is considered to have a “Low” consequence of failure based on CDA (2007). The considerations for this classification are described below:

- No or low risk of loss of life;
- Failure of the berm may result in the water in CP6 flowing into the receiving environment, under a remote case when the water elevation in CP6 is higher than the ground upstream of the berm, which will have minimal environmental and cultural impacts; and
- The failure of the berm will have low economic losses.

## 4.3 Inflow Design Flood and Earthquake Levels

The IDF for a given classification is suggested in CDA (2007). For a structure classified as “Low”, the suggested annual exceedance probability (AEP) is 1/100 for the IDF. Critical flood for a given water retention structure can result from extreme rainfall events at various durations, melting of extreme snowpack during spring freshet period, or even extreme annual precipitation condition. Extreme wet year spring freshet from snow melting or high intensity short-term rainfall event are most critical to the design of CP6 (and associated CP6 Berm) with a pumping system. The resulting water level rise in the pond for the short-term events is greater than the water level rise under a longer precipitation event. The long-term event allows time for the excess water in CP6 to be pumped out by a pumping system to CP1.

For the design of CP6 and CP6 Berm, it has been assumed that no water would be pumped out from the CP6 pond during the first three days of the assumed seven-day spring freshet or during an extreme rainfall event. The IDF adopted for CP6 and CP6 Berm meets the most critical of the following cases:

- 3/7 of the equivalent unit runoff during spring freshet for a 1 in 100 return wet year; or
- One 1 in 100 return 24-hour extreme rainfall event.

Table 4 summarizes the IDF value for CP6 and CP6 Berm and an adopted design IDF value of the equivalent unit runoff of 73 mm.

**Table 4: Value for IDF Adopted for CP6 and CP6 Berm Design**

| Structure | Cases of IDF Considered | Value for IDF (mm) |
|---|---|---|
| CP6 and CP6 Berm | 3/7 of equivalent unit runoff during spring freshet for 1 in 100 return wet year | **73** |
| | Equivalent unit area runoff for one 1 in 100 return 24-hour extreme rainfall | 65 |

For a structure with a “Low” classification, CDA (2007) suggests that AEP of 1/500 be adopted for the design earthquake. since the site is located in a low seismic zone and the seismic loading is not a controlling factor, a conservative AEP value of 1/2,475 was adopted for seismic loading in stability evaluations. The estimated PGA is 0.037 g for a 1 in 2,475 year return for the site area.

## 4.4 Design Criteria for Berm Freeboard and Crest Elevation

CDA (2007) states that the top elevation of the water containment element (e.g., the till core in the berm) should be higher than the water level during the IDF plus wind set-up plus settlement due to consolidation of foundation and embankment materials after construction. CDA (2007) also suggests that the top elevation of the berm crest should be higher than the maximum pond operating water level during the IDF plus wind set-up plus wave run-up plus settlement due to consolidation of foundation and embankment materials after berm construction. In this study, the freeboards and crest elevations for CP6 and CP6 Berm exceed the requirements as suggested in CDA (2007).

The design of CP6 and CP6 Berm has considered the specific design objectives as presented in Section 4.1.

## 4.5 Design Concept, Typical Section, and Parameters

The design of CP6 and CP6 Berm uses the nearly or fully ice-saturated permafrost zone below the natural ground around CP6 and CP6 Berm as seepage control measures.

The catchment area for CP6 is approximately 447,885 $m^2$. For an IDF of 73 mm, the required pond storage capacity for CP6 is 32,696 $m^3$.

The design drawings for construction of CP6 and CP6 Berm are presented in Appendix B.

The key design parameters for CP6 and CP6 Berm are summarized as below:

- The pond bottom elevation: 54 m;
- The pond excavation depth from the original ground: approximately 7.0 m to 12 m;

- The maximum berm height above the original ground during construction: approximately 6.0 m;
- The total berm length: 360 m;
- The design top elevation of the till core in the berm for construction: 67.0 m;
- The design minimum top elevation of the till core after post-construction thaw-consolidation: 66.0 m;
- The design crest elevation of the berm for construction: 68.0 m;
- The design minimum crest elevation of the berm after post-construction thaw-consolidation: 67.0 m; and
- The design maximum water elevation in CP6 under the IDF: 60.0 m.

A ramp with a safety berm on the outside is incorporated in the pond design to serve as a temporary haul road for the pond excavation during construction and as a service road during operation. In accordance with the Mine Safety Act, a safety berm is proposed to be constructed on the pond side of the ramp to minimize the risk of people or vehicles accidently falling into the pond. Both the ramp and safety berm are designed for an assumed rock truck type of Volvo A40F or CAT 745 or equivalent. Both Volvo A40F and CAT 745 haul trucks were previously used in construction of similar ponds (CP3 and CP4) at the site. The single-lane ramp has a minimum road width of 7.0 m and a typical longitudinal slope of approximately 10%. The design height of the safety berm is 1.5 m.

Nonwoven geotextile will be placed over the downstream slope of the till core of CP6 to reduce the risk of loss of fines from the overburden till into the downstream rockfill shell. Nonwoven geotextile could also be placed between the rockfill cover (rip rap) and the excavated overburden slope around the pond to reduce the risk of loss of fines from the overburden into the rockfill. The potential consequence of loss of fines from the overburden soils migrating into the rockfill would include fines sedimentation in the pond, high suspended solids in the water, deformation of the rockfill cover, and sink holes on the crest and slopes of the rockfill cover. This can be mitigated through regular maintenance when required. It is expected that this potential consequence will not pose an unacceptable slope stability risk to either the pond slopes or the berm. Agnico Eagle indicated that they will accept any potential issues of sedimentation and/or maintenance should any fines from the overburden soils migrate into the rockfill during the pond operation.

## 4.6 Water Storage Curve for CP6

The pond stage-storage capacity and water surface area with elevations for CP6 are summarized in Table 5.

**Table 5: Stage-Storage Capacity and Pond Surface Area with Elevations for CP6**

| Pond Elevation (m) | Pond Storage Volume ($m^3$) | Pond Surface Area ($m^2$) |
|---|---|---|
| 54.0 | 0 | 3,826 |
| 55.0 | 4,000 | 4,174 |
| 56.0 | 8,350 | 4,528 |
| 57.0 | 13,067 | 4,910 |
| 58.0 | 18,338 | 5,899 |
| 59.0 | 24,846 | 7,177 |
| 60.0 | 32,757 | 8,602 |
| 61.0 | 42,138 | 10,031 |

## 4.7 Thermal Analysis

Permafrost is expected to exist beneath the footprint of CP6 and CP6 Berm. Thermal analyses were conducted to facilitate the design of the pond and berm. The thermal analysis has simulated the pond and berm construction and operation conditions and considered the effects of water ponding and various climatic conditions including potential extreme warm years and long-term climate change (global warming) on the thermal performance of the berm. Based on the thermal analysis findings, the design intent to promote the permafrost development in the original ground below the center of the berm and maintain the permafrost during the pond operation can be achieved.

Based on the thermal analysis results, the following findings can be made:

- Water in the pond will thaw the ground close to the pond;
- The overburden and bedrock below the center of the berm will remain in a frozen condition under various air temperature conditions;
- The predicted maximum thaw depth below the crest of the berm is 2.5 m under the worst climate condition (a 1 in 100 return event warm year condition). The thawing front stays in the till zone and does not penetrate into the original ground surface for the typical section simulated in the analysis; and
- The predicted permafrost ground temperature at 2.0 m below the original ground surface at the center of the berm ranges from -1.5°C to -2.0°C under the worst climate conditions adopted in the thermal analysis.

## 4.8 Stability Analysis

A series of limit equilibrium slope stability analyses were carried out using the two-dimensional analysis software, Slope/W of GeoStudio 2016 (Geo-Slope International Ltd., Version 8.16.1.13452) to evaluate the stability of the typical design section of CP6 and CP6 Berm.

The stability was evaluated under the long-term static and seismic loading conditions (after construction). The analysis results indicate that the calculated minimum factors of safety for the pond and berm meet or exceed the adopted minimum factors of safety, as suggested by CDA (2007) and CGS (2006).

The rock slope stability assessment was not conducted during the design. The rock slope was conservatively designed to be 1H:1V. The actual rock slope will vary (1H:1V or steeper to 1H:10V) depending on the rock quality encountered during construction. It is recommended that the rock conditions and its stability be assessed during the rock excavation by a qualified geotechnical engineer to determine the final rock slope geometry. If required, the rock slope should be flattened to reduce the potential risk of local failure or rock falls.

## 4.9 Seepage Evaluation

Based on the proposed construction schedule, the construction of CP6 and CP6 Berm will take place in March 2020. At that time any initially unfrozen original ground is expected to become frozen during the construction of the pond and berm. Therefore, the volume of the seepage water into the pond during the construction period is expected to be none or insignificant.

During mine operation, the maximum operating water level under the IDF in CP6 was designed to be at 60.0 m, which is at least 2.0 m to 5.0 m below the original ground elevations around the perimeter of the pond. The typical active layer in the area away from the CP6 pond area is expected to be approximately 1.5 m to 2.0 m thick. Moreover, CP6 Berm will be constructed in the area where the original ground surface elevation is lower and serve

as a thermal protection berm to preserve the permafrost underneath the berm. Thermal analyses have indicated that the overburden and bedrock below the center of the berm will remain in a frozen condition during mine operation and interim closure. Therefore, seepage from CP6 to downstream environment through the frozen berm foundation and natural permafrost surrounding the pond is expected to be none or minimal.

## 4.10 Deformation Evaluation

The overburden material excavated from the construction of CP6 will be used for the construction of the till core of CP6 Berm. The overburden material is expected to be in a frozen condition. Based on the previous experience on the material placed and compacted in winter season, some thaw-induced ground deformation will occur for CP6 Berm in the following summers. Depending on the height of the berm and the efforts and efficiency of compaction, the final settlement of the berm crest may be in the order of 0.2 m to 1.0 m. It should be noted that potential deformation after the construction has been considered in the thermal analysis and crest elevation determination.

It is expected that some thaw-induced ground deformation may occur in the pond perimeter area close to the excavated overburden zone. The deformation is acceptable. If required, additional fill can be placed to offset any ground settlement.

# 5.0 CONSTRUCTION OF CP6 AND CP6 BERM

## 5.1 Construction Materials and Specifications

Three types of construction materials will be used in the construction of CP6 and CP6 Berm, including clean rockfill from pond excavation, excavated overburden till fill, and nonwoven geotextile. The detailed material specifications and placement specifications for construction are provided in the Geotechnical Specifications for Construction of CP6 and CP6 Berm as attached in Appendix C. A summary of each material is presented as follows:

### Clean Rockfill (600 mm Minus)

The clean rockfill material will be sourced from the pond excavation or mine development. The clean rockfill will be free from snow, ice, frozen chunks, organic matters, and debris and can have a wide variation of gradation with a maximum particle site of 600 mm. The clean rockfill will be NPAG.

### Overburden Till Fill (300 mm Minus)

The excavated overburden material from pond excavation will be used for the berm core construction to serve as a thermal protection layer over the original ground. Any snow, ice, loose organic matters, and boulders shall be removed prior to the fill placement for berm construction. The material can have a wide variation in gradation with a maximum particle size of 300 mm. The excavated overburden material used for construction of the berm should have a fines (<0.075 mm in size) content of 10% to 60% by weight to have a relatively low hydraulic conductivity. The till fill should be placed in lifts no greater than 0.5 m thick and shall be subjected to at least six full passes with a smooth drum vibratory compactor weighing not less than 10 tonnes or other method approved by the Engineer, where a full pass is defined as one forward pass followed by a backward pass.

### Geotextile

Table 6 presents the geotextile specifications of the nonwoven, needle-punched geotextile to be used for construction. Alternatives can be used with approval of the Design Engineer.

### Table 6: Geotextile Specifications for Construction

| Parameter | Required Minimum Value |
|---|---|
| Nominal Thickness of Geotextile (ASTM D5199) (mm) | 1.7 |
| Typical Unit Weight (ASTM D5261) (g/m$^2$) | 200 |
| Puncture Resistance (ASTM D4833) (N) | 380 |

## 5.2 Estimated Quantities of Construction Material

Table 7 presents the estimated in-place quantities of the construction materials for CP6 and CP6 Berm.

### Table 7: Material Quantities for Construction of CP6 and CP6 Berm

| Item | Estimated In-Place Quantity |
|---|---|
| Clean Rockfill from Excavation and Other Sources (600 mm Minus) (m$^3$) | 32,265 |
| Overburden Till Fill from Pond Excavation (300 mm Minus) (m$^3$) | 58,640 |
| Nonwoven Geotextile for CP6 Berm (m$^2$) | 5,325 |
| Total CP6 Pond Excavation Volume (m$^3$) | 71,885 |
| Estimated Overburden Excavation Volume (no bulking factor) (m$^3$) | 50,935 |
| Estimated Rock Excavation Volume (no bulking factor) (m$^3$) | 20,950 |

Note: The actual material quantities for construction and excavation may vary depending on actual overburden thickness in the CP6 area, and actual excavation slope and depth et. al.

## 5.3 Key Construction Activities

The key site activities related to the construction of CP6 and CP6 Berm are summarized as follows:

- Layout and survey for the earthworks;
- Foundation preparation for the berm – where snow/ice, loose organics, and loose material (including boulders) will be removed prior to placement of the fill material;
- Drilling and blasting overburden and bedrock material for CP6 excavation;
- Placement and compaction of the excavated overburden material for berm construction;
- Installation of the nonwoven geotextile on the downstream face of the compacted till zone for the berm;
- Placement of the clean rockfill from the pond excavation to cap the till zone;
- Placement of the clean rockfill on the excavated overburden slope as designed;
- Placement of the clean rockfill on the CP6 Berm upstream side between the berm and the pond as erosion and thermal protection layer; and
- Ground temperature cable installation in CP6 Berm.

## 5.4 Water Management during Construction and Erosion Control

Seepage water from overburden soils into the excavated area during the construction is expected to be none or insignificant. During construction, any seepage water encountered will be collected in a designated sump at the bottom of the excavation, the collected water will be pumped to CP1.

As described in Section 3.2, the construction of CP6 and CP6 Berm will take place in winter season, therefore surface erosion during construction is not expected. In the event of any erosion occurring during construction, sediment control measures (such as silt fence, settling pond, and diversion ditch) will be employed. In order to reduce the erosion during operation, a layer of rockfill will be placed on both of the side slopes and over the top of the till core of the berm to prevent surface erosion of the till material. Nonwoven geotextile will be placed along the downstream slope of the till core of the berm. Similarly, a layer of rockfill will also be placed over the excavated overburden slopes around the perimeter of CP6 to prevent surface erosion and increase the long-term slope stability.

The following key mitigation measures will be employed to ensure the works will have a minimum effect on the water quality either within the project footprint, downstream, or upstream of the construction include:

- Implementing best practice construction methodologies at all times;
- Operators of heavy equipment will be well-trained to avoid any adverse effects;
- Avoidance of work within waterbodies as far as practicable except for the waterbody (drained Lake H19) impacted by CP6 construction;
- Avoidance of any activities that affect lake beds and bank structures as far as practicable;
- Cleaning of all machinery and equipment before entering waterways;
- Ensuring that hazardous substances such as petroleum products are managed in accordance with the Hazardous Material Management Plan (Version 4) (Agnico Eagle 2015b) to prevent these substances entering waterways; and
- Environmental inspections for the work site will be completed to ensure any potential impacts are mitigated as reasonably possible.

## 5.5 Quality Assurance and Quality Control (QA/QC)

A quality assurance/quality control (QA/QC) program is required during construction of the pond and berm to ensure that construction-sensitive features of the design are achieved. The specific requirements and testing frequencies for the quality assurance process have been set out in the Construction Specifications attached in Appendix C of this report.

It is recommended that the rock conditions and its stability be assessed during CP6 excavation by a qualified geotechnical engineer to determine the final rock slope geometry. If required, the rock slope should be flattened to reduce the potential risk of local failure or rock falls.

Soil testing for the construction QA/QC program and associated documentation will be carried out by either the Engineer or a separate contractor hired by the Owner. The Contractor for construction of the pond and berm may have their own quality control team, if required.

## 5.6 Survey Requirements

An as-built survey and documentation is required to verify quantities and produce as-built drawings for the pond and berm.

The Surveyor should carry out the following tasks, but not be limited to:

- During and after construction, the following tasks should be performed:
  - Survey the as-built conditions of excavations and fills including different material boundaries as required;
  - Survey of any measurement for payment items;
  - Provide quantities of each of excavation and fill materials on critical stages or as required;
  - Provide the Engineer an AutoCAD drawing showing 3D lines and surfaces of each of the excavations and fill materials at critical stages or as required; and
  - Provide the as-built AutoCAD drawing showing 3D lines and surfaces of each of the excavations and fill materials after the completion of each structure.

# 6.0 MONITORING AND INSPECTION

Performance monitoring is an integral part of the operation of any water retention structure, particularly in an arctic environment. Geotechnical instrumentation is required to monitor the behavior of the pond and berm and their foundations during construction and operation. It is intended to provide the following information:

- Confirmation that the performance of the pond and berm and foundations are consistent with the predictions made during the design, notably in terms of stability, deformation, seepage, and thermal analyses and assessment.
- Early warning of the development of potentially adverse trends such as seepage, deformation, and permafrost degradation.

The instrumentation plan therefore includes three GTCs for the berm constructed at the downstream side of the pond, installed to a minimum depth of 15 m along the centreline to verify that the foundations are frozen. The details on GTCs information is presented in Drawing 65-695-230-012. Thermistor readings will be measured once a month during the first two years, and then on a quarterly basis during operation, with the measured readings analyzed and reported in the annual inspection report.

Visual inspection and monitoring can provide early warning of many conditions that can contribute to structure failures and incidents. Monitoring and inspection during construction and operation may include, but not be limited to, settlement/movement monitoring, seepage monitoring, pond water level and water quality monitoring if required. Agnico Eagle should regularly undertake a visual inspection of the pond and berm, especially during spring and summer periods. Agnico Eagle should note any water seepage through the berm, unusual settlement/deformation, cracks and should contact Tetra Tech. Any monitoring data should be sent to Tetra Tech for review and evaluation.

An annual inspection, in accordance with Part I, items 14 and 15 of Water Licence - 2AM-MEL1631 will be conducted by a qualified Geotechnical Engineer to document the performance of each structure. These visits should take place between the months of July and September of each year. The inspection shall be conducted in accordance with the Canadian Dam Safety Guideline. The specific tasks conducted during these visits should

include: inspection of the upstream and downstream slopes for any sign of distress, inspection of the structure crest for any sign of transverse cracking, and inspection of the abutments and downstream toe for any evidence of seepage. The reports will be submitted to the Nunavut Water Board as per the water license requirements.

# 7.0 REPORTING

During the construction of the pond and berm, a daily field report will be prepared to outline the construction activities inside and outside of the work area. The daily report should be prepared by the on-site construction QA/QC team. The daily report will include, but not be limited to, the following:

- Up to date information of daily construction activities including a list of equipment on-site and weather conditions;
- A summary of visual inspections and observations from inside and outside the work area;
- Records of any construction deficiency and appropriate actions taken, if any;
- Records of QA/QC results and monitoring data; and
- Report on construction and design changes made during construction.

Upon the completion of the construction activities, an as-built construction report will be prepared and submitted to the Nunavut Water Board within 90 days after construction is completed. The Construction summary report should meet the requirement of Water Licence Schedule D and provide all relevant supporting documentation compiled during implementation of the QA/QC plan. The construction report will include, but not be limited to the following:

- Construction drawings based on the as-built survey information of the surface of all material placed;
- Actual construction quantities;
- All testing records, a summary of all test sample locations, collection methods, and test results;
- Summary of the construction issues and resolution applied;
- Report on construction and design changes made during construction; and
- Installation details of any required instrumentation or monitoring devices, if any.

## 8.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

REGISTERED PROFESSIONAL ENGINEER
G. ZHANG
LICENSEE
N.W.T.
Jan 24, 2020



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Jan 24, 2020



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**PERMIT TO PRACTICE**
**TETRA TECH CANADA INC.**
Signature _____
Date Jan 24, 2020
**PERMIT NUMBER: P 018**
NT/NU Association of Professional Engineers and Geoscientists

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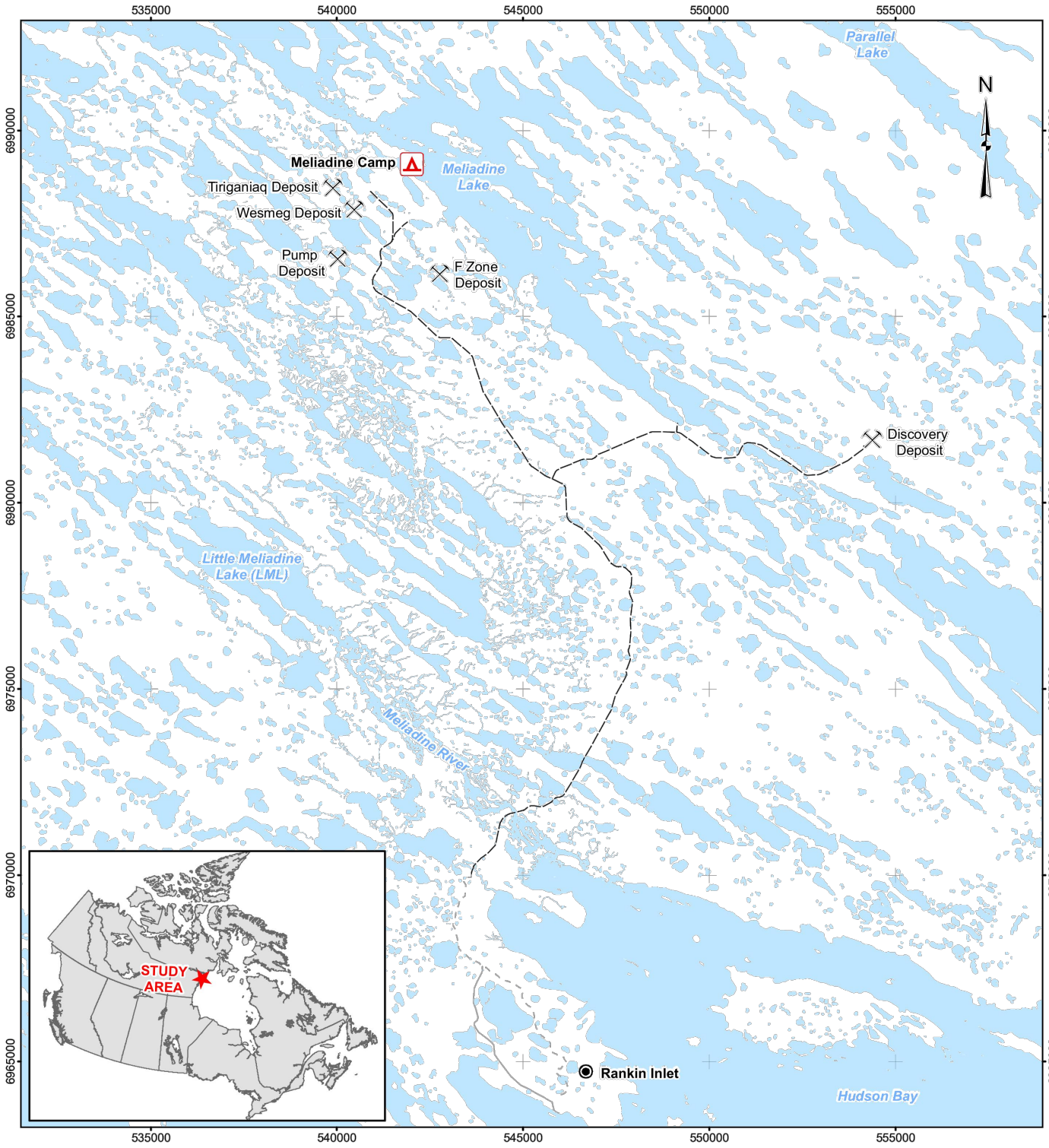
# FIGURES

Figure 1 General Project Location Plan

Figure 2 Location Plan for CP6 and CP6 Berm as Shown in General Site Layout Plan for Proposed Infrastructure during Mine Operation (Year 7)

Figure 3 Proposed CP6 and CP6 Berm and Borehole Locations




LEGEND

- Camp
- Proposed Mine Site
- All-weather Access Road (AWAR)
- Road - New
- Road - Existing
- Watercourse
- Waterbody

AGNICO EAGLE – MELIADINE DIVISION

AGNICO EAGLE

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AGNICO EAGLE – MELIADINE DIVISION

FIGURE 1 GENERAL PROJECT LOCATION PLAN

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TEMPORARY OVERBURDEN STOCKPILE
CHANNEL2
INDUSTRIAL SITE PAD
FRESH WATER INTAKE CAUSEWAY
LANDFARM
WTP INTAKE CAUSEWAY
WATER TREATMENT PLANT
ORE STOCKPILE PAD
MELIADINE LAKE
BERM2
TAILINGS STORAGE FACILITY (TSF)
CP1
CHANNEL1
CULVERT1
CP3
CP3 BERM
ORE STOCKPILE PAD
CULVERT2
CULVERT3
LANDFILL
CULVERT4
CHANNEL3
CHANNEL7
CHANNEL8
BERM1
WASTE ROCK & OVERBURDEN STORAGE FACILITY 2 (WRSF2)
PROPOSED CP6 BERM
EXPLORATION CAMP
EFFLUENT DIFFUSER
CHANNEL4
WASTE ROCK & OVERBURDEN STORAGE FACILITY 1 (WRSF1)
CULVERT5
PROPOSED CP6
SALINE WATER STORAGE POND
CP4 BERM
CP4
CHANNEL6
CP5 NORTH
CP5 JETTY
WASTE ROCK & OVERBURDEN STORAGE FACILITY 3 (WRSF3)
CP5 SOUTH
CULVERT6
D-CP5
CHANNEL5
TIRIGANIAQ PIT 2 (TIRI_1000_02)
BERM3
TIRIGANIAQ PIT 1 (TIRI_1000_01)
0 500 m
Scale: 1: 15 000

LEGEND
- CATCHMENT BOUNDARY
- SERVICE ROAD
- HAUL ROAD
- WATERBODY
- WATER COLLECTION POND
- DRAINED POND AREA
- OPEN PIT
- OVERBURDEN
- WASTE ROCK
- ORE
- TAILINGS
- INDUSTRIAL SITE PAD
- CONTACT WATER FLOW DIRECTION

AGNICO EAGLE
TETRA TECH



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AGNICO EAGLE – MELIADINE GOLD PROJECT
FIGURE 2 LOCATION PLAN FOR CP6 AND CP6 BERM AS SHOWN ON GENERAL SITE LAYOUT PLAN FOR PROPOSED INFRASTRUCTURE DURING MINE OPERATION (YEAR 7)

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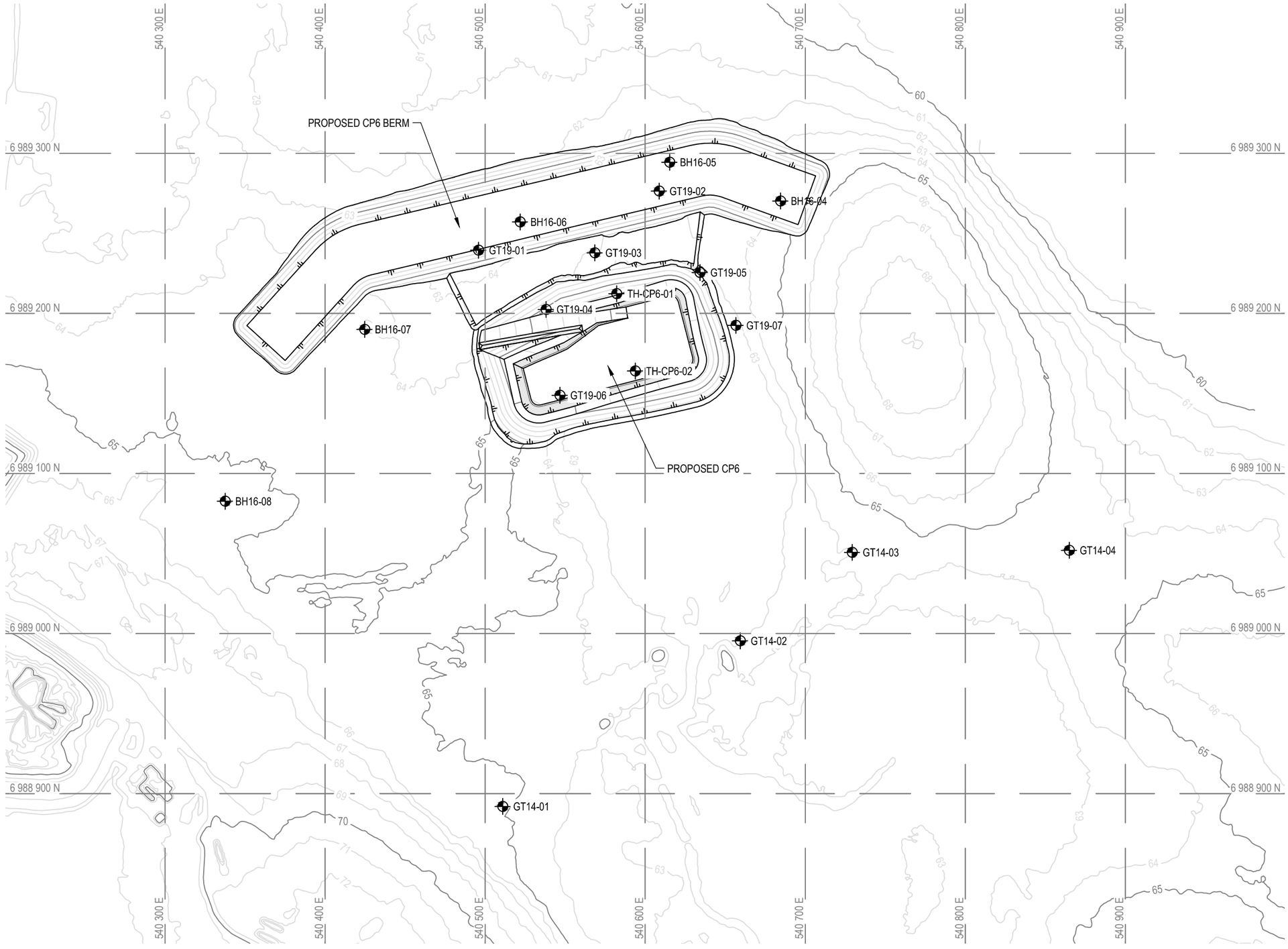


**LEGEND:**

BOREHOLE

AGNICO EAGLE

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| DATE | 01–22–2020 | |

TITRE / TITLE

AGNICO EAGLE MELIADINE GOLD PROJECT

PROPOSED CP6 AND CP6 BERM
AND BOREHOLE LOCATIONS

| | | | |
|---|---|---|---|
| ÉCHELLE/ SCALE | 1:2500 | FICHIER FILE | .DWG |
| No. DESSIN/ DRAWING NO. | | REVISION 0 | FEUILLE/SHT 1 / 1 |

AE–CART–ANSI B

Q:\Edmonton\Engineering\E141\Projects_MELIADINE\ENG.EARC03140–06 (CP6)\Figure for Design Report\Figure 3 IFU.dwg–2013–02–19 14:03:29

# APPENDIX A

## BOREHOLE LOGS FOR BH16-04 TO BH16-07

# Agnico Eagle Mines

# Borehole No: **BH16-04**

| | |
|---|---|
| Project: Winter 2016 Geotechnical Site Investigation | Project No: ENG.EARC03020-01 |
| Location: Meliadine Project, Nunavut | Ground Elev: 64.5 m |
| | UTM: 540684.6 E; 6989270.2 N; Z 15 |

| Depth (m) | Method | Lithological Description | Ground Ice Description | Sample Type | Sample/Run Number | Moisture Content (%) | Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80) | Fracture Frequency (2 4 6 8) / RQD (%) (40 60 80 100) / Recovery (%) (40 60 80 100) | Elevation (m) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Diamond Core Drilling | PEAT - fine fibrous, light brown grey to black, interbedded with silt and fine sand, (240 mm thick) | - Vs, Vx 5-10%, clear subhorizontal ice lenses | | | | | | 64 |
| | | COBBLES AND BOULDERS - matrix consisting of sand, some gravel, trace to some silt , well graded, light brown, subrounded gravel | | | R1 | | | | |
| 1 | | - at 0.24 m, 360 mm thick greywacke boulder - foliated, dark grey, fine grained | - at 0.62 m, Vx, Vs 5-10% | | | | | | |
| | | - at 0.62 m, dark brown to black, subvertical contact intrusion | - at 0.88 m, Vs 10%, 1 mm thick clear ice lenses randomly spaced in subvertical orientation | | 1S | 14.9 | | | |
| | | - at 0.65 m, 230 mm thick greywacke cobble - foliated, dark grey, fine grained | | | 2S | 42.8 | | | 63 |
| 2 | | - at 1.00 m, 160 mm thick greywacke cobble - foliated, dark grey, fine grained | - at 1.16 m, Vx, Vc 5-10%, clear ice | | R2 | | | | |
| | | - at 1.16 m, gravelly, some silt, brown, subangular | - at 1.68 m, Vs, Vx 10% in sand layers, clear ice | | | | | | |
| | | - at 1.37 m, 210 mm thick greywacke cobble - foliated, dark grey, fine grained | | | | | | | 62 |
| 3 | | - at 1.75 m, 150 mm thick greywacke cobble - foliated, dark grey, fine grained | | | 3S | 6.7 | | | |
| | | | | | R3 | | | | |
| | | SAND - gravelly, some silt, cobbles and boulders disseminated throughout, grey, subangular | - at 3.63 m, Nbe | | | | | | 61 |
| 4 | | - at 2.40 m, 100 mm thick granite cobble | | | | | | | |
| | | - at 2.58 m, 170 mm thick greywacke cobble - foliated, dark grey, fine grained | | | 4S | 6 | | | |
| | | SAND AND GRAVEL - silty, cobbles and boulders disseminated throughout, well graded, brown, subangular | | | R4 | | | | 60 |
| 5 | | - at 2.75 m, (Gravel - 37.2%; Sand - 37.6%; Fines - 25.2%) | - at 4.92 m, Nbe | | 5S | 10.9 | | | |
| | | - at 3.31 m, 320 mm thick granite boulder - very strong, dark grey, black and grey, fine to medium grained | | | | | | | 59 |
| 6 | | - at 4.00 m, some silt | | | 6S | 12 | | | |
| | | - at 4.00 m, (Gravel - 40.4%; Sand - 41.6%; Fines - 18.0%) | | | R5 | | | | 58 |
| | | SAND - silty, some gravel, cobbles and boulders disseminated throughout, light brown, subrounded gravel, coarse sand | | | | | | | |
| 7 | | - at 5.45 m, 330 mm thick greywacke boulder | | | | | | | |
| | | - at 5.61 m, 10 mm thick silt layer | | | 7S | 11.6 | | | 57 |
| | | - at 6.80 m, 480 mm thick greywacke boulder - foliated, dark grey, fine grained | | | R6 | | | | |
| 8 | | - at 7.28 m, well graded, brown, subangular | | | | | | | |
| | | - at 8.23 m, 270 mm thick greywacke cobble - foliated, dark grey, fine grained | | | | | | | 56 |
| | | - at 8.30 m, 20 mm thick sand layer | | | | | | | |
| 9 | | GREYWACKE (BEDROCK) - fresh (W1), foliated, very strong, dark grey to greenish black, quartz veins, fine grained, JSN: 1 | | | R7 | | | | |
| | | - at 9.30 and 9.55 m, subvertical joints - undulating, smooth, slightly weathered (W2) face | | | | | | | 55 |
| 10 | | END OF BOREHOLE (10.0 metres) | | | | | | | |
| | | | | | | | | | 54 |
| 11 | | | | | | | | | |

TETRA TECH EBA

| | |
|---|---|
| Contractor: Orbit Garant Drilling Inc. | Completion Depth: 10 m |
| Drilling Rig Type: Diamond Drill Rig | Start Date: 2016 March 27 |
| Logged By: EP | Completion Date: 2016 March 27 |
| Reviewed By: GZ | Page 1 of 1 |

# Agnico Eagle Mines

# Borehole No: **BH16-05**

| | |
|---|---|
| Project: Winter 2016 Geotechnical Site Investigation | Project No: ENG.EARC03020-01 |
| Location: Meliadine Project, Nunavut | Ground Elev: 62.9 m |
| | UTM: 540615.3 E; 6989294.4 N; Z 15 |

| Depth (m) | Method | Lithological Description | Ground Ice Description | Sample Type | Sample/Run Number | Moisture Content (%) | Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80) | Fracture Frequency (2 4 6 8) / RQD (%) (40 60 80 100) / Recovery (%) (40 60 80 100) | GTC 4 | Elevation (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | PEAT - very woody, coarse fibrous, black, rootlets | - Vx 10-20%, clear ice | | | | | | | |
| | | - at 0.04 m, woody, fine fibrous, black | | | R1 | | | | | |
| 1 | | | - at 0.84 m, Vx, Vs 40-50% | | 1S | 730.9 | | | | 62 |
| | | - at 1.07 m, 70 mm thick grey cobble | - at 1.14 m, 20 mm thick horizontal ice lens | | | | | | | |
| | | SAND AND GRAVEL - trace to some silt, grey to light grey, boulder fragments, subrounded | - at 1.16 m, Vx 5-10% | | | | | | | |
| | | SAND - trace gravel, trace silt, grey, subrounded | - at 1.48 m, Vx 30-40% | | 2S | 36 | | | | |
| 2 | | - at 1.84 m, light brown | - at 1.77 m, 15 mm thick clear ice lens | | R2 | | | | | 61 |
| | | GRAVEL AND SAND - some shells, trace silt, light grey, grey and brown, subangular | - at 2.20 m, Vx 5% | | 3S | 15.9 | | | | |
| | | - at 2.33 m, (Gravel - 57.7%; Sand - 37.9%; Fines - 4.4%) | | | | | | | | |
| 3 | | BOULDERS - matrix consisting of sand, gravelly, trace silt | - at 2.82 m, 100 mm thick ice and sand layer - clear ice | | | | | | | 60 |
| | | - at 2.82 m, 100 mm thick ice and sand layer - some gravel, grey | | | R3 | | | | | |
| | | - at 3.14 m, 400 mm thick greywacke boulder - moderately weathered (W3), orange to red, white to red quartz veins, fine grained | | | 4S | 8.5 | | | | |
| 4 | | - at 4.06 m, 480 mm thick greywacke boulder - fresh (W1), white quartz veins, fine grained | | | | | | | | 59 |
| | | | - at 4.54 m, Nbe | | R4 | | | | | |
| 5 | | GREYWACKE (BEDROCK) - fresh (W1), massive, black, white quartz veins, fine grained, JSN: 0.5 | | | | | | | | 58 |
| | | | | | R5 | | | | | |
| 6 | | - at 5.72 m, slightly weathered (W2) | | | | | | | | 57 |
| | | - at 6.2, 6.27 and 6.43 m, yellow to green weathering | | | R6 | | | | | |
| 7 | | | | | | | | | | 56 |
| | | END OF BOREHOLE (7.2 metres) | | | | | | | | |
| 8 | | Single bead Ground Temperature Cable 4 installed to 2.00 metres and backfilled with 30 mm crush. | | | | | | | | 55 |
| 9 | | | | | | | | | | 54 |
| 10 | | | | | | | | | | 53 |
| 11 | | | | | | | | | | 52 |

Diamond Core Drilling

TETRA TECH EBA

| | |
|---|---|
| Contractor: Orbit Garant Drilling Inc. | Completion Depth: 7.2 m |
| Drilling Rig Type: Diamond Drill Rig | Start Date: 2016 March 27 |
| Logged By: RG | Completion Date: 2016 March 27 |
| Reviewed By: GZ | Page 1 of 1 |

# Agnico Eagle Mines

# Borehole No: **BH16-06**

| | |
|---|---|
| Project: Winter 2016 Geotechnical Site Investigation | Project No: ENG.EARC03020-01 |
| Location: Meliadine Project, Nunavut | Ground Elev: 62.3 m |
| | UTM: 540521.9 E; 6989257.1 N; Z 15 |

| Depth (m) | Method | Lithological Description | Ground Ice Description | Sample Type | Sample/Run Number | Moisture Content (%) | Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80) | Fracture Frequency (2 4 6 8) / RQD (%) (40 60 80 100) / Recovery (%) (40 60 80 100) | GTC 3 | Elevation (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Diamond Core Drilling | PEAT - woody, fine fibrous, black, (60 mm thick) | - Nbe | | | | | | | 62 |
| | | - at 0.03 m, 30 mm thick grey cobbles | - at 0.06 m, Nbe | | 1S | 27.1 | | | | |
| | | SAND AND GRAVEL - trace silt, rootlets, well graded, dark brown, black organic inclusions, subrounded to subangular | - at 0.49 m, Nbe | | R1 | | | | | |
| 1 | | | | | 2S | 15.7 | | | | 61 |
| | | - at 0.48 m, 60 mm thick cobble - highly weathered (W4), fractured, grey | - at 1.15 m, Vs 5-10% | | 3S | 18.2 | | | | |
| | | SAND - trace to some gravel, trace silt, abundant shells, brown, black organic inclusions, subangular | | | 4S | 7.5 | | | | |
| 2 | | - at 1.02 m, no visible shells | - at 1.80 m, Vx 10-15% | | R2 | | | | | 60 |
| | | - at 1.15 m, silty, trace gravel, greenish grey, parallel laminations | | | 5S | 7 | | | | |
| | | - at 1.18 m, (Gravel - 0.5%; Sand - 64.5%; Fines - 35.0%) | - at 2.65 m, Vx, Vs 5-10% | | | | | | | |
| 3 | | SAND AND SILT - some gravel, cobbles and boulders disseminated throughout, poorly graded, grey, subangular to angular | - at 3.13 m, 20 mm thick ice lens - some clay | | R3 | | | | | 59 |
| | | - at 1.69 m, 90 mm thick greywacke cobbles - grey to black, white quartz veins, fine grained | | | | | | | | |
| 4 | | - at 2.18 m, 70 mm thick greywacke cobbles - grey to black, white quartz veins, fine grained | | | | | | | | 58 |
| | | - at 2.27 m, 110 mm thick granite cobble, strong, grey to blue, fine grained | | | | | | | | |
| | | - at 2.39 m, (Gravel - 17.4%; Sand - 45.5%; Fines - 37.1%) | | | | | | | | |
| 5 | | GREYWACKE (BEDROCK) - moderately weathered (W3) on joints, grey to black, silt infills, white to yellow quartz veins, fine grained, subvertical joints, - undulating, smooth, JSN: 2 | | | R4 | | | | | 57 |
| 6 | | - at 4.15 m, slightly weathered (W2), JSN: 3 | | | | | | | | |
| | | END OF BOREHOLE (5.7 metres) | | | | | | | | 56 |
| | | Slough - 1.50 metres at 0 hrs. | | | | | | | | |
| | | Single bead Ground Temperature Cable 3 installed to 1.50 metres and backfilled with 30 mm crush. | | | | | | | | |
| 7 | | | | | | | | | | 55 |
| 8 | | | | | | | | | | 54 |
| 9 | | | | | | | | | | 53 |
| 10 | | | | | | | | | | 52 |
| 11 | | | | | | | | | | |

TETRA TECH EBA

| | |
|---|---|
| Contractor: Orbit Garant Drilling Inc. | Completion Depth: 5.7 m |
| Drilling Rig Type: Diamond Drill Rig | Start Date: 2016 March 28 |
| Logged By: RG | Completion Date: 2016 March 28 |
| Reviewed By: GZ | Page 1 of 1 |

# Agnico Eagle Mines

# Borehole No: **BH16-07**

| | |
|---|---|
| Project: Winter 2016 Geotechnical Site Investigation | Project No: ENG.EARC03020-01 |
| Location: Meliadine Project, Nunavut | Ground Elev: 64 m |
| | UTM: 540424.7 E; 6989190 N; Z 15 |

| Depth (m) | Method | Lithological Description | Ground Ice Description | Sample Type | Sample/Run Number | Moisture Content (%) | Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80) | Fracture Frequency (2 4 6 8) / RQD (%) (40 60 80 100) / Recovery (%) (40 60 80 100) | Backfill | Elevation (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | ORGANICS - grassy, coarse fibrous, green to black, (60 mm thick) | - Vs 10-15%, 2-5 mm thick horizontal ice lenses separated by 15-18 mm | | 1S | 30.4 | | | | 64 |
| | | SAND AND SILT - trace gravel, rootlets, grey, subrounded | - at 0.30 m, Nbe | | R1 | | | | | |
| | | - at 0.30 m, brown | - at 0.48 m, Nf | | 2S | 14.3 | | | | |
| 1 | | - at 0.36 m, brown to black, subangular | - at 0.66 m, Nbe | | 3S | 18.4 | | | | 63 |
| | | - at 0.48 m, olive grey to green | - at 1.01 m, Vx 15-20%, clear ice | | 4S | 99.1 | | | | |
| | | - at 0.66 m, olive grey to green, subrounded | | | R2 | | | | | |
| | | - at 0.66 m, (Gravel - 7.7%; Sand - 47.7%; Fines - 44.6%) | - at 1.60 m, Clear ice | | | | | | | |
| 2 | | ICE AND SAND - trace silt, grey | - at 1.75 m, Vx 5% | | 5S | 7.1 | | | | 62 |
| | | GRAVEL AND SAND - silty, cobbles and boulders disseminated throughout, poorly graded, subangular | | | | | | | | |
| | | - at 1.84 m, (Gravel - 42.1%; Sand - 35.2%; Fines - 22.7%) | - at 2.39 m, Nbe | | | | | | | |
| 3 | | - at 2.29 m, 100 mm thick greywacke cobble - strong, grey to black, white quartz veins | | | R3 | 8.3 | | | | 61 |
| | | - at 2.39 m, some silt | | | 6S | | | | | |
| | | - at 2.60 m, 110 mm thick greywacke cobble - strong, grey to black, white quartz veins | | | | | | | | |
| 4 | | - at 3.65 m, 250 mm thick greywacke cobble - strong, grey to black, white quartz veins | | | | | | | | 60 |
| | | - at 3.90 m, 150 mm thick greywacke cobble - strong, grey to black, white quartz veins | | | 7S | 6.4 | | | | |
| | | - at 4.45 m, 150 mm thick greywacke cobble - strong, grey to black, white quartz veins | | | R4 | | | | | |
| 5 | | | | | | | | | | 59 |
| | | | | | | | | | | |
| 6 | | | | | R5 | | | | | 58 |
| | | GREYWACKE (BEDROCK) - fresh (W1), foliated, very to extremely strong, dark grey to greenish black, 1 mm thick quartz veins, fine grained, JSN: 1 | | | | | | | | |
| 7 | | - at 6.8 m, subvertical joint - undulating, smooth | | | | | | | | 57 |
| | | - at 7.29, 8.12, 8.44 and 8.47 m, subhorizontal joints - stepped, smooth, slight orangish weathering (W2) | | | R6 | | | | | |
| 8 | | | | | | | | | | 56 |
| | | END OF BOREHOLE (8.5 metres) Note: Backfilled with 30 mm crushed gravel | | | | | | | | |
| 9 | | | | | | | | | | 55 |
| 10 | | | | | | | | | | 54 |
| 11 | | | | | | | | | | 53 |

Diamond Core Drilling

TETRA TECH EBA

| | |
|---|---|
| Contractor: Orbit Garant Drilling Inc. | Completion Depth: 8.5 m |
| Drilling Rig Type: Diamond Drill Rig | Start Date: 2016 March 27 |
| Logged By: RG/EP | Completion Date: 2016 March 27 |
| Reviewed By: GZ | Page 1 of 1 |

# APPENDIX B

## ISSUED FOR CONSTRUCTION DRAWINGS FOR CP6 AND CP6 BERM

NO. DESSIN
DRAWING NO. 65-695-230-009

FORMAT ARCHD

| BERM CENTRELINE LAYOUT COORDINATES | | |
|---|---|---|
| STATION | NORTHING | EASTING |
| 0+000 | 6 989 155.30 | 540 356.09 |
| 0+010 | 6 989 162.69 | 540 362.83 |
| 0+020 | 6 989 170.09 | 540 369.56 |
| 0+030 | 6 989 177.48 | 540 376.29 |
| 0+040 | 6 989 184.88 | 540 383.02 |
| 0+050 | 6 989 192.27 | 540 389.75 |
| 0+060 | 6 989 199.67 | 540 396.49 |
| 0+070 | 6 989 207.06 | 540 403.22 |
| 0+080 | 6 989 214.46 | 540 409.95 |
| 0+090 | 6 989 221.77 | 540 416.76 |
| 0+100 | 6 989 226.87 | 540 425.29 |
| 0+110 | 6 989 229.32 | 540 434.98 |
| 0+120 | 6 989 231.64 | 540 444.71 |
| 0+130 | 6 989 233.96 | 540 454.43 |

| BERM CENTRELINE LAYOUT COORDINATES | | |
|---|---|---|
| STATION | NORTHING | EASTING |
| 0+140 | 6 989 236.28 | 540 464.16 |
| 0+150 | 6 989 238.60 | 540 473.89 |
| 0+160 | 6 989 240.92 | 540 483.62 |
| 0+170 | 6 989 243.24 | 540 493.34 |
| 0+180 | 6 989 245.56 | 540 503.07 |
| 0+190 | 6 989 247.88 | 540 512.80 |
| 0+200 | 6 989 250.20 | 540 522.52 |
| 0+210 | 6 989 252.52 | 540 532.25 |
| 0+220 | 6 989 254.84 | 540 541.98 |
| 0+230 | 6 989 257.16 | 540 551.71 |
| 0+240 | 6 989 259.48 | 540 561.43 |
| 0+250 | 6 989 261.80 | 540 571.16 |
| 0+260 | 6 989 264.12 | 540 580.89 |
| 0+270 | 6 989 266.44 | 540 590.61 |

| BERM CENTRELINE LAYOUT COORDINATES | | |
|---|---|---|
| STATION | NORTHING | EASTING |
| 0+280 | 6 989 268.76 | 540 600.34 |
| 0+290 | 6 989 271.08 | 540 610.07 |
| 0+300 | 6 989 273.40 | 540 619.80 |
| 0+310 | 6 989 275.72 | 540 629.52 |
| 0+320 | 6 989 277.61 | 540 639.33 |
| 0+330 | 6 989 276.09 | 540 649.14 |
| 0+340 | 6 989 272.70 | 540 658.55 |
| 0+350 | 6 989 269.30 | 540 667.96 |
| 0+360 | 6 989 265.91 | 540 677.36 |
| 0+370 | 6 989 262.52 | 540 686.77 |
| 0+380 | 6 989 259.13 | 540 696.18 |
| 0+390 | 6 989 255.73 | 540 705.58 |
| 0+400 | 6 989 252.34 | 540 714.99 |

| CP6 GTC LAYOUT POINTS | | |
|---|---|---|
| POINT | NORTHING | EASTING |
| GTC01 | 6 989 255.40 | 540 490.44 |
| GTC02 | 6 989 270.48 | 540 553.67 |
| GTC03 | 6 989 284.40 | 540 612.03 |

| CP6 LAYOUT POINTS | | | |
|---|---|---|---|
| POINT | NORTHING | EASTING | ELEVATION |
| 1 | 6 989 229.91 | 540 632.94 | 62.87 |
| 2 | 6 989 225.48 | 540 639.20 | 63.14 |
| 3 | 6 989 217.94 | 540 643.11 | 62.82 |
| 4 | 6 989 176.00 | 540 655.34 | 62.28 |
| 5 | 6 989 168.04 | 540 655.53 | 62.30 |
| 6 | 6 989 157.26 | 540 652.28 | 62.30 |
| 7 | 6 989 148.65 | 540 645.68 | 62.30 |
| 8 | 6 989 141.34 | 540 631.65 | 62.30 |
| 9 | 6 989 128.81 | 540 569.81 | 62.44 |
| 10 | 6 989 121.84 | 540 545.57 | 63.10 |
| 11 | 6 989 119.10 | 540 541.67 | 63.67 |
| 12 | 6 989 116.61 | 540 536.59 | 64.16 |
| 13 | 6 989 115.72 | 540 530.12 | 64.46 |
| 14 | 6 989 115.76 | 540 523.89 | 64.86 |
| 15 | 6 989 117.53 | 540 515.61 | 65.40 |
| 16 | 6 989 122.56 | 540 509.35 | 65.30 |
| 17 | 6 989 129.67 | 540 504.14 | 65.13 |

| CP6 LAYOUT POINTS | | | |
|---|---|---|---|
| POINT | NORTHING | EASTING | ELEVATION |
| 18 | 6 989 137.90 | 540 501.74 | 64.70 |
| 19 | 6 989 168.17 | 540 493.28 | 64.31 |
| 20 | 6 989 177.54 | 540 491.79 | 63.96 |
| 21 | 6 989 183.67 | 540 492.06 | 63.71 |
| 22 | 6 989 189.79 | 540 493.11 | 63.63 |
| 23 | 6 989 202.03 | 540 513.30 | 64.00 |
| 24 | 6 989 219.66 | 540 544.80 | 63.51 |
| 25 | 6 989 220.62 | 540 562.02 | 62.34 |
| 26 | 6 989 223.41 | 540 573.41 | 62.20 |
| 27 | 6 989 230.70 | 540 615.82 | 62.30 |
| 28 | 6 989 189.45 | 540 497.84 | 63.10 |
| 29 | 6 989 203.07 | 540 548.85 | 57.82 |
| 30 | 6 989 198.23 | 540 550.10 | 57.82 |
| 31 | 6 989 215.09 | 540 611.50 | 58.91 |
| 32 | 6 989 215.96 | 540 617.54 | 59.12 |
| 33 | 6 989 214.41 | 540 621.50 | 59.15 |
| 34 | 6 989 212.00 | 540 623.87 | 59.03 |

| CP6 LAYOUT POINTS | | | |
|---|---|---|---|
| POINT | NORTHING | EASTING | ELEVATION |
| 35 | 6 989 207.00 | 540 625.61 | 58.71 |
| 36 | 6 989 177.00 | 540 632.00 | 57.46 |
| 37 | 6 989 172.00 | 540 633.27 | 57.53 |
| 38 | 6 989 168.52 | 540 632.98 | 57.60 |
| 39 | 6 989 164.30 | 540 630.20 | 57.70 |
| 40 | 6 989 162.40 | 540 626.10 | 57.76 |
| 41 | 6 989 137.53 | 540 538.97 | 60.21 |
| 42 | 6 989 136.55 | 540 534.50 | 60.20 |
| 43 | 6 989 137.49 | 540 529.01 | 60.15 |
| 44 | 6 989 142.00 | 540 524.02 | 60.05 |
| 45 | 6 989 148.00 | 540 522.12 | 59.93 |
| 46 | 6 989 168.52 | 540 517.53 | 59.29 |
| 47 | 6 989 181.71 | 540 549.06 | 58.51 |
| 48 | 6 989 188.56 | 540 561.01 | 56.89 |
| 49 | 6 989 194.16 | 540 569.90 | 55.93 |
| 50 | 6 989 197.09 | 540 589.08 | 54.00 |

NOTE: THE LOCATION OF LAYOUT POINTS (POINT 30 TO POINT 48) MAY VARY DEPENDING ON THE ACTUAL BEDROCK DEPTH ENCOUNTERED DURING EXCAVATION.

CP6 THERMAL PROTECTION BERM

PROPOSED CP6
(BOTTOM ELEVATION 54.0 m)

ACCESS RAMP

THE ACCESS RAMP SURFACE IN THIS OVERBURDEN ZONE TO BE SURFACED WITH SELECTED RUN-OF-MINE ROCKFILL FOR OPERATIONAL TRAFFIC

SAFETY BERM

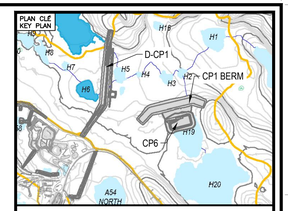
TOE OF RIP RAP FILL

CREST OF RIP RAP FILL

OUTER BOUNDARY OF CP6 POND EXCAVATION

ROCK SURFACE SLOPE MAY VARY BETWEEN 1H:1V TO 1H:10V DEPENDING ON ACTUAL ROCK QUALITY ENCOUNTERED DURING EXCAVATION

TOE OF CP6 EXCAVATION MAY VARY DEPENDING ON ACTUAL ROCK / SLOPE DURING CONSTRUCTION




TETRA TECH

## NOTES GÉNÉRALES / GENERAL NOTES

1. ASSUMED CONSTRUCTION SCHEDULE MARCH 2020
2. ASSUMED OPERATION SCHEDULE STARTING TO STORE WATER FROM FRESHET OF 2020.
3. POND DESIGN CAPACITY IS BASED ON STORING 3/7 OF FRESHET WATER UNDER 1:100 WET YEAR CONDITION.
4. THE MAXIMUM ALLOWABLE OPERATING WATER LEVEL IS AT ELEVATION 60.0 m UNDER THE DESIGN IDF CONDITION.
5. MATERIAL PLACEMENT AND FOUNDATION PREPARATION SHOULD BE IN ACCORDANCE WITH THE REQUIREMENTS OF GEOTECHNICAL CONSTRUCTION / MATERIAL SPECIFICATIONS (TETRA TECH 2020).
6. THE SINGLE-LANE RAMP HAS A MINIMUM ROAD WIDTH OF 7.0 m (FOR VOLVO A40F OR CAT 745 HAUL TRUCKS OR SMALLER EQUIPMENT).



## DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

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TITRE / TITLE
AGNICO EAGLE MELIADINE GOLD PROJECT

CP6 AND CP6 BERM
LAYOUT PLAN

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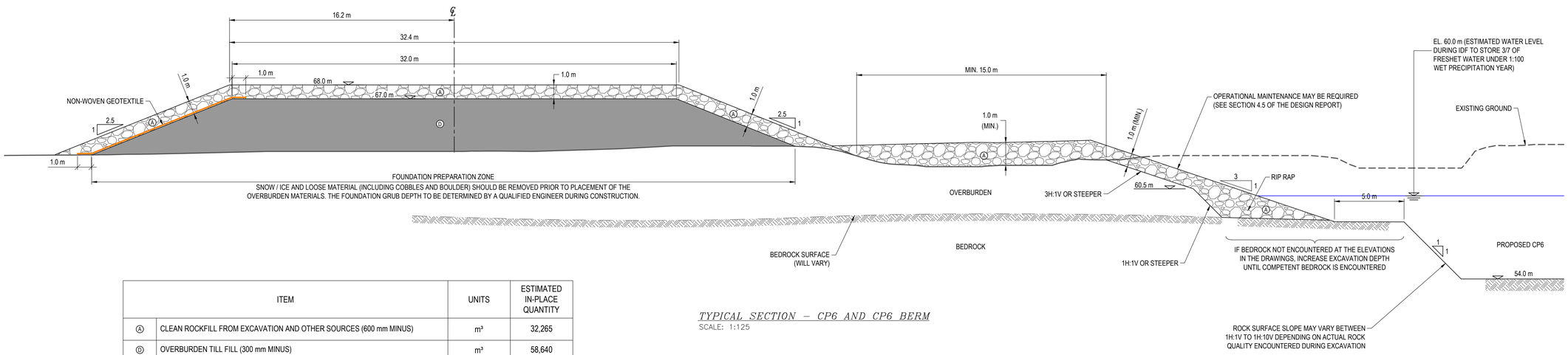
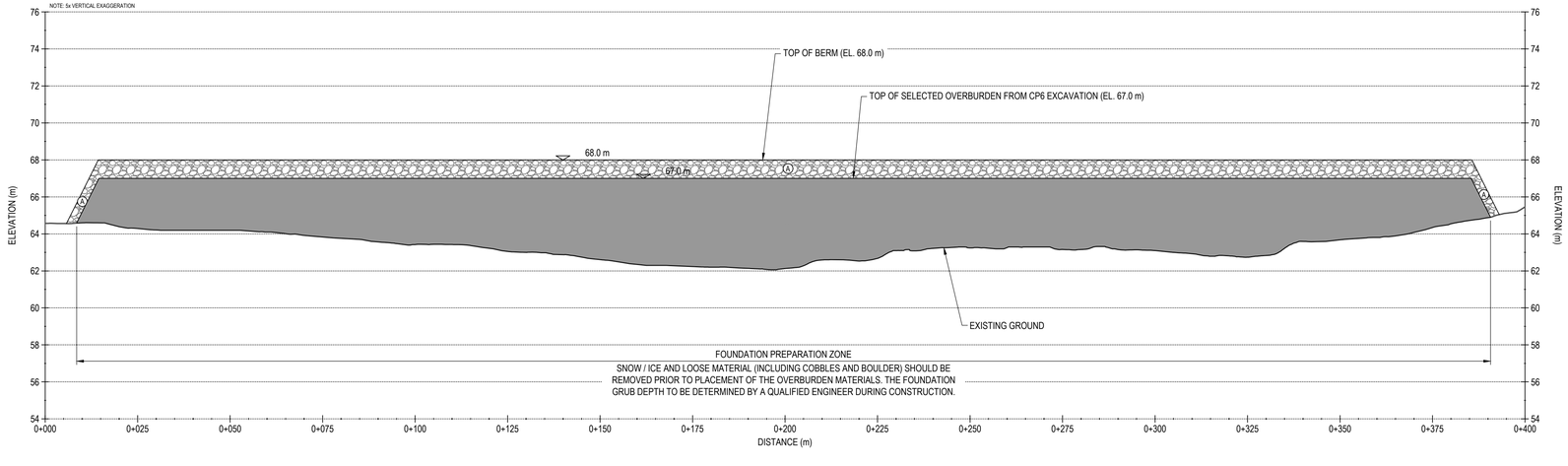
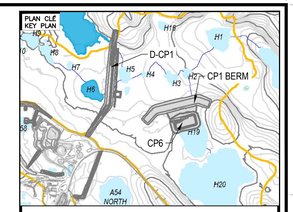



| | ITEM | UNITS | ESTIMATED IN-PLACE QUANTITY |
|---|---|---|---|
| Ⓐ | CLEAN ROCKFILL FROM EXCAVATION AND OTHER SOURCES (600 mm MINUS) | m³ | 32,265 |
| Ⓓ | OVERBURDEN TILL FILL (300 mm MINUS) | m³ | 58,640 |
| | NON-WOVEN GEOTEXTILE FOR CP6 BERM | m² | 5,325 |
| | TOTAL CP6 EXCAVATION VOLUME | m³ | 71,885 |
| | ESTIMATED OVERBURDEN EXCAVATION VOLUME (NO BULKING FACTOR) | m³ | 50,935 |
| | ESTIMATED ROCK EXCAVATION VOLUME (NO BULKING FACTOR) | m³ | 20,950 |

*TYPICAL SECTION – CP6 AND CP6 BERM*
SCALE: 1:125




*CP6 – BERM PROFILE*
SCALE: H-1:750 V-1:150

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NOTES GÉNÉRALES / GENERAL NOTES

1. ASSUMED CONSTRUCTION SCHEDULE MARCH 2020
2. ASSUMED OPERATION SCHEDULE STARTING TO STORE WATER FROM FRESHET OF 2020.
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6. THE CREST ELEVATION SHOWN ON DRAWINGS FOR CP6 BERM AREA FOR CONSTRUCTION. POST-CONSTRUCTION SETTLEMENT IS EXPECTED, SO FINAL CREST ELEVATIONS DURING OPERATION WOULD BE LOWER.



DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

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CP6 AND BERM TYPICAL SECTION AND
CP6 BERM PROFILE

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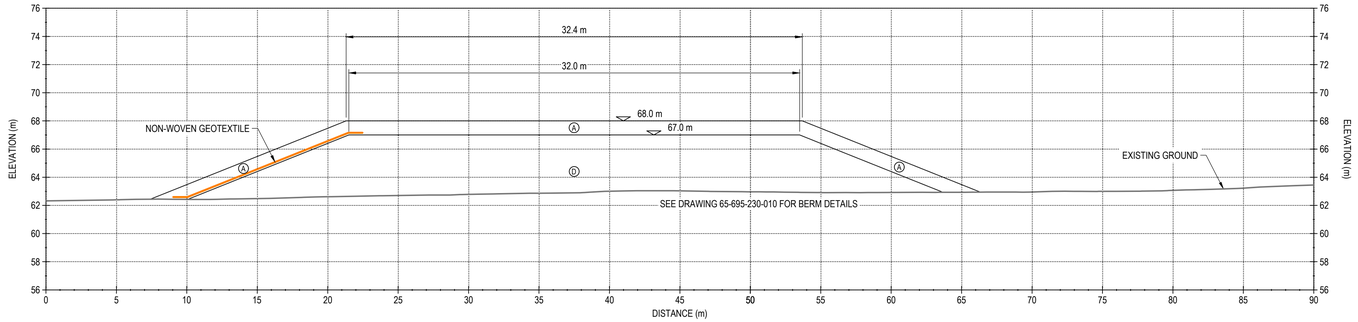


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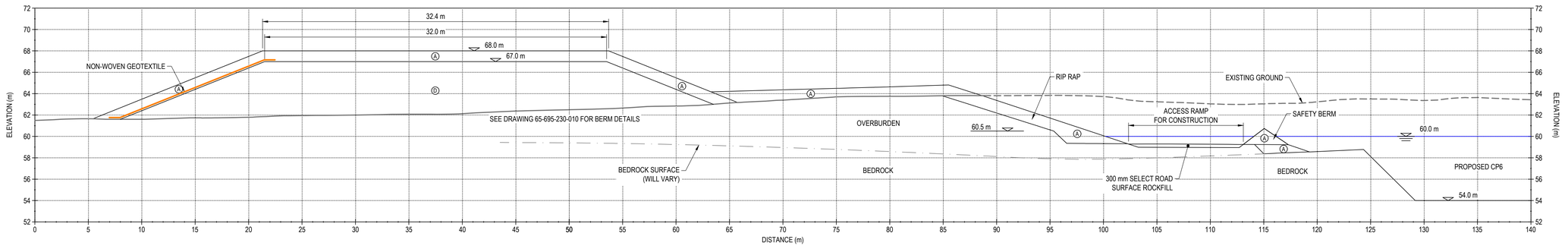


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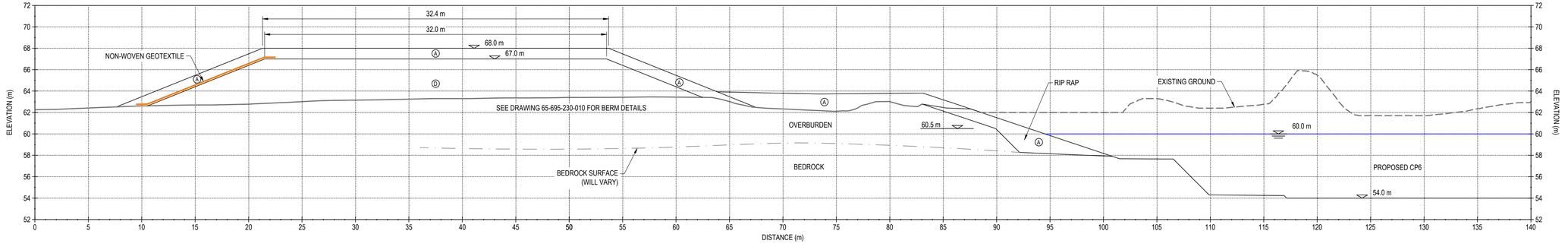


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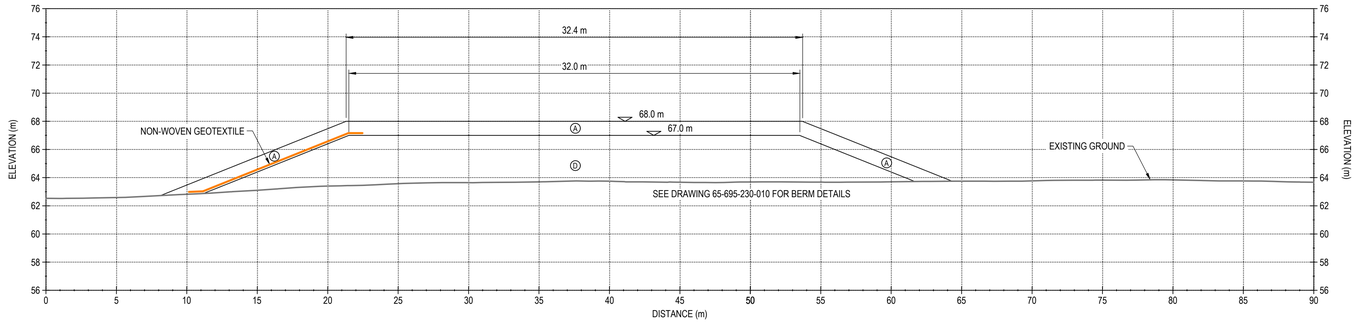


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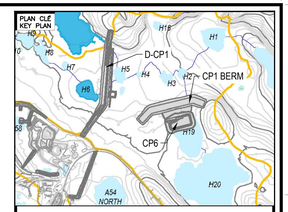


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LEGEND

(A) CLEAN ROCKFILL FROM EXCAVATION (600 mm MINUS)

(D) OVERBURDEN FROM EXCAVATION (300 mm MINUS)



## DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

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LICENSEE
2020

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CP6 AND CP6 BERM
SECTIONS

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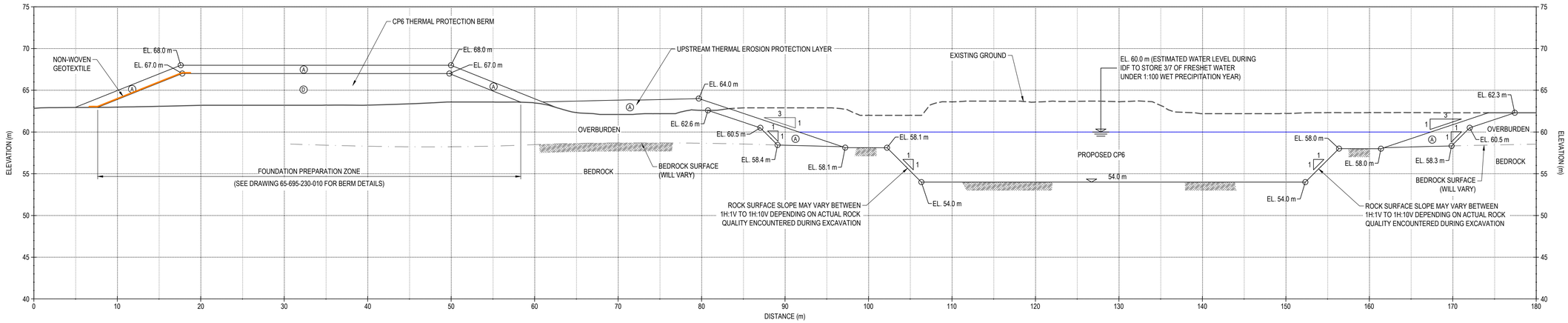


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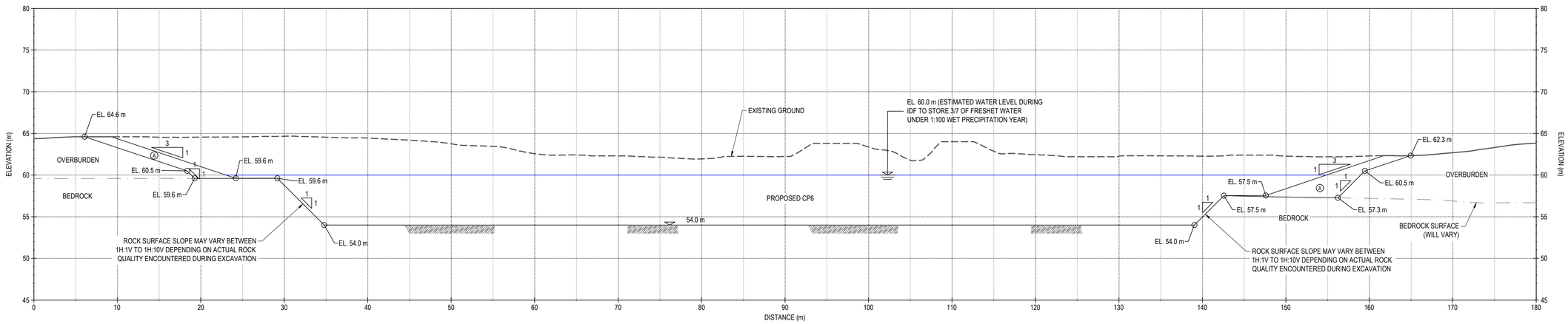


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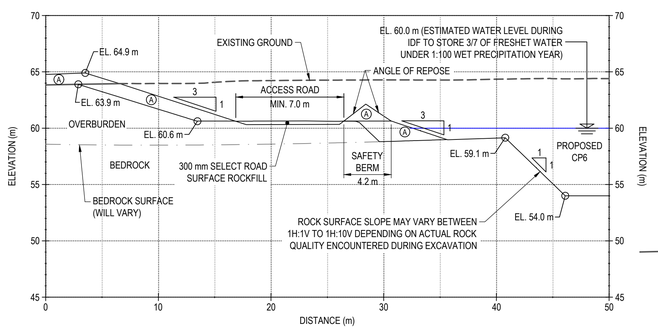


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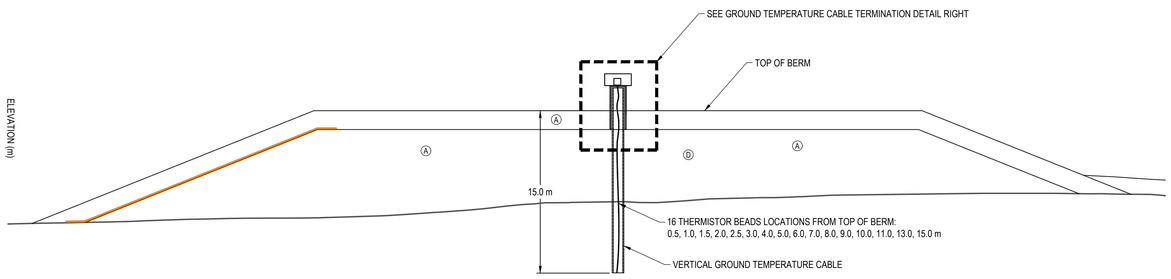
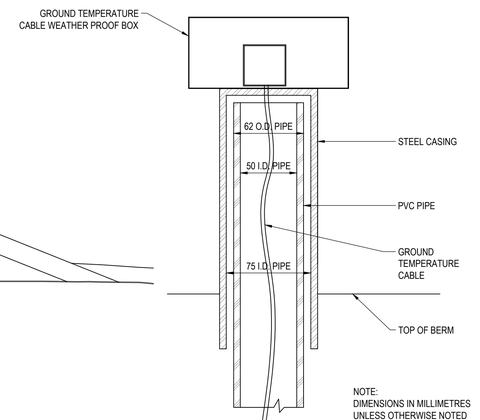



*TYPICAL SECTION – CP6 BERM GROUND TEMPERATURE CABLE INSTALLATION*




*DETAIL – GROUND TEMPERATURE CABLE TERMINATION*
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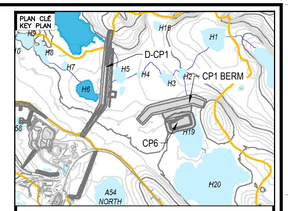


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LEGEND

Ⓐ CLEAN ROCKFILL FROM EXCAVATION (600 mm MINUS)
Ⓓ OVERBURDEN FROM EXCAVATION (300 mm MINUS)



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CP6
CROSS-SECTIONS

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# APPENDIX C

## GEOTECHNICAL SPECIFICATIONS FOR CONSTRUCTION OF CP6 AND CP6 BERM

# Geotechnical Specifications for Construction of CP6 and CP6 Berm, Meliadine Gold Project, NU

PRESENTED TO

**Agnico Eagle Mines Limited**

JANUARY 24, 2020
ISSED FOR USE
FILE: ENG.EARC03140-06
AGNICO EAGLE DOCUMENT NUMBER: 6526-695-100-SPT-001

Tetra Tech Canada Inc.
14940 - 123 Avenue
Edmonton, AB T5V 1B4 CANADA
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Prepare by:

REGISTERED PROFESSIONAL ENGINEER
G. ZHANG
LICENSEE
NWT/NU

Jan 24 2020

FILE: ENG.EARC03140-06
FILE: ENG.EARC03140-06
FILE: ENG.EARC03140-06

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Principal Specialist, Arctic Region
Direct Line: 587.460.3650
GuangwenGordon.Zhang@tetratech.com

Reviewed by:

REGISTERED PROFESSIONAL ENGINEER
W.T. HORNE
LICENSEE
N.W.T.

Jan 24 2020

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FILE: ENG.EARC03140-06
FILE: ENG.EARC03140-06

Bill Horne, M.Sc., P.Eng.
Principal Consultant, Arctic Region
Direct Line: 587.460.3528
Bill.Horne@tetratech.com

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# SECTION 1001 – DEFINITIONS & ACRONYMS

## 1.1 General

.1 Definitions of terms and acronyms used throughout the Geotechnical Specifications for Construction of CP6 and CP6 Berm are presented in this Section.

## 1.2 Definitions

Construction Drawings or Drawings: The design drawings as issued for construction.

Construction Specifications: This document.

Contract: The legal and binding agreement between the Contractor and Agnico Eagle Mines Limited (Agnico Eagle) regarding construction of CP6 and CP6 Berm of the project.

Contractor: The general contractor responsible for construction.

Engineer: Tetra Tech Canada Inc, owner's on-site geotechnical representative during construction or related activities.

Owner: Agnico Eagle Mines Limited.

Site: The area in which construction or related activities are occurring.

Unsuitable: Not meeting the requirements stated herein or not receiving the Engineer's approval.

Civil Component: Any portion of construction relating to civil works.

## 1.3 Acronyms

| | |
|---|---|
| ASTM | American Society for Testing and Materials |
| Agnico Eagle | Agnico Eagle Mines Limited |
| GTC | Ground Temperature Cable |
| Mine | Meliadine Gold Mine |
| NAG | Non-Acid Generating |
| NU | Nunavut Territories |
| QA/QC | Quality Assurance and Quality Control |
| TSS | Total Suspended Solids |

## 1.4 Units of Measure

| | |
|---|---|
| km | kilometre |
| m | metre |
| mm | millimeter |
| $m^3$ | cubic metres |
| $m^2$ | square metres |

**END OF SECTION**

# SECTION 1002 – GENERAL

## 1.1 General

.1 This specification has been prepared for construction of CP6 and CP6 Berm at the Meliadine Gold Mine in the Nunavut Territories (NU) and for the exclusive use at this specific project.

.2 This document follows the International System of Units (SI).

## 1.2 Construction Methods

.1 The elevations and dimensions shown on the Construction Drawings are for the purpose of construction and measurement. The Contractor shall ensure that all grades, elevations, and dimensions are adhered to. Any deviation or change from the Construction Drawings requires the approval of the Engineer.

.2 The Contractor will be responsible for the specific method of construction to meet the design intent/requirements and Construction Specifications. The specific method of the construction from the Contractor shall be approved by the Engineer before the start of the construction.

## 1.3 Drawing Discrepancies

.1 Any discrepancies found on the Construction Drawings shall be brought to the immediate attention of the Engineer. No deviations shall be permitted from the Construction Drawings without written approval from the Engineer.

.2 The Contractor shall immediately submit in writing to the Engineer any conflicts discovered within this document or between this document, the purchase order, the accompanying data sheets and drawings, and any other supplemental information or specifications. The Engineer will then make a ruling and clarify the matter in writing.

## 1.4 Supply of Construction Materials

.1 The materials referenced in Section 1005 – Granular Fill Materials of this document are designated on the Drawings. Estimated “in-place” material quantities are also presented on the Drawings. The clean rockfill quantity should be increased by a minimum of 10% to account for overbreak, waste, and/or overbuild that may occur during construction. The geotextile material should be increased by 20% to account for overlap, damaged sections, and/or waste that may occur during construction.

.2 Overburden till will be available during excavation of CP6. A selected portion of the excavated till that meets the material specifications will be used as Overburden Till Fill (Type D) for the berm construction. Re-using of the overburden as Type D Material is the responsibility of the Contractor.

.3 The clean rockfill from the pond excavation and other sources approved by the Owner will be used as Clean Rockfill (Type A) or Rip Rap for the pond and berm construction.

.4 The nonwoven geotextile will be provided by the Owner. The Contractor of this package will install the supplied nonwoven geotextile for the berm construction.

## 1.5 Site Cleanup

.1 The Contractor shall remove all temporary structures and shall clean up the construction area and stockpile areas after completion of the Contract work.

## 1.6 As-built Survey

.1 A survey contractor will be directly hired by the Owner to carry out as-built survey and documentation to verify quantities and produce as-built drawings for each structure.

.2 The Survey Contractor should carry out the following tasks, but not be limited to:

- .a Survey the as-built conditions of excavations and fills including different material boundaries as required;
- .b Survey the geotextile installation locations and elevations;
- .c Survey the instrumentation installation locations and elevations;
- .d Survey of any measurement for payment items;
- .e Provide quantities of each of excavations and fill materials on critical stages or as required;
- .f Provide the Engineer an AutoCAD drawing showing 3D lines and surfaces of each of excavations and fill materials at critical stages or as required; and
- .g Provide the as-build AutoCAD drawing showing 3D lines and surfaces of each of excavations and fill materials after the completion of each structure.

## 1.7 QA/QC Testing

.1 Soil testing for the construction Quality Assurance and Quality Control (QA/QC) program and associated documentation will be carried out by either the Engineer or a qualified site representative hired by the Owner.

## 1.8 Equipment and Tools for Construction

.1 The Contractor shall be responsible for the equipment and tools that are required for construction of the pond and berm. The equipment and tools may include, but is not limited to, the following:

- .a Equipment for material loading, hauling, placing, and compacting;
- .b Equipment for frozen overburden and rock excavation including drill/blast operation;
- .c Equipment and tools that are required for geotextile installation and QA/QC testing;
- .d Equipment for temporary water/erosion management during construction if required;
- .e A drill rig to drill holes for installing vertical ground temperature cables through the thermal protection berm; and
- .f Any other equipment that may be required for construction.

**END OF SECTION**

# SECTION 1003 – EXCAVATION, SITE, AND FOUNDATION PREPARATION

## 1.1 General

.1 This section describes the general requirements with respect to excavation, site, and foundation preparation.

## 1.2 General Excavation

.1 The Contractor shall undertake all excavation to the dimensions and lines shown on the Construction Drawings or as directed by the Engineer.

.2 The Contractor will be solely responsible for the method of excavation which may include manual excavation, hydraulic excavation, ripping, and blasting.

.3 The Contractor shall use excavation methods that minimize the disturbance and/or fracturing beyond excavation limits. Excavation beyond the limits shown on the Construction Drawings shall not be undertaken without prior approval of the Engineer. Any excavation completed outside the design limits without the Engineer's approval shall be done at the Contractor's expense. The actual excavation depth and side slopes could be different from those shown on the drawings.

.4 Over-excavation affecting the design gradelines or elevations shall be backfilled as directed by the Engineer. Backfill shall be placed in accordance with Section 1006 – Granular Fill Placement.

.5 All completed excavations shall be free of loose or deleterious material.

.6 The original ground shall remain undisturbed. Any disturbed areas surrounding excavations shall be graded following construction to promote positive drainage away from the work areas.

.7 The Contractor will be solely responsible for the control and diversion of surface and subsurface water flows into and around the excavation. Measures should be taken to minimize the total suspended solids (TSS) in the water collected.

.8 The Contractor will be responsible for all aspects of safety during the excavation operations including the stability of the excavations.

## 1.3 Pond Excavation

.1 All unsuitable foundation soils or rocks shall be removed from within the pond and berm footprints as directed by the Engineer and detailed in the Construction Drawings. Excavated materials shall be disposed at approved spoil locations if not used for construction.

.2 The pond shall be excavated according to the Construction Drawings or approved by the Engineer. Blasting may be required to excavate the frozen overburden and bedrock.

.3 The final slope of rock faces after excavation will be determined during construction by a qualified Geotechnical Engineer, based on the actual rock conditions (joints, faults, evaluation height etc.) and risk of local failure or rock falls. If required, the rock faces will be flattened to increase the stability.

.4 Excavation of rock shall be conducted in a manner that avoids excessive fracturing or the creation of voids in the underlying rock.

.5 Any inflow of water into the excavation shall be controlled by sumps and pumps in a manner that minimizes thaw and erosion at the excavation base and side slopes. The water shall be disposed of in a manner to not contaminate the receiving water bodies. Sedimentation or treatment may be required. The discharge location of the collected water in sumps during the excavation will be determined by the Owner or the Engineer.

.6 As indicated in the Construction Drawings, the base of till berm should be stripped to remove snow/ice, loose materials (organics/peat, boulders/cobbles etc.), and other high permeability materials. The required depth of the berm base stripping shall be determined at the time of construction by the Engineer.

## 1.4 Drilling and Blasting

.1 The Contractor is responsible for ensuring that blasting procedures used are within guidelines set by all regulatory bodies and authorities having jurisdiction on site.

.2 The Contractor shall use excavations methods that minimize fracturing beyond excavation limits.

.3 Care shall be taken in locating the drill holes, orienting the drills, and while drilling so that accurate positioning and alignment of the drill holes is achieved.

.4 Controlled blasting techniques shall be used to satisfy the excavation requirements stated herein. The initial explosive type and quantity, blasting sequence, and delay pattern shall be modified where required to achieve the requirements specified herein.

.5 The Contractor shall submit complete details of any proposed blast to the Engineer 24 hours prior to commencement of drilling for each blast. Data should include the following:

- .a The location, depth, and area of the blast;
- .b The type, strength, quantity, column load, and distribution of explosives to be used per hole, per day, and per blast;
- .c The sequence and pattern of the delay; and,
- .d The description and purpose of any special methods to be adopted.

.6 If, in a specific area, a plan that was previously adopted does not produce conditions in accordance with the requirements stated herein, the Contractor shall submit a revised blasting plan to the Engineer before continuing with drilling and blasting in adjacent areas.

## 1.5 Foundation Preparation

.1 All fill shall be placed on a firm bearing surface, free from snow, soft and/or loosened areas, ice, or other detritus material. All unsuitable foundation soils, as determined by the Engineer, shall be excavated and replaced with the appropriate material specified in the drawings. This material shall be placed and compacted in accordance with Section 1006 – Granular Fill Placement.

.2 Boulders must be removed as determined by the Engineer.

.3 The survey contractor shall carry out an accurate (i.e., no more than ±10 mm) survey to act as a reference for material quantities.

.4 Surficial vegetation, loose organic soils, open graded boulders, or other high permeable materials shall be removed according to the Construction Drawings or as determined by the Engineer.

.5 Ice-rich or other soils beneath the berm footprint deemed to be unsuitable by the Engineer shall be removed.

.6 Refer to the Construction Drawings for other foundation preparation requirements specified for each structure.

## 1.6 Foundation Approval

.1 The ground surface shall be inspected and approved by the Engineer before any fill material is placed. The Contractor shall give, not less than 24 hours' notice to the Engineer for subgrade inspection.

**END OF SECTION**

# SECTION 1004 – WATER, SNOW/ICE, EROSION, AND TURBIDITY CONTROL

## 1.1 General

.1 This section describes water, snow/ice, erosion, and turbidity control during construction.

.2 Natural runoff/run-on water due to rainfall events and the seepage water though unfrozen overburden into the excavations or construction areas during construction are not expected based on the current construction schedule (March 2020). If required, the pond and berm footprint areas shall be dewatered to allow for fill placement in a relatively dry environment.

.3 The excavation shall be protected to avoid erosion by rainfall or freshet runoff if required.

.4 Water, snow, ice control, and construction related dewatering are the responsibilities of the Contractor.

## 1.2 Water Control

.1 If required, the Contractor shall employ all measures necessary to control inflow into the various required excavations during construction. This may include construction of temporary water control structures, such as, berms around excavation perimeters, or excavation of interceptor trenches and/or sumps.

.2 Construction, maintenance, and operation of any temporary water control works shall be the responsibility of the Contractor.

.3 Water collected during construction shall be discharged after the water quality meets discharge criteria (if required, TSS removal or treatment may be required) or pumped to a temporary storage pond at the site, as directed by the Owner. Discharge of water shall not cause erosion or a decrease of water quality in the receiving water body. Water shall be discharged within the controlled area. The discharge water shall not adversely affect the water quality in the controlled area. TSS reduction may be required prior to discharge. Sedimentation, settling ponds, or treatment may be required.

.4 Following completion of the work, all temporary water control works shall be removed and the affected areas graded to provide positive drainage as directed by the Engineer.

.5 All temporary sumps shall be backfilled as directed by the Engineer. Backfill shall be placed in accordance with Section 1006 – Granular Fill Placement or as per Engineer's direction.

## 1.3 Snow and Ice Control

.1 The Contractor shall employ all measures necessary to control snow and ice accumulation in the open work areas during construction. This may include snow ploughing and grading.

.2 No snow or ice is allowed to be backfilled with fill materials. Any snow or ice shall be cleared off before fill materials are placed and compacted.

.3 Construction, maintenance, and operation of any temporary snow and ice control works shall be the responsibility of the Contractor.

.4 Following completion of the work, all temporary snow and ice control works shall be removed and the affected areas graded to provide positive drainage as directed by the Engineer.

## 1.4 Erosion Control

.1 The excavation face and backfill shall be protected, when required, to minimize erosion due to heavy rainfall events during construction.

.2 The erosion protection measures shall be removed following completion of the construction.

## 1.5 Turbidity Control

.1 Runoff water from the fill or excavation surfaces during construction may have excess TSS. The Contractor shall take necessary measures to control the turbidity of the water, if there is a risk of the runoff water flowing into a nearby water body to be protected from excess turbidity.

.2 The turbidity control measures shall be approved by the Engineer or the Owner.

**END OF SECTION**

# SECTION 1005 – GRANULAR FILL MATERIAL

## 1.1 General

.1 This Section describes the available granular fill materials for construction.

## 1.2 Reference Standards

.1 Where material properties are specified the following standards are applicable:

.a ASTM D422, Test Method for Particle-Size Analysis of Soils.

.b ASTM D1140, Test Method for Amount of Material in Soils Finer than the No. 200 (75 µm) Sieve.

.c ASTM C136, Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.d ASTM D2216, Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.

## 1.3 Material Sources

.1 No material of any type shall be borrowed or excavated without the Owner's prior approval.

.2 Borrow pits and/or quarries shall be maintained and managed in accordance with the requirements set out in the Owner's Land Use and Quarry Permits.

.3 The fills that require processing shall be processed from materials obtained from sources approved by the Owner, provided the final product meets the requirements specified herein. Processing may be required to achieve the specified gradations of some fills.

.4 The parent rock from which all fill materials are derived shall be non-acid generating (NAG) rock and consist of sound, hard, durable material free from soft, thin, elongated, or laminated particles and shall contain no unsuitable substances. The potential quarry source shall be approved by the Owner or the Engineer. The construction material should be verified with the client's representative to make sure the material can be used as the construction material with no environmental issues.

.5 A selected portion of the excavated till during excavation of CP6 that meets the material specifications can be used as Overburden Till Fill (Type D) for the berm construction.

.6 The clean rockfill from the pond excavation and other sources approved by the Owner will be used as Clean Rockfill (Type A) or Rip Rap for the pond and berm construction.

## 1.4 Material Specifications

.1 Clean Rockfill (**600 mm Minus**)

The Clean Rockfill can have a wide variation of gradation with a maximum particle size of 600 mm. Any oversized boulders should be removed before the rockfill is placed into the earth structures. Rockfill particles shall be angular and shall be derived from hard, durable rock. Any significant concentration of unsatisfactory materials shall be removed and directed to the waste disposal area or, with the Owner's approval, mixed with other materials to produce a material, which would meet specifications.

NAG rock shall be used for earth work construction. The clean rockfill will be sourced from the pond excavation or mine development. The clean rockfill shall be free from snow, ice, frozen chunks, organic matters, and debris.

.2 Overburden Till Fill (**300 mm Minus**)

Till Fill represents a wide range of natural overburden materials including inorganic, till, and native granular materials. The material can have a wide variation in gradation with a maximum particle size of 300 mm and a fines (less than 0.08 mm) content of between 10% and 60% by weight to have a relatively low hydraulic conductivity after compacted. The fill shall consist of mineral soils, be free of oversized boulders, roots/peats/organics, topsoil, and other deleterious material. The Till can be obtained from the pond excavation. The selected overburden waste from excavation during construction or mine operation can be used as the till fill.

.3 Rip-rap

Rip-rap shall be used as the erosion protection material for the pond. The particle size specifications for the graded rip-rap materials are minimum particle size of 20 mm and maximum particle size of up to 600 mm to 200 mm. The material shall be free of roots, organics, and other deleterious material. Processing may be required to achieve the specified gradation. The material can be processed from hard, durable, NAG rock.

**END OF SECTION**

# SECTION 1006 – GRANULAR PLACEMENT

## 1.1 General

The placement methods to be used during construction are described in this Section.

.1 Construction shall be performed in accordance with the best modern practices and with equipment best adapted to the work being performed.

.2 Fill materials shall be placed so that each layer is homogeneous, free of snow/ice, stratifications, ice chunks, organics, and deleterious materials.

.3 No fill material shall be placed on any part of the foundation until it has been prepared as specified herein and approved by the Engineer. Placement of fill material shall conform to the lines, grades, and elevations shown on the Construction Drawings.

.4 No fill should be placed in ponded water.

.5 Construction shall not proceed when the work cannot be performed in accordance with the requirements of the Specifications. Any part of fill material that has been damaged by the action of rain, snow, or any other cause shall be removed and replaced with the appropriate material conforming to the requirements stated herein before succeeding layers are placed.

.6 Stockpiling, loading, transporting, placing, and spreading of all materials shall be carried out in such a manner to avoid segregation. Segregated materials may need to be removed and replaced with the materials meeting the requirements stated herein, as required by the Engineer.

.7 The Contractor shall remove all debris, vegetation, or any other material not conforming to the requirements stated herein. The Contractor shall dispose of these materials in an area approved by the Owner.

.8 All fills shall be placed and compacted in horizontal lifts from the bottom up over a slope, except for special cases that are approved by the Design Engineer.

## 1.2 Reference Standards

.1 Where material properties are specified the following standards are applicable:

.a ASTM D422, Test Method for Particle-Size Analysis of Soils.

.b ASTM D1140, Test Method for Amount of Material in Soils Finer than the No. 200 (75 µm) Sieve.

.c ASTM C136, Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.d ASTM D2216, Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.

## 1.3 Placement of Fill

.1 Clean Rockfill (**600 mm minus**)

.a Clean Rockfill shall be placed in loose lift thicknesses not exceeding 900 mm.

.b Clean Rockfill shall be subjected to at least six full passes with a smooth drum vibratory compactor weighing not less than 10 tonnes or other method approved by the Engineer, where a full pass is defined as one forward pass followed by a backward pass.

.c Clean Rockfill must be stockpiled, transported, and placed using techniques, which avoid segregation and nesting of coarse particles. With the approval of the Engineer, the segregated coarse particles may be placed on the outside face of the structure to serve as erosion protection material.

.d The material shall be placed and compacted to the satisfaction of the Engineer. Subsequent lifts of material shall not be placed without approval of the Engineer.

.e Care shall be taken not to puncture the nonwoven geotextile when placing the rockfill. Any damaged nonwoven geotextile shall be repaired or replaced as requested by the Engineer.

.2 Overburden Till Fill (**300 mm minus**)

.a Overburden Till Fill shall be placed in loose lift thicknesses not exceeding 500 mm.

.b Overburden Till Fill must be stockpiled, transported, and placed using techniques, which avoid segregation and nesting of coarse particles.

.c Overburden Till Fill shall be subjected to at least six full passes with a smooth drum vibratory compactor weighing not less than 10 tonnes or other method approved by the Engineer, where a full pass is defined as one forward pass followed by a backward pass.

.3 Rip-rap

.a Specified size of Rip-rap, as defined in Section 1005 shall be used.

.b The rip-rap shall be placed on the pond excavated surfaces or as directed by the Engineer on the excavation bottom or slope.

**END OF SECTION**

# SECTION 1007 – NONWOVEN GEOTEXTILE

## 1.1 General

.1 The product and installation specifications for the nonwoven geotextile to be used for the construction are presented in this Section.

.2 This specification covers nonwoven geotextile test properties for subsequent use as protection (or cushioning) materials

## 1.2 References

Where material properties are specified the following standards are applicable:

.1 ASTM D4355, Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).

.2 ASTM D4533, Test Method for Trapezoidal Tearing Strength of Geotextiles.

.3 ASTM D4632, Test Method for Grab Breaking Load and Elongation of Geotextiles.

.4 ASTM D4833, Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

.5 ASTM D5261, Test Method for Measuring Mass per Unit Area of Geotextiles.

.6 ASTM D6241, Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50 mm Probe.

.7 ASTM D4751, Test Method for Determining Apparent Opening Size of a Geotextile.

.8 ASTM D5199, Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.

## 1.3 Geotextile

.1 Nonwoven geotextile shall comprise needle punch polypropylene fabric made of 100% polypropylene staple fibers conforming to the properties in Table 1.

.2 Recommended Minimum Nonwoven Geotextile Properties are as follows:

### Table 1: Recommended Minimum Nonwoven Geotextile Properties

| Test Parameter | Required Specifications | ASTM Test Method (or Approved Equal) |
|---|---|---|
| Nominal Thickness of Geotextile (mm) | 1.7 | D5199 |
| Grab Tensile (N) | 710 | D4632 |
| Elongation (%) | 50 | D4632 |
| Trapezoidal Tear (N) | 270 | D4533 |
| Puncture Resistance (N) | 380 (or 1820) | D4833 (or D6241) |
| Typical Unit Weight ($g/m^2$) | 200 | D5261 |
| UV Resistance (500 hrs) | 70% | D4355 |
| Apparent Opening Size (AOS) (mm) | 0.212 | D4751 |

## 1.4 Installation Method

.1 The Contractor shall place the geotextile once the excavation or bedding surface (if required) has been completed and approved by the Engineer.

.2 If the excavation is conducted when the overburden soils are frozen, bedding material may be required to be placed over the excavated surface to form a smooth surface for geotextile installation.

.3 Place geotextile material by unrolling onto graded, smooth surface.

.4 Place geotextile material smooth and free of tension, stress, folds, wrinkles, and creases.

.5 Place geotextile material on sloping surfaces in one continuous length from toe of slope to over crest.

.6 Overlap each successive length of geotextile 450 mm, or to manufacturer's instructions.

.7 Heat tack or sew seams.

.8 Protect installed geotextile material from displacement and damage. Replace damaged and deteriorated geotextile.

.9 Do not permit passage of any vehicle directly on geotextile at any time.

**END OF SECTION**

# SECTION 1008 – QUALITY ASSURANCE TESTING

## 1.1 General

.1 This section describes the quality assurance testing that shall be carried out during construction.

.2 The testing shall be carried out by the Engineer or a qualified site representative of the Owner.

## 1.2 Reference Standards

.1 ASTM C136-04 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.2 ASTM D2216, Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.

## 1.3 Granular Fill Testing Requirements

.1 Moisture content test

.a Moisture content testing shall be completed in accordance with ASTM D2216.

.b Moisture content testing shall be completed on representative samples obtained during placement of the Overburden Till Fill.

.c Samples shall be collected and tested at the following frequencies or as directed by the Engineer:

(a) Selected Overburden Till Fill (300 mm Minus): one sample per 3,000 $m^3$ of material produced or one sample per 24 hours of production, whichever is more frequent.

.2 Particle Size Analysis

.a Particle size analyses shall be completed in accordance with ASTM C136.

.b Particle size analysis testing shall be completed on representative samples obtained during production of the Overburden Till Fill.

.c Samples shall be collected and tested as directed by the Engineer.

## 1.4 Field Density Testing

.1 Proof rolling can be conducted on the compacted Clean Rockfill using a loaded haul truck. The number of full passes should be at least six, or until the subgrade does not exhibit more than 12.5 mm rutting. A full pass is defined as one forward pass followed by a backward pass. Proof rolling may be conducted on Clean Rockfill at the discretion of the Engineer.

**END OF SECTION**

# SECTION 1009 – INSTRUMENTATION INSTALLATION

## 1.1 General

.1 This section describes the instrumentation and installation for the berm.

.2 The instrumentation to be installed in CP6 Berm include three vertical ground temperature cables (GTCs).

.3 The instrumentation will be provided to the Contractor by the Engineer.

.4 The Contractor shall install the instrumentation under the direct supervision of the Engineer.

## 1.2 Installation and Monitoring

.1 Each instrumentation device shall be installed as specified in the Construction Drawings.

.2 Survey confirmation of the instrumentation locations is required before and after instrumentation installation.

.3 Care should be taken to avoid sharply bending the GTCs under cold temperatures. If required, the GTCs can be warmed in a heated space to facilitate unwarping the cables before installation.

.4 Before installation, initial reading should be made by the Engineer for each GTC to confirm the normal function of each thermistor bead.

.5 The Contractor shall ensure that the instrumentation shall not be damaged by construction activities during and after instrumentation installation.

.6 After the completion of the dike construction, regular readings (bi-weekly or as required by the Design Engineer) of the GTCs shall be made by the Owner. The readings should be sent to the Design Engineer for review and record.

**END OF SECTION**

# APPENDIX D

## TETRA TECH'S LIMITATIONS ON USE OF THIS DOCUMENT

# LIMITATIONS ON USE OF THIS DOCUMENT

## GEOTECHNICAL

### 1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

The Professional Document is intended for the sole use of TETRA TECH's Client (the "Client") as specifically identified in the TETRA TECH Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). TETRA TECH does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by TETRA TECH.

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### 1.2 ALTERNATIVE DOCUMENT FORMAT

Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

### 1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

### 1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

### 1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by persons other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

### 1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary investigation and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

### 1.7 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, TETRA TECH has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

### 1.8 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. TETRA TECH does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

### 1.9 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

### 1.10 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. TETRA TECH does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

### 1.11 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

### 1.12 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

### 1.13 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

### 1.14 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

### 1.15 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

### 1.16 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

### 1.17 SAMPLES

TETRA TECH will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.