



July 31<sup>st</sup> 2017

Karen Kharatyan  
Manager of Licensing  
Nunavut Water Board  
P.O. Box 119  
Gjoa Haven, NU  
X0B 1J0

**Re: Water License 2AM-MEL1631 Part D, Items 1&2 - Submission of Final Design and Construction Drawings for Culverts 7-8-10-11-16**

Mr. Kharatyan,

Agnico Eagle Mines Limited (Agnico Eagle) is developing the Meliadine Project (the Project), a gold mine located approximately 25 km north of Rankin Inlet, and 80 km southwest of Chesterfield Inlet in the Kivalliq Region of Nunavut. Situated on the western shore of Hudson Bay, the Project site is located on a peninsula between the east, south, and west basins of Meliadine Lake (63°1'23.8" N, 92°13'6.42"W) on Inuit Owned Land. Agnico Eagle is developing the mine for production in late 2019.

In accordance with Water License 2AM-MEL1631, Part D, Items 1 and 2, please find enclosed with this letter, a copy of the final design and construction drawings for Culverts 7-8-10-11-16.

Should you have any questions regarding this submission, please contact me.

Regards,

**Agnico Eagle Mines Limited – Meliadine Division**

A handwritten signature in blue ink, appearing to read "Manon Turmel". The signature is stylized with a large, sweeping loop at the end.

Manon Turmel  
manon.turmel@agnicoeagle.com  
819-759-3555 x8136  
Environmental Compliance Counselor

# DESIGN REPORT FOR CULVERTS #7, #8, #10, #11, #16 MELIADINE PROJECT, NUNAVUT



PRESENTED TO  
**Agnico Eagle Mines Ltd.**

AUGUST 2017  
ISSUED FOR USE  
TETRA TECH PROJECT NUMBER: 28920  
AGNICO EAGLE DOCUMENT NUMBER: 6515-E-132-005-132-REP-007

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## APPENDICES

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Appendix B	Figure 2 – Proposed Culverts location
Appendix C	Construction Drawing 65-417-230-203 for Typical culvert cross-section
	Construction Drawing 65-417-230-201 for Culverts #8, #11
	Construction Drawing 65-417-230-224 for Culverts #7, #10, #16

## 1.0 INTRODUCTION

### 1.1 Site Location and Access

Agnico Eagle Mines Limited (Agnico Eagle) is developing the Meliadine Project (the Project), a gold mine located approximately 25 km north from Rankin Inlet, and 80 km southwest from Chesterfield Inlet in the Kivalliq Region of Nunavut. The proposed 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) on Inuit Owned Land.

The mine site is accessible from the all-weather gravel road linking the Meliadine mine site with Rankin Inlet.

The culverts covered in this report are located in the Meliadine Site area, more specifically around Portal#2. The site location is shown in figure 1 (Appendix A).

### 1.2 Existing and future Facilities at the mine site

Current facilities at the Meliadine Project site include the camp located on the shores of Meliadine Lake, approximately 2.3 km east of the Tiriganiaq deposit. The self-contained camp can accommodate up to 520 people. Power for the camp is currently provided by diesel generators. Potable water for the camp is pumped from Meliadine Lake.

Facilities that are planned to be constructed for the operation of the future Meliadine Mine include haul roads, process plant, power plant, maintenance facilities, tank farm for fuel storage, water treatment plant, sewage treatment plant, and a crusher.

The Nunavut Water Board (NWB) has issued Type A Water License 2AM-MEL1631 to Agnico Eagle Mines Limited (Agnico Eagle) for the Meliadine Gold Project site authorizing the use of water and the disposal of waste required by mining and milling and associated uses.

### 1.3 Scope of Work

Agnico Eagle retained the services of Tetra Tech to carry out the planning and design works associated with the Water Management and Environment and the Civil Works components of the Project. As part of the scope of work, Agnico Eagle asked Tetra Tech to:

- Conduct a detailed design for the haul roads including the crossing culverts;
- Produce construction drawings and specification for the roads and culverts;
- Prepare a design report for the culverts around Portal#2.

This report summarizes the site conditions, design basis, and considerations including the final design and construction drawings for the culverts #7, #8, #10, #11, #16, as specified under Water License 2AM-MEL1631, Part D Item1.

## 2.0 DESIGN

### 2.1 Culvert Design Basis and Water Management Strategy

The overall objective of the water management strategy of this project is to develop a practical and feasible site-wide water management plan to minimize the potential negative impacts of mining development on the surrounding environment including habitats for fish and wildlife, and to facilitate mine operation and long-term closure and reclamation of the mine site. To attain this objective, culverts are used to control and divert runoff underneath the road and new facilities.

Culverts #7, #8, #10, #11 and #16 are required to allow the passage of runoff water under the future haul roads around Portal#2. The runoff water from Portal#2 area is flowing downstream into CP1.

The location of the proposed culverts is shown in Appendix B.

### 2.2 Hydraulic analyses and peak flow calculations

Hydrologic and hydraulic analyses were carried out to determine culvert sizes to accommodate a 25-year peak design flow.

The Rational Method was applied. The Intensity-Duration-Frequency (IDF) curve developed by Environment and Climate Change Canada for Rankin Inlet was used (Environment Canada 2014). A 1 in 25 year rainfall intensity for a duration equivalent to the time of concentration of the catchment area was used to determine the design peak flow for each culvert.

### 2.3 Culvert Specifications

The culverts that are proposed will be in service for up to 15 years. The standard galvanized, corrugated steel pipe culvert, with a profile of 68x13 mm and a minimum thickness of 2.0 mm is proposed.

The location and layout for the culverts are shown on drawings 65-417-230-201 and 65-417-230-224 presented in Appendix C.

The design haul trucks to be used at the mine site will be CAT AD60 for underground trucks and Komatsu HD465 model or equivalent for open pit trucks. A minimum of fill cover will be placed over the culverts according to the material thickness and the manufacturer's recommendations for heavy traffic on haul roads as shown in the table provided on drawing 65-417-230-203 presented in Appendix C. The backfill around the culverts will be granular fill 0-50 mm, or an approved equivalent, and will be placed in lifts no greater than 0.3 m thick and compacted to a minimum of 95% of Standard Proctor Maximum Dry Density (ASTM D698). Typical cross-section for the culverts are shown on drawing 65-417-230-203 provided in appendix B.

Table 1 presents the main characteristics of the culverts.

**Table 1: Characteristics of the culverts**

<b>Culvert</b>	<b>#7</b>	<b>#8</b>	<b>#10</b>	<b>#11</b>	<b>#16</b>
Number of pipes x Ø (mm)	2 x Ø600	1 x Ø600	1 x Ø600	2 x Ø800	4 x Ø1200
Length of each culvert (m)	30	32	34	28	39
Slope (%)	1	1	1	1	0.4
Corrugated profile (mm)	68x13	68x13	68x13	68x13	68x13
Thickness (mm)	2.0	2.0	2.0	2.8	2.8
Minimum cover over culvert (mm)	750	750	750	750	850
Estimated Peak Flow (m <sup>3</sup> /s)	0.42	0.05	0.11	0.87	4.98
Culvert Flow Capacity (m <sup>3</sup> /s)	0.73	0.33	0.33	1.43	5.63

## 2.4 Erosion Control

To control erosion, rip rap of diameter 50-300 mm will be installed around the culvert inlet and outlet areas, and on a length of 3 meters minimum. The rip rap material will come from a NPAG source of rock. For the rip rap section, see drawing 65-417-230-203 given in Appendix C.

During the installation of the culverts, if required, straw logs will be used in the work area to prevent total suspended solids from reaching downstream water bodies.



### 3.0 FIGURES AND DRAWINGS

Figure 1 in appendix A presents the location of the mine site.

Figure 2 in appendix B presents the proposed culverts location.

The following construction drawings are presented in Appendix C and present the details for the culverts construction:

- 65-417-230-201 : Haul Road TIRI-01 – Plan and profile – 1+500 to 2+200
- 65-417-230-224 : North and East Haul Road – Plan and profile
- 65-417-230-203 : Typical section for haul road and culverts

### 4.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Agnico Eagle Mines Ltd. and their agents. 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 Ltd., 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 report is subject to the terms and conditions stated in Tetra Tech's Services Agreement.

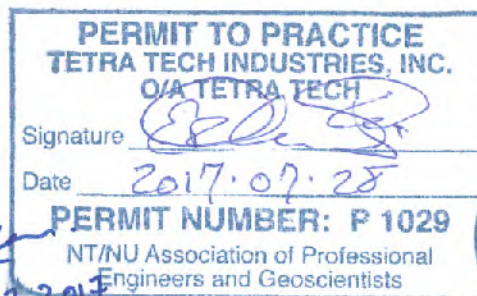
### 5.0 CLOSURE

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

Respectfully submitted,  
Tetra Tech



Prepared by:  
Solène Moreau, Eng.  
Direct Line: 514.257.2427 x3443  
Solene.moreau@tetrattech.com

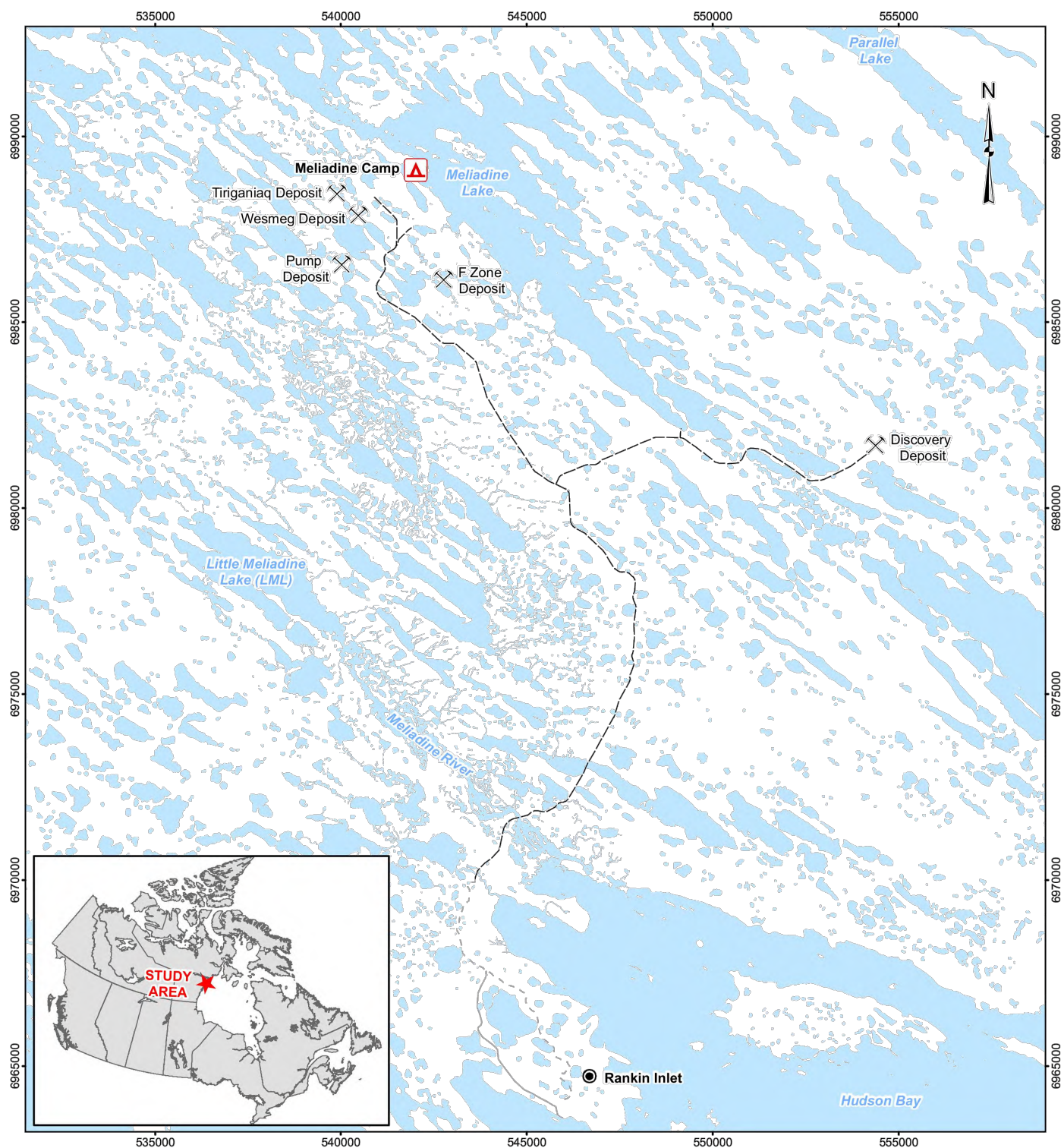


Reviewed by:  
Josée Alarie, P. Eng.  
Direct Line: 514.257.2427 x3323  
Josée.Alarie@tetrattech.com

## APPENDIX A

### Figure 1 – Site Location





**LEGEND**

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

**AGNICO EAGLE – MELIADINE DIVISION**



**AGNICO EAGLE – MELIADINE DIVISION**  
GENERAL PROJECT LOCATION PLAN

No. PROJECT PROJECT No.		DATE 2017-05-04	
DESSINE PAR DRAWN BY	M. SENNADJ	FEUILLE/SHT 1 / 1	
APPROUVE PAR APPROVED BY	R. PANAZAN		
NO. DESSIN DRAWING NO.	FIGURE 1	REVISION A	

## **APPENDIX B**

### **Figure 2 – Proposed Culverts Location**





## APPENDIX C

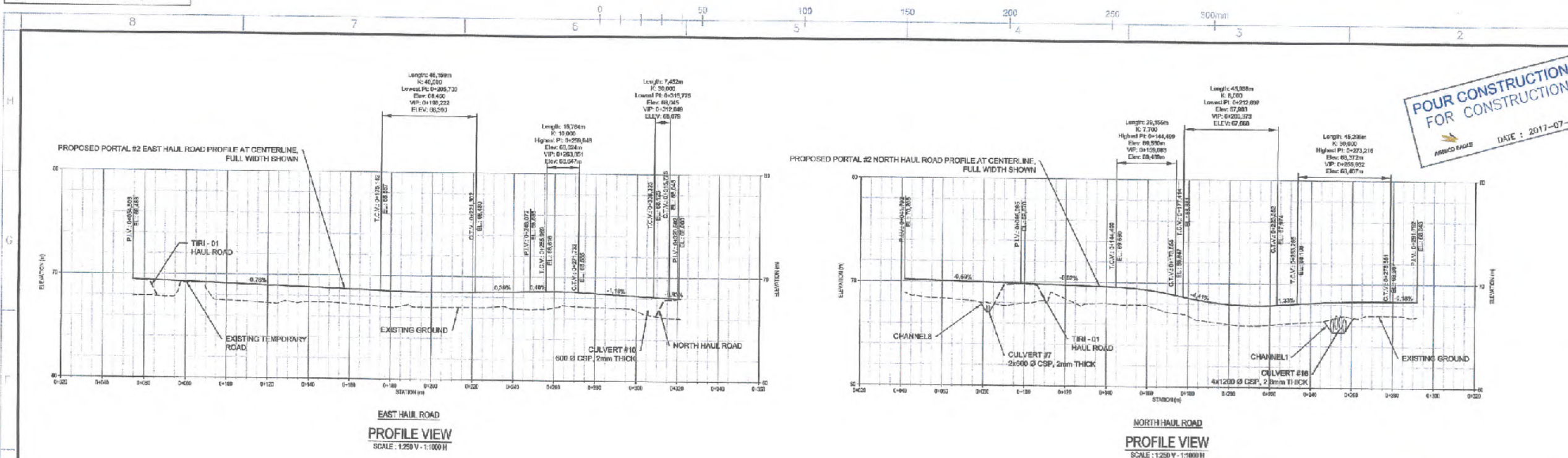
### Construction drawings :

- 65-417-230-201
- 65-417-230-224
- 65-417-230-203









**POUR CONSTRUCTION FOR CONSTRUCTION**

DATE: 2017-07-28



**TETRA TECH**

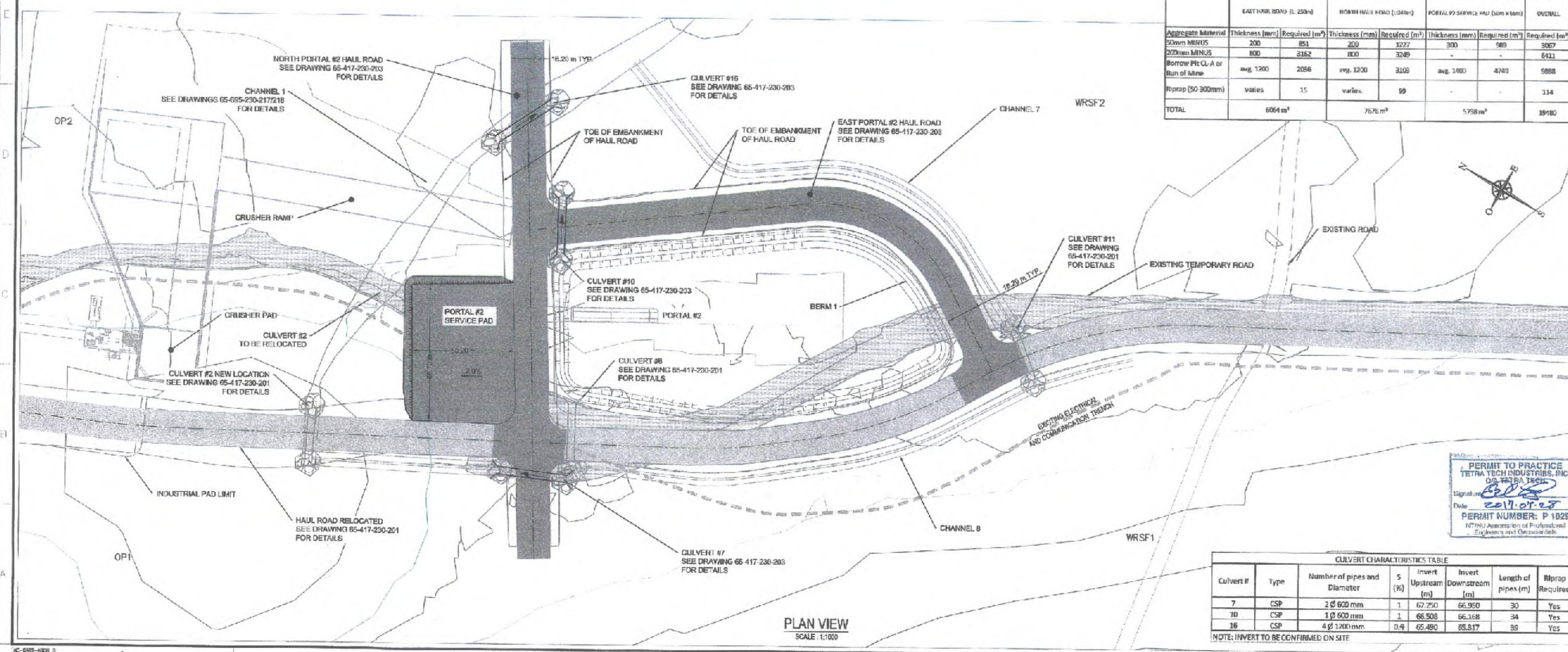
**NOTES GÉNÉRALES / GENERAL NOTES**

1. EXISTING GROUND DATA PROVIDED BY A.C.M.
2. ALL UNITS ARE IN METERS.
3. GRANULAR MATERIAL SHALL BE PLACED IN LIFT NOT EXCEEDING 300mm AND COMPACTED AS INDICATED. BORROWPIT MATERIAL OR RUN OF MINE MATERIAL SHALL BE PLACED IN LIFTS NOT EXCEEDING 300mm AND COMPACTED TO A MIN. OF 95% OF MAXIMUM DRY DENSITY. MOISTURE CONDITIONS MAY BE REQUIRED PRIOR TO COMPACTION.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE SAFETY SECURITY AND RISK OF ALL EXCAVATIONS, BACKFILL AND SHALL ABIDE BY ALL RELEVANT STANDARDS AND REGULATIONS THE STABILITY, DEMARCATION AND MAINTENANCE OF ALL EXCAVATIONS OR BACKFILL SHALL BE CONTRACTOR'S RESPONSIBILITY.
5. TYPICAL FILL SLOPE TO BE 1:2.5H. FILL SLOPE TO BE COMPROMISED IN THE FIELD BY GEOTECHNICAL ENGINEER.
6. THE LOCATION ELEVATION AND LENGTH OF CULVERT GROUP SHALL BE CONFIRMED ON SITE.
7. FOR SUMMER CONSTRUCTION GEOTEXTILE SHALL BE INSTALLED BETWEEN THE ORIGINAL GROUND AND THE GRANULAR MATERIAL. WHEREVER THE ORIGINAL GROUND IS UNSTABLE TO SUPPORT FILL MATERIAL COMPACTION.

**QUANTITY CONSTRUCTION CHART\***

\* QUANTITIES MEASURED IN METERS

	EAST HAUL ROAD (L 250m)		NORTH HAUL ROAD (L 250m)		PORTAL #2 SERVICE PAD (L 250m)		OVERALL
	Thickness (mm)	Required (m³)	Thickness (mm)	Required (m³)	Thickness (mm)	Required (m³)	Required (m³)
Aggregate Material							
50mm MINUS	200	851	200	1227	300	589	3067
200mm MINUS	800	3162	800	3249	-	-	6411
Borrow Pit CL-A or Run of Mine	avg. 1200	2056	avg. 1200	2105	avg. 1200	4243	5888
Riprap (50 300mm)	varies	15	varies	99	-	-	114
<b>TOTAL</b>		<b>6064 m³</b>		<b>7676 m³</b>		<b>5758 m³</b>	<b>19480</b>



**PERMIT TO PRACTICE**  
TETRA TECH INDUSTRIES, INC.  
DATE: 2017-07-28  
Signature: [Signature]  
Date: 2017-07-28  
PERMIT NUMBER: P 1029  
ATTN: Association of Professional Engineers and Geoscientists

**CULVERT CHARACTERISTICS TABLE**

Culvert #	Type	Number of pipes and Diameter	S (%)	Invert Upstream (m)	Invert Downstream (m)	Length of pipes (m)	Riprap Required
7	CSP	2 @ 600 mm	1	67.250	66.950	30	Yes
10	CSP	1 @ 600 mm	1	66.508	66.168	34	Yes
16	CSP	4 @ 1200 mm	0.4	65.480	65.517	38	Yes

NOTE: INVERT TO BE CONFIRMED ON SITE

**DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS**

REV.	DATE	DESCRIPTION
1	2017-07-28	ISSUED FOR CONSTRUCTION
2	2017-08-02	ISSUED FOR COMMENTS
3	2017-08-02	ISSUED FOR COMMENTS

**AGNICO EAGLE**

**REVISIONS**

REV.	DATE	DESCRIPTION	BY	APP.
1	2017-07-28	ISSUED FOR CONSTRUCTION	ALANIE JOSE	ALANIE JOSE
2	2017-08-02	ISSUED FOR COMMENTS	CHRISTOPHER MORIN	CHRISTOPHER MORIN

**TIME / TITLE**

AGNICO EAGLE - DIVISION  
417 - HAUL ROAD - INDUSTRIAL SITE  
230 - GENERAL EARTH WORKS  
NORTH & EAST PORTAL #2 HAUL ROAD  
PLAN / PROFILE

**DESIGNER**  
MOURAD SENHADJ  
DATE: 2017-05-05

**CHECKED BY**  
CHRISTOPHER MORIN  
DATE: 2017-08-02

**APPROVED BY**  
ALANIE JOSE  
DATE: 2017-08-02

**SCALE**  
AS SHOWN  
DATE: 2017-08-02

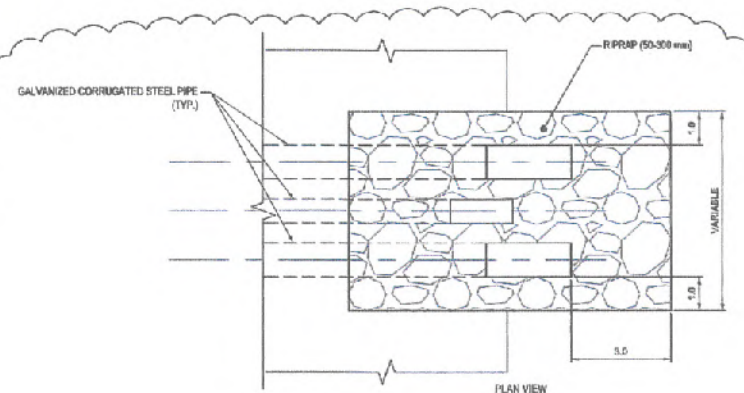
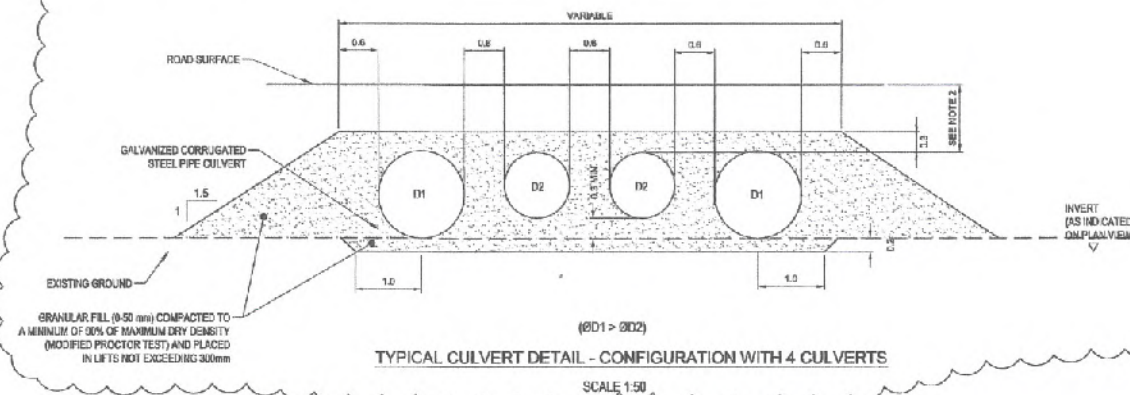
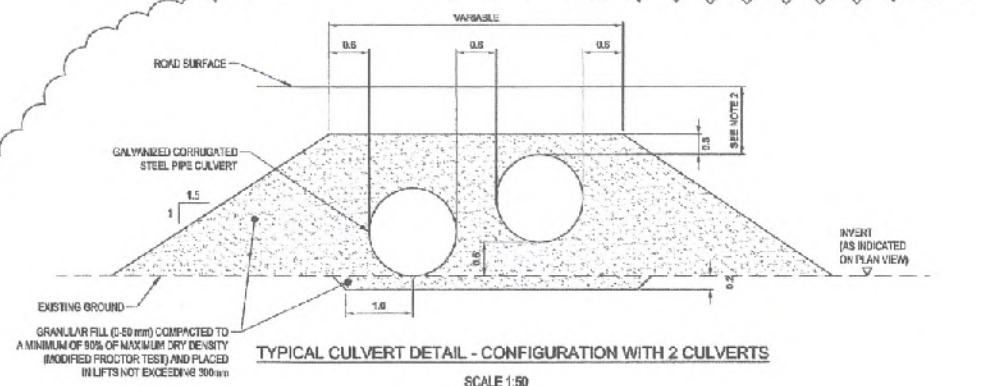
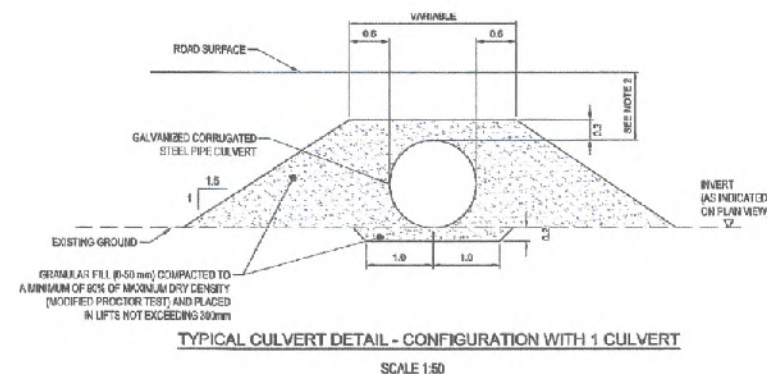
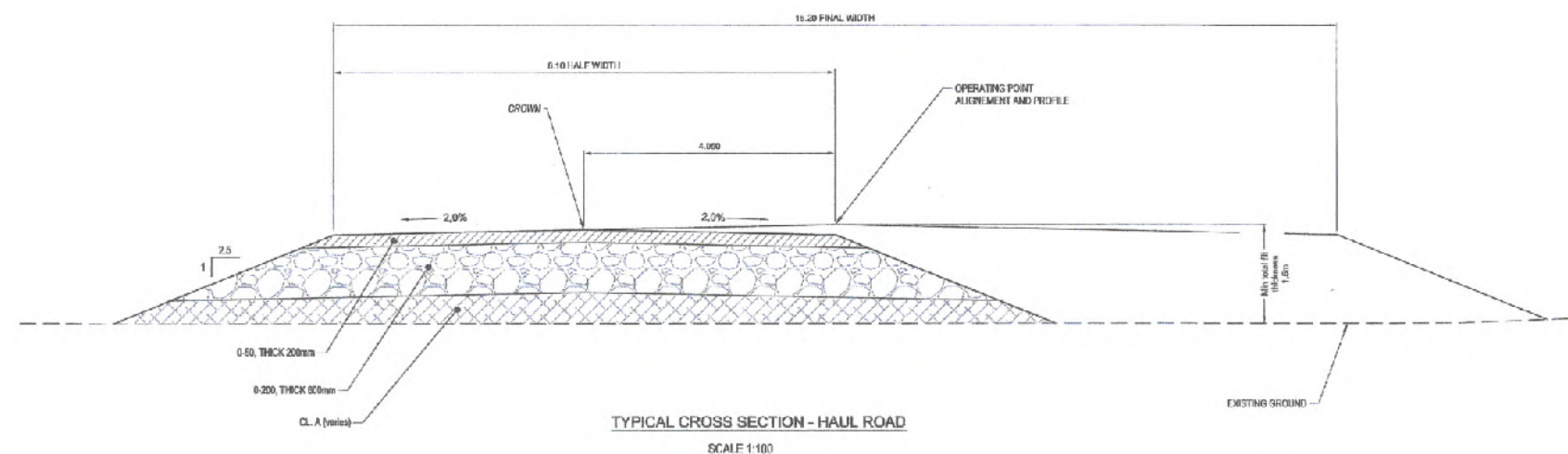
**NO. DESIGN DRAWING NO.**  
65-417-230-224

**NO. PROJECT PROJECT NO.**  
6515 / 28920

**REVISION**  
0

**FEEDBACK / RIT**  
1 / 1





Notes:

- Culverts are provided by AEM. Culverts will be Galvanized Corrugated Pipes, with a profile of 68x13 mm.
- At any time, the minimum backfill cover indicated in the table below shall be respected.

CULVERT DIAMETER (mm)	GAUGE (mm)	PROFILE (mm)	MIN COVER (mm) (required at any time)
600	2	68x13	750
700	2	68x13	800
800	2.8	68x13	825
900	2.8	68x13	825
1000	2.8	68x13	850
1200	2.8	68x13	850

- The installation of the culverts shall be conform to the Manufacturer instructions.
- The maximum allowable slope for culverts is 6%. Install RipRap to fill the gap between the pipe bottom and the existing ground if required.

PLAN, ELEV  
NOTES

**TETRA TECH**

NOTES GÉNÉRALES / GENERAL NOTES

**POUR CONSTRUCTION  
FOR CONSTRUCTION**  
DATE : 2017-07-28

AGNICO EAGLE

REV.	DATE	DESCRIPTION	FOR/AS APPL. CLIENT
2	2017-07-28	REVISED FOR CONSTRUCTION	S.M. J.A.
1	2017-07-28	REVISED FOR CONSTRUCTION	A.M. J.A.
0	2017-07-28	REVISED FOR CONSTRUCTION	A.M. J.A.
A	2017-07-28	REVISED FOR CONSTRUCTION	P.J. J.A.
A	2017-07-28	REVISED FOR CONSTRUCTION	P.J. J.A.

PERMIT TO PREPARE THIS  
DRAWING FOR CONSTRUCTION  
Signature: *[Signature]*  
Date: 2017-07-28  
PERMIT NUMBER: P 1029  
NTS/NTS Association of Professional  
Engineers and Geoscientists

DATE / DATE: 2015-08-14  
AGNICO-EAGLE - DIVISION  
417 - HAUL ROAD - INDUSTRIAL SITE TO TRIGANUK  
230 - GENERAL EARTH WORKS  
TYPICAL SECTION  
HAUL ROAD

DESIGNED BY	CHECKED BY	APPROVED BY	DATE
PATRICK HAMEL	SOLENE MOREAU	JOSEF ALARIE	2015-08-14

NO. DESIGN  
65-417-230-203

NO. PROJECT  
6515/28920

REVISION  
2

FILE / SHF  
/