AGNICO EAGLE

MELIADINE GOLD MINE

Groundwater Management Plan

MARCH 2019
VERSION 4

EXECUTIVE SUMMARY

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

The Mine Plan proposes mining methods for the development of the Tiriganiaq gold deposit, with two open pits (Tiriganiaq Pit 1 and Tiriganiaq Pit 2) and one Underground Mine. Based on the current Mine Plan, the Mine will produce approximately 14.9 million tonnes (Mt) of ore, 31.4 Mt of waste rock, 7.1 Mt of overburden waste, and 14.9 Mt of tailings (Agnico Eagle 2019). There are four phases to the development of the Mine; just over 4 years of construction (Q4 Year -5 to Q2 Year -1)), 8.5 years of Mine operation (Q2 Year 1 to Year 8), 3 years of closure (Year 9 to Year 11), and post-closure (Year 11 forwards).

Tiriganiaq Underground Mine is planned to extend to approximately 625 m below the ground surface; therefore, part of the Underground Mine will operate below the base of the continuous permafrost. The underground excavations will act as a sink for groundwater flow during operation, with water induced to flow through the bedrock to the Underground Mine workings once the Mine has advanced below the base of the permafrost. Over 2018, there was a net positive balance of stored underground water. The mean daily addition to underground water storage was estimated at 51 m^3/day. Groundwater quality data from samples taken underground 2017 through 2018 from diamond drillholes (DDHs) indicate TDS concentrations are less than predicted at an average concentration of 56,000 mg/L.

Saline water generated from the Underground Mine is currently stored underground and on surface at the P-Area and in Saline Pond 1 (SP1). A second containment pond, Saline Pond 2 (SP2), is being constructed in Q1 2019 and will be an addition to the surface saline water containment system. Saline groundwater stored on site is currently pumped to the Saline Water Treatment Plan (SWTP) for treatment and discharge to CP1. As part of the strategy to manage excess groundwater infiltration of saline water within the underground portion of the mine, Agnico Eagle received approval from the Nunavut Impact Review Board to discharge saline water to the sea (Melvin Bay, Rankin Inlet). Total dissolved solids of water discharged to sea and daily discharge volumes will not exceed 39,600 mg/L and 800 m^3/day, respectively.

This document presents the Groundwater Management Plan (GWMP) for the collection, treatment, storage and discharge of saline groundwater in accordance with Agnico Eagle's Type A Water Licence 2AM-MEL1631, Part E, Item 14.

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ᐊᒡᓃᑯ ᐃᒎ ᐅᔭᕋᒃᑕᕆᐊᒃᑯᑦ (ᐊᒡᓃᑯᒃᑯᑦ) ᑕᓯᕐᔪᐊᕐᒥᑦ ᐅᔭᕋᒃᑕᕆᐊᓕᐅᖅᐸᓪᓕᐊᔪᑦ (ᐅᔭᕋᒃᑕᕆᐊᖅ), 25 ᑭᓵᒥᑕᓂᒃ ᐅᖓᓯᒃᑎᒋᔪᖅ ᐅᐊᖕᓇᖓᓂᑦ ᑲᖏᖅᖠᓂᐅᑉ, ᐊᒻᒪᓗ 80 ᑭᓵᒥᑕᓂᒃ ᐅᖓᓯᒃᑎᒋᑉᓗᓂ ᓂᒡᒋᐊᓂᑦ ᐱᖓᖓᖅᐸᓯᐊᓂᑦ ᐃᒡᓗᓕᕆᕐᔫᑉ ᑭᕙᓪᓕᕐᒥᑦ ᓄᓇᕗᒻᒥᑦ.

ᐅᔭᕋᒃᑕᕆᐊᕐᒧᑦ ᐸᕐᓇᐅᑎ ᐅᔭᕋᒃᑕᕐᓂᕐᒧᑦ ᐱᓕᕆᐊᖃᕈᒪᔪᑦ ᐊᑐᖅᑕᐅᓂᐊᖅᑐᓂᒃ ᐱᕙᓪᓕᐊᓗᒍ ᑎᕆᒐᓂᐊᖅ ᒎᓗᑕᓕᒃ, ᒪᕐᕉᖕᓂᒃ ᓄᓇᒥᑦ ᐅᒃᑯᐃᖓᔪᓂᑦ (ᑎᕆᒐᓂᐊᖅ 1 ᐊᒻᒪᓗ ᑎᕆᒐᓂᐊᖅ 2) ᐊᒻᒪᓗ ᐊᑕᐅᓯᖅ ᓄᓇᐅᑉ ᐃᓗᐊᓂᑦ ᐅᔭᕋᒃᑕᕐᓂᖅ. ᒪᓕᒃᓱᒍ ᒫᓐᓇᐅᔪᖅ ᐅᔭᕋᒃᑕᕆᐊᕐᒧᑦ ᐸᕐᓇᐅᑎ, ᐅᔭᕋᒃᑕᕆᐊᖅ 14.9 ᒥᓕᔭᓐ ᑖᓐ-ᓗᐊᓂᒃ ᐅᔭᕋᒃᑕᖃᑦᑕᕐᓂᐊᖅᑐᑦ, 31.4 ᒥᓕᔭᓐ ᑖᓐ-ᓂᒃ ᐊᒃᑖᖅᑕᐅᔪᓂᒃ ᐅᔭᖅᑲᓂᒃ, 7.1 ᒥᓕᔭᓐ ᑖᓐ-ᓂᒃ ᐅᖓᑕᐅᑦᑎᔪᓂᒃ ᐊᒃᑖᖅᑕᐅᔪᓂᒃ, ᐊᒻᒪᓗ 14.9 ᒥᓕᔭᓐ ᑖᓐ-ᓂᒃ ᕿᒪᒃᑎᑦᑐᓂᒃ (ᐊᒡᓃᑯᒃᑯᑦ 2019). ᓯᑕᒪᐅᓕᖓᓂᐊᖅᑐᖅ ᐱᕙᓪᓕᐊᓂᖅ ᐅᔭᕋᒃᑕᕆᐊᕐᒥᑦ; ᓯᑕᒪᓄᑦ ᐅᑭᐅᖏᓐᓇᕐᓄᑦ ᓴᓇᔭᐅᓗᓂ (Q4 ᐅᑭᐅᖅ - 5-ᒥᑦ Q2 ᐅᑭᐅᖅ - 1-ᒧᑦ)), 8.5 ᐅᑭᐅᓂᒃ ᐊᐅᓚᕐᓗᓂ ᐅᔭᕋᒃᑕᕆᐊᕐᓂᖅ (Q2 ᐅᑭᐅᖅ 1-ᒥᑦ ᐅᑭᐅᖅ 8-ᒧᑦ), ᐱᖓᓱᓂᒃ ᐅᑭᐅᓂᒃ ᐅᒃᑯᐊᖅᐸᓪᓕᐊᓗᒍ (ᐅᑭᐅᖅ 9-ᒥᑦ ᐅᑭᐅᖅ 11-ᒧᑦ), ᐊᒻᒪᓗ ᐅᒃᑯᐊᖅᓯᒪᓕᖅᑎᓪᓗᒍ (ᐅᑭᐅᖅ 11-ᒥᑦ ᐅᖓᑖᓄᑦ).

ᑎᕆᒐᓂᐊᖅ ᓄᓇᐅᑉ ᐃᓗᐊᓂᑦ ᐅᔭᕋᒃᑕᕐᓂᖅ ᐊᑦᑎᒃᓯᒋᐊᖅᑕᐅᒃᑳᓂᕐᓂᐅᔭᖅᑐᖅ 625 ᒦᑕᓂᒃ ᓄᓇᐅᑉ ᖃᖓᑕ ᐊᑖᓄᑦ; ᑕᐃᒪᓐᓇᒧᑦ, ᐃᓚᖓ ᓄᓇᐅᑉ ᐃᓗᐊᓂᑦ ᐅᔭᕋᒃᑕᕆᐊᖅ ᐊᐅᓛᕐᓂᐊᖅᑐᖅ ᑭᒡᓕᒋᔭᐅᔪᖅ ᕿᐊᖑᐃᓐᓇᐅᔭᖅᑑᑉ ᐊᑖᓂᑦ. ᓄᓇᐃᔭᐃᓂᖅ ᓄᓇᐅᑉ ᐃᓗᐊᓂᑦ ᐃᒻᒥᖅᑐᕐᓂᐊᖅᑐᖅ ᑯᕙᔪᒥᒃ ᐃᒪᕐᒥᒃ ᐊᐅᓚᖅᑎᑦᑎᓂᐅᑎᓪᓗᒍ, ᐃᒪᖅ ᑯᕕᑎᑕᐅᓗᓂ ᐅᔭᕐᒧᑦ ᓄᓇᐅᑉ ᐃᓗᐊᓂᑦ ᐅᔭᕋᒃᑕᕆᐊᕐᒥᑦ ᐱᓕᕆᕝᕕᐅᔪᒥᑦ ᕿᐊᖑᐃᓐᓇᐅᔭᖅᑑᑉ ᐊᑖᓄᑦ ᐅᔭᕋᒃᑕᕆᐊᖅ ᓯᕗᒻᒧᒃᓯᒪᓕᖅᑎᓪᓗᒍ. 2018-ᒥᑦ, ᐂᖅᓯᕝᕙᐅᖅᑳᖅᑎᓪᓗᒍ ᐱᐅᔪᒥᒃ ᓄᓇᐅᑉ ᐃᓗᐊᓂᑦ ᑐᖅᑯᖅᑕᐅᓯᒪᔪᖃᓚᐅᖅᑐᖅ ᐃᒪᕐᒥᒃ. ᖃᐅᑕᒫᒃᑯᑦ ᐃᓚᕙᓪᓕᐊᔪᖅ ᓄᓇᐅᑉ ᐃᓗᐊᓃᑦᑐᒧᑦ ᐃᒪᕐᒧᑦ ᑐᖅᑯᖅᓯᒪᔪᖅ ᓇᓚᐅᑦᑖᖅᑕᐅᔪᖅ 51 m^3-ᖑᐸᓗᓂ/ᖃᐅᑕᒦᖅ. ᓄᓇᐅᑉ ᐃᓗᐊᓂᑦ ᐃᒪᐅᑉ ᖃᓄᐃᓐᓂᖓᓄᑦ ᓈᓴᐅᑏᑦ/ᑎᑎᖅᑲᐃᑦ ᐆᒃᑐᕋᕈᑎᓂᑦ ᐱᔭᐅᔪᑦ ᓄᓇᐅᑉ ᐃᓗᐊᓂᑦ 2017-ᒥᑦ 2018-ᒧᑦ ᓯᑎᔪᓂᒃ ᐅᔭᖅᑲᓂᒃ ᐃᑰᑕᖅᑕᐅᓯᒪᔪᓂᑦ, ᓇᓗᓇᐃᖅᓯᔪᑦ TDS ᑲᑎᑎᓯᒪᔪᑦ ᐊᒥᓲᖕᒋᓐᓂᖅᓴᐅᓂᖏᓐᓄᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᓚᐅᖅᑐᓂᐅᖓᓂᑦ ᐊᑕᐅᓯᖕᖑᖅᓱᒍ ᓈᓴᐅᑎ ᑲᑎᓯᒪᔪᓂᑦ 56,000 mg/L-ᖑᐸᓗᓂ.

ᑕᕆᐅᓕᒃ ᐃᒪᖅ ᐱᔪᖅ ᓄᓇᐅᑉ ᐃᓗᐊᓂᑦ ᐅᔭᕋᒃᑕᕆᐊᕐᒥᑦ ᒦᓐᓇᐅᔪᖅ ᑐᖅᑯᖅᑕᐅᖃᑦᑕᖅᑐᖅ ᓄᓇᐅᑉ ᐃᓗᐊᓂᑦ ᐊᒻᒪᓗ ᖄᖓᓂᑦ P-ᐃᓂᐅᔪᒧᑦ ᐊᒻᒪᓗ ᑕᕆᐅᓕᒃ ᑕᓯᕋᔭᒃ 1-ᒧᑦ (SP1). ᑐᓪᓕᐊ ᑕᓯᕋᔭᒃ, ᑕᕆᐅᓕᒃ ᑕᓯᕋᔭᒃ 2 (SP2), ᓴᓇᔭᐅᕙᓪᓕᐊᔪᖅ Q1 2019-ᒥᑦ ᐊᒻᒪᓗ ᐃᓚᓕᐅᑎᔭᐅᓂᐊᖅᑐᖅ ᖄᖓᓂᑦ ᑕᕆᐅᓕᒃ ᐃᒪᖃᐅᓯᕝᕙᖕᒧᑦ. ᑕᕆᐅᓕᒃ ᓄᓇᒥᑦ ᐃᒪᖅ ᑐᖅᑯᖅᑕᐅᓂᐊᖅᑐᖅ ᐅᔭᕋᒃᑕᕆᐊᕐᒥᑦ ᑯᕕᑎᑕᐅᖃᑦᑕᖅᑐᖅ ᑕᕆᐅᓕᒃ ᐃᒪᓕᕆᕝᕕᖕᒧᑦ (SWTP) ᐱᓕᕆᐊᖑᓂᐊᕐᓗᓂ ᐊᒻᒪᓗ ᑯᕕᑎᑕᐅᓗᓂ CP1-ᒧᑦ. ᐃᓚᒋᔭᐅᑉᓗᓂ ᖃᓄᖅᑑᕆᓂᕐᒧᑦ ᐊᐅᓚᓐᓂᐊᕐᓗᒍ ᐱᑕᖃᓗᐊᕐᓂᖅ ᓄᓇᒥᑦ ᐃᒪᖅ ᓴᓗᒪᐃᔭᐃᔾᔪᑎ ᑕᕆᐅᓕᖕᒥᑦ ᐃᒪᕐᒥᒃ ᓄᓇᐅᑉ ᐃᓗᐊᓂᑦ ᐅᔭᕋᒃᑕᕆᐊᕐᒥᑦ, ᐊᒡᓃᑯᒃᑯᑦ ᓈᒻᒪᒋᔭᐅᔪᒥᒃ ᐱᓚᐅᖅᑐᑦ ᐊᕙᑎᓕᕆᔩᒃᑯᓐᓂᑦ ᑯᕕᑎᓐᓂᐊᕐᓗᒍ ᑕᕆᐅᓕᒃ ᐃᒪᖅ ᑕᕆᐅᕐᒧᑦ (ᐃᑎᕝᕙᐊᓄᑦ, ᑲᖏᖅᖠᓂᕐᒥᑦ). ᑲᑎᕝᕙᒋᑦ ᓄᖑᑎᖅᓯᒪᔪᑦ ᓯᑎᔪᐃᑦ ᐃᒪᕐᒥᑦ ᑯᕙᔭᐅᔪᖅ ᑕᕆᐅᕐᒧᑦ ᐊᒻᒪᓗ ᖃᐅᑕᒦᑦ ᑯᕙᔪᑦ ᐅᖓᑕᐅᑦᑎᔾᔮᙱᑦᑐᑦ 39,600 mg/ᓖᑕᓂᒃ ᐊᒻᒪᓗ 800 m^3/ᐅᓗᑕᒦᑦ.

ᑖᒻᓇ ᑎᑎᖅᑲᖅ ᐱᔾᔪᑎᖃᖅᑐᖅ ᓄᓇᒥᑦ ᐃᒪᕐᒥᒃ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᐸᕐᓇᐅᑎᒥᒃ ᑲᑎᖅᓱᐃᓂᕐᒧᑦ, ᐱᓕᕆᐊᕆᓗᒍ, ᑐᖅᑯᕐᓗᒍ ᐊᒻᒪᓗ ᑯᕕᑎᓗᒍ ᑕᕆᐅᓕᒃ ᓄᓇᒥᑦ ᐃᒪᖅ ᒪᓕᒡᓗᒋᑦ ᐊᒡᓃᑯᒃᑯᑦ Type A ᐃᒪᕐᒧᑦ ᓚᐃᓴᓐᓯᖓᑦ 2AM-MEL1631, ᐊᕕᒃᓯᒪᓂᖓ E, ᑎᑎᕋᖅᓯᒪᔪᖅ 14.

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1	February 2018	All		In compliance with Agnico Eagle's Type A Water Licence 2AM-MEL1631, Part E, Item 14	Golder Associates Ltd. on behalf of Agnico Eagle Mines Limited
2	June 2018	4		In compliance with ECCC comments from 16 March 2018	Golder Associates Ltd. on behalf of Agnico Eagle Mines Limited
3.	December 2018	All		In compliance with Agnico Eagle's Type A Water Licence 2AM-MEL1631, Part E, Item 11	Agnico Eagle Mines Ltd.
		Exec Summary		Updated dates and quantities	
		2.4		Revised mine development plan bullets	
		3.3		Updated saline GW quality	
		3.4		Updated groundwater management strategies	
		4.1		Updated GW monitoring program quantity and quality data	
		4.4		Expanded table 5 monitoring to include SWTP	
4.	March 2019	All		In compliance with Agnico Eagle's amended No. 006 Project Certificate, Condition No. 25	Agnico Eagle Mines Ltd.
		Exec Summary		Updated to include discharge to sea approval	
		1	1-2	Update to include requirements of No. 006 Project Certificate Condition No. 25	
		2.4	5	Addition of SWTP and discharge to sea	
		3.1	6-7	Section revision	
		3.1.1	7-8	Addition of inflow model assumptions/uncertainties	
		3.2	8-9	Updated with discharge to sea	
		3.3	9-10	Interpretation added and table Aug-18 results corrected	
		3.4	11-15	Addition of discharge to sea and update of SWTP performance	
		3.6	16-18	Addition of mitigation measures under greater than expected inflows	
		4.2	19	Addition of second pumping line from UG	
		4.3	21-23	Addition of discharge to sea related sampling/monitoring	

ACRONYMS

Agnico Eagle	Agnico Eagle Mines Limited
ANFO	Ammonium Nitrate/Fuel Oil
CP	Collection Pond
DDH	Diamond Drillhole(s)
EMPP	Environment Management and Protection Plan
EWTP	Effluent Water Treatment Plant
FEIS	Final Environmental Impact Statement
GWMP	Groundwater Management Plan
MDMER	Metal and Diamond Mining Effluent Regulations
NIRB	Nunavut Impact Review Board
NWB	Nunavut Water Board
Mine	Meliadine Gold Mine
QA	Quality Assurance
QC	Quality Control
RO	Reverse Osmosis
SD	Support Document
SSWQO	Site Specific Water Quality Objectives
SWTP	Saltwater Treatment Plant
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
WMP	Water Management Plan

UNITS

%	percent
°C	degrees Celsius
°C/m	degrees Celsius per metre
ha	hectare(s)
mg/L	milligram(s) per litre
km	kilometer(s)
km^2	kilo square meter(s)
m	metre(s)
m/day	metre(s) per day
mm	millimetre(s)
m^3	cubic metre(s)
m^3/day	cubic metre(s) per day
m^3/s	cubic metre(s) per second
m^3/hour	cubic metre(s) per hour
m^3/year	cubic metre(s) per year
Mm^3/year	million cubic metre(s) per year
Mm^3	million cubic metre(s)
t	tonne(s)
tpd	tonne(s) per day
Mt	million tonne(s)

SECTION 1 • INTRODUCTION

Agnico Eagle Mines Limited (Agnico Eagle) is developing the Meliadine Gold Mine (Mine), located approximately 25 kilometres (km) north of Rankin Inlet, and 80 km southwest of Chesterfield Inlet in the Kivalliq Region of Nunavut. The Mine is subject to the terms and conditions of both the Mine Project Certificate (No. 006) issued by the Nunavut Impact Review Board in accordance with the Nunavut Agreement Article 12.5.12 on February 26, 2015 and Nunavut Water Board Type A Water Licence (No. 2AM-MEL1631, 2016) issued by the Nunavut Water Board (NWB) on April 1, 2016.

This document presents the Groundwater Management Plan (GWMP) for the collection, treatment, storage and discharge of saline groundwater in accordance with the Type A Water Licence 2AM-MEL1631 (Licence) and in accordance with Condition No. 25 of the amended Mine Project Certificate. The overall water management plan for the life of the Mine and post-closure is described in the Agnico Eagle Meliadine Gold Mine 2019 Water Management Plan (WMP) (Version 6). The WMP provides descriptions of the Mine water control structures and associated design criteria. The WMP was updated in March 2019 and reflects the groundwater management strategy presented in this document.

1.1 Concordance

The Mine is subject to the land and resource management processes established by the Nunavut Agreement and other Federal laws and regulations. Agnico Eagle submitted a Licence Application for a Mining and Milling Undertaking (Application) required to use water and to deposit waste in development of the Mine, in accordance with the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* and Nunavut Water Regulations.

The Licence was issued on April 1, 2016 and signed by the Minister on May 19, 2016. The GWMP reflects the commitments made with respect to submissions provided during the technical review of the Application, as well as final submissions and issues raised during the Public Hearing Process, where applicable, to comply with Part B Section 13, and Part E Section 14 of the Licence.

In 2018, Agnico Eagle submitted a Saline Effluent Discharge proposal to the Nunavut Impact Review Board (NIRB). NIRB provided approval and issued the amended Mine Project Certificate for the Meliadine Gold Mine Project to Agnico Eagle on February 26, 2019. The GWMP reflects the revised Condition No. 25, which states the Proponent shall submit a detailed Groundwater Management Plan to the NIRB that includes mitigation measures under greater than expected groundwater inflow rates, treatment and disposal methods for discharge to sea, and details of its plan to monitor saline water at site.

1.2 Objectives

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

- Introductory section (Section 1);
- A brief summary of the physical setting at the mine site and the mine development plan (Section 2);
- A description of groundwater inflow forecasts and management strategies (Section 3); and
- A description of the groundwater monitoring program (Section 4);
- A description of the measures in place to ensure quality control and quality assurance is maintained in groundwater monitoring (Section 5).

The GWMP will be updated as required to reflect any changes in operations or economic feasibility that occurs, and to incorporate new information and latest technology, where appropriate, to comply with Part B Section 15 of the Licence.

SECTION 2 • BACKGROUND

2.1 Site Conditions

The Mine is located in an area of poorly drained lowlands near the northwest coast of Hudson Bay. The dominant terrain in the Mine area consists of glacial landforms such as drumlins (glacial till), eskers (gravel and sand), and many small lakes. The topography is gently rolling with a mean elevation of 65 metres above sea level (masl) and a maximum relief of 20 metres (m).

The local overburden consists of a thin layer of topsoil overlying silty gravelly sand glacial till. Cobbles and boulders are present throughout the region at various depths. Bedrock at the mine site area consists of a stratigraphic sequence of clastic sediments, oxide iron formation, siltstones, graphitic argillite and mafic volcanic flows (Snowden 2008; Golder 2009).

The climate is extreme in the area, with long cold winters and short cool summers, and mean air temperatures of 12 °C in July and -31 °C in January. The mean annual air temperature at the Mine site is approximately -10.4 °C (Golder 2012a). Strong winds blow from the north and north-northwest direction more than 30 percent of the time.

The mean annual precipitation in the area is approximately 412 mm and is typically equally split between rainfall and snowfall.

Late-winter ice thicknesses on freshwater lakes in the mine site area were recorded from 1998 to 2000. The measured data indicated that ice thickness ranges from 1.0 to 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 ice melt typically begins in mid-June and is complete by early July (Golder 2012b).

2.2 Local Hydrology

The Mine is located within the Meliadine Lake watershed. Meliadine Lake has a surface water area of approximately 107 square kilometres (km^2), a maximum length of 31 km, features a highly convoluted shoreline of 465 km and has over 200 islands. Unlike most lakes, it has two outflows that drain into Hudson Bay through two separate river systems. It has a drainage area of 560 km^2 from its two outflows. Most drainage occurs via the Meliadine River, which originates at the southwest end of the lake. The Meliadine River flows for a total stream distance of 39 km. The Meliadine River flows through a series of waterbodies, until it reaches Little Meliadine Lake and then continues into Hudson Bay. A second, smaller outflow from the west basin of Meliadine Lake drains into Peter Lake, which discharges into Hudson Bay through the Diana River system (a stream distance of 70 km). At its mouth, the Diana River has a drainage area of 1,460 km^2.

Watersheds in the Mine area are comprised of an extensive network of waterbodies, and interconnecting streams. The hydrology of these watersheds is dominated by lake storage and evaporation.

2.3 Hydrogeology

The Mine is located in an area of continuous permafrost. Based on thermal studies and measurements of ground temperatures, the depth of permafrost at the mine site is estimated to be in the order of 360 to 495 m. The depth of the active layer ranges from about 1 m in areas with shallow overburden, up to about 3 m adjacent to the lakes. The depth of the permafrost and active layer varies depending on proximity to the lakes, overburden thickness, vegetation, climate conditions, and slope direction (Golder 2012b). The typical permafrost ground temperatures at the depths of zero annual amplitude are in the range of -5.0 to -7.5 °C in the areas away from lakes and streams. The geothermal gradient ranges from 0.012 to 0.02 °C/m (Golder 2012c).

Groundwater characteristics at the Mine are detailed in Final Environmental Impact Statement (FEIS) Volume 7, Section 7.2 Hydrogeology and Groundwater, and in an updated hydrogeological assessment completed for the Mine (Golder 2016). The groundwater characteristics for the Mine are briefly summarized herein.

Two groundwater flow regimes in areas of continuous permafrost are generally present:

- a deep groundwater flow regime beneath the base of the permafrost; and
- a shallow flow regime located in an active (seasonally thawed) layer near the ground surface.

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. Mine area groundwater in the active layer flows to local depressions and ponds that drain to larger lakes.

Taliks exist beneath waterbodies that have sufficient depth such that they do not freeze to the bottom over the winter. Beneath small waterbodies that do not freeze to the bottom over the winter, a talik bulb that is not connected to the deep groundwater flow regime will form (a closed talik). Elongated waterbodies with terraces (where the depth is within the range of winter ice thickness), a central pool(s) (where the depth is greater than the range of winter ice thickness), and a width of 340 to 460 m or greater are expected to have open taliks extending to the deep groundwater flow regime at the Mine site. A review of bathymetric data, ice thickness data, and results of thermal modelling suggests that Meliadine Lake and Lake B7 are likely to have open taliks connected to the deep groundwater flow regime (Golder 2012a).

Tiriganiaq Underground Mine is planned to extend to approximately 625 m below the ground surface; therefore, part of the underground mine will be operated below the base of the frozen permafrost (top of the cryopeg). The underground excavations will act as a sink for groundwater flow during operation, with water induced to flow through the bedrock to the underground mine workings once the mine has advanced below the base of the frozen permafrost.

Both Tiriganiaq Pit 1 and Tiriganiaq Pit 2 will be mined within the frozen permafrost, therefore, groundwater inflows to the open pits is expected to be negligible and were not considered in the WMP.

2.4 Mine Development Plan

The Mine Plan proposes mining methods for the development of the Tiriganiaq gold deposit, with two open pits (Tiriganiaq Pit 1 and Tiriganiaq Pit 2) and one Underground Mine. Based on the current Mine Plan, the Mine will produce approximately 14.9 million tonnes (Mt) of ore, 31.4 Mt of waste rock, 7.1 Mt of overburden waste, and 14.9 Mt of tailings (Agnico Eagle 2019). The following phased approach is proposed for the development of the Tiriganiaq gold deposit:

- Tiriganiaq underground mine will be developed and operated from Year -5 to Year 7;
- Tiriganiaq Pit 1 will be mined from Year 2 to Year 7; and
- Tiriganiaq Pit 2 will be mined from Year 4 to Year 7.

Mine facilities on surface include a plant site and accommodation buildings, two ore stockpiles, a temporary overburden stockpile, a tailings storage facility, three waste rock storage facilities, a water management system that includes containment ponds, water diversion channels, retention dikes/berms, a final Effluent Water Treatment Plant (EWTP) and a Saline Water Treatment Plant (SWTP). An additional treatment plant to apply break-point chlorination, oil and grease, and total suspended solids (TSS) removal will be added by end of Q2, 2019 as part of the saline effluent discharge to sea management system.

SECTION 3 • GROUNDWATER MANAGEMENT STRATEGY

3.1 Groundwater Volumes

In the WMP of the water licence application (Agnico Eagle 2015a) it was stated that supplemental hydrogeological investigations were to be undertaken to provide additional information on potential volumes and quality of the saline groundwater to be managed. These investigations were undertaken in 2015 and 2016 and are summarized in Golder (2016). They included the completion of 24 packer tests, two pumping tests, two injection tests, 11 groundwater samples, and seven surface water samples. The work plan for the fieldwork was developed in consultation with two independent technical advisors, Dr. Shaun K. Frape and Dr. Walter A. Illman (both of the University of Waterloo).

The additional hydraulic conductivity measurements resulted in a refined interpretation on the variability of hydraulic conductivity between geological formations and data on the storage properties of the bedrock. A summary of predicted groundwater inflows between 2017 and 2032, based on this refined interpretation, are provided in Table 1. A revision of the modelled inflow volumes is currently being conducted and is scheduled to be completed by the end of April 2019. The purpose of this update is to provide more accurate estimates, thereby increasing informative capabilities regarding planning of management strategies. The results will be submitted in the 2020 WMP or as an addendum to the 2019 WMP.

Table 1: Predicted Groundwater Inflow to Underground Mine (2017 to 2032)

Period	Predicted Groundwater Inflow (m^3/day)
2017	230
2018	300
2019	280
2020	300
2021	340
2022	340
2023-2024	420
2025-2026	380
2027-2028	390
2029-2030	380
2031-2032	360

Source: Updated Predictions of Groundwater Inflow to Tiriganiaq Underground Mine (Golder 2016).

The groundwater inflow predictions presented in Table 1 do not account for grouting currently being conducted as a mitigation to reduce groundwater inflows to the underground development, water being removed in waste rock, or potential losses through the ventilation system. Both mechanisms reduce the actual groundwater inflows to the Underground Mine relative to that which was predicted. As such, these predicted inflows to the underground development represent unmitigated estimates.

Actual inflow values to the Underground Mine, which included the impact of grouting, ventilation losses, loss of water in waste rock pore space, treatment by the SWTP, and loss due to re-use of water in mining operations were estimated based on changes in water volumes stored in the underground water storage system. Changes in storage were calculated on a daily basis and used to produce monthly values of mean daily net inflow rate. Based on these monthly estimates of mean daily inflow, mean net inflow rate over 2018 was 51 m^3/day. This is not the groundwater inflow rate to the mine but rather the balance of inflows, the aforementioned water losses, and water used for operations. Thus, the 51 m^3/day estimate is the surplus of inflows that was placed in storage.

It should be noted that the net inflow rate generally increased over 2018. During Q4 of 2018 the mean daily inflow rate was approximately 105 m^3/day. The increasing trend is the result of the progression of development, especially development approaching the lower fault (near the ore body), where hydraulic conductivities are expected to be relatively high ($1x10^{-7}$ m/s). Going forward, daily net inflow rates will increase when stoping within cryopeg begins (Q1 of 2019), as greater surface area of rock will be exposed, stoping will proceed within the ore body where water bearing structures exist, and grouting of inflows will not be possible within stopes.

3.1.1 Groundwater Inflow Predictions – Assumptions and Uncertainties

Hydraulic conductivities of both the Hanging Wall and Footwall units are assumed to be reduced by an order of magnitude between the top of the basal cryopeg and the bottom of the cryopeg. This assumption reflects that this portion of the permafrost, which will contain unfrozen groundwater due to freezing point depression (salinity and pressure induced), is expected to have reduced hydraulic conductivity relative to the unfrozen bedrock because of the presence of isolated pockets of frozen groundwater within this zone. Linearly decreasing hydraulic conductivity with temperature is assumed within this zone, with a full order of magnitude decrease assumed at the top of the basal cryopeg, and hydraulic conductivity equivalent to the unfrozen rock at the bottom of the cryopeg.

In crystalline rocks, fault zones may act as groundwater flow conduits, barriers, or a combination of the two in different regions of the fault depending on the direction of groundwater flow and the fault zone architecture. These zones, termed Enhanced Permeability Zones (EPZs), were assigned hydraulic conductivity values based on both field measurements and testing conducted at similar faulting in various locations within the Canadian Shield. Furthermore, EPZs were assumed not to be impacted by isolated freezing in the cryopeg and were therefore assigned similar hydraulic conductivity values within and below the cryopeg. The latter assumption along with the assumption that all faults are considered EPZs is considered conservative. For instance, observations made at other gold mines in the Canadian Shield indicate not all faults are EPZs (Golder, 2016).

Based on the geometry of water bodies, it was assumed that Lake B7, Lake D7, and Meliadine Lake possess open taliks connected to the deep groundwater flow regime. It was conservatively assumed that the surface water/groundwater interaction through open taliks is not impeded by lower-permeability lakebed sediments that may exist.

Combined, the assumptions discussed above result in the following sources of uncertainty in the groundwater inflow model:

- If there is a lack of reduction in hydraulic conductivity between the top of the basal cryopeg and the bottom of the cryopeg, it is likely that greater than expected inflows upon stoping will occur in the cryopeg (300 to 450 m below ground surface).
- If faults within the model do not act as EPZs, then it is expected that inflows resulting from development near these structures will be less than expected. The degree of deviation from expected inflows and timing will be dependent on the location of the structure in relation to development.
- If hydraulic conductivity of faults within the cryopeg are impacted by isolated freezing, then lower than expected inflows will be observed when development in the cryopeg progresses near the structures. The degree of deviation from expected inflows and timing will be dependent on the location of impacted EPZs in relation to development.
- If significant thicknesses of lakebed sediments with relatively low permeability exist within in the flow path connecting surface water to groundwater through open taliks, it is likely that mine-wide inflows will be less than expected due to a reduction in expected recharge to the groundwater flow regime.

Quantification of the uncertainty associated with the realization of the listed scenarios has not been conducted. As the invalidity of the above assumptions would result in less than expected inflows, the model is considered conservative and quantification of associated uncertainty is not required.

3.2 Existing Groundwater Management Control Structures

Contact water in the Underground Mine is contained within underground sumps and the Saline Pond. A proportion of the underground water is recirculated as make-up water for underground drilling. The remaining underground water is stored for treatment by the SWTP. During the open water season of 2019, saline water treated to remove TSS, oil and grease, and ammonia will be discharged to sea at Melvin Bay (Section 3.4.3).

Calcium chloride is currently not added to the underground water but has been used in the past to prevent freezing in drill holes when drilling in permafrost with low salinity drill water. The potential for use again in the future is low due to the existing calcium chloride levels in the groundwater that is used for drilling.

Groundwater inflows to the Underground Mine since 2015 have not been discharged to the environment and are being stored underground and in the surface storage pond, Saline Pond 1. Based on adaptive management strategies, the project requires a second saline water storage pond, Saline Pond 2 (SP2). Saline Pond 2 is to be temporary in nature and is being constructed in bedrock within the footprint of Tiriganiaq Pit 2. Saline Pond 2 has an initial storage estimate of 78,862 m^3 which will be added to the saline water storage system in Q1 of 2019. Details of the underground dewatering system are provided in the Mine Plan (Agnico Eagle 2015a) and details of the ponds are provided in the WMP (Agnico Eagle 2019). The pond capacities and maximum water elevation for storage of the saline water are presented in Table 2.

Table 2: Salt Water Storage Capacity at the Mine for Groundwater and Water Primarily Influenced by Underground Workings

Surface Pond	Capacity (m^3)	Maximum Water Elevation (m)
Saline Pond	32,686	62.9
Saline Pond 2 (Q1, 2019)	78,862	62.5
P1	20,781	68.5
P2	6,828	66.5
P3	18,432*	67.0

Source: Agnico Eagle (2017).
* Volume excludes Saline Pond 3 capacity (Section 3.4.3.1).

3.3 Groundwater Quality

Groundwater investigations suggested that total dissolved solids (TDS) concentrations are relatively consistent below the permafrost at approximately 64,000 mg/L (Golder 2016). Groundwater quality data from samples taken underground 2017 through 2018 from diamond drillholes (DDHs) indicate mostly stable concentrations for several parameters (Table 3) and indicate that TDS concentrations are less than predicted at an average concentration of 56,000 mg/L. The discrepancy between expected and observed TDS levels is potentially due to the difference of sampling depth between pre-development testing and samples collected during development. Pre-development samples were collected below permafrost (>450 m below ground surface), whereas the bulk of samples collected to-date have been collected in the basal cryopeg (280 m to 450 m below ground surface). Samples and trends will continue to be assessed as development progresses below the cryopeg. It should also be noted that mining operations include drill-and-blast excavation for the development of the Underground Mine, which results in certain parameters in groundwater to be influenced by explosives (particularly ammonia and nitrate due to emulsion explosives).

With respect to high nitrate, nitrite and ammonia concentrations in February 2017, the anomaly is due to one sampling event (Feb. 24) believed to be conducted without proper flushing of the DDH. Thus, the results from this sampling event are similar to those observed in underground contact water (i.e., sump water). The February 24, 2017 DDH sample produced nitrate, nitrite and ammonia results of 344 mg/L, 23.5 mg/L and 300 mg/L, respectively. Whereas Sump 125 (contact water) results from February 12, 2017 show nitrate, nitrite and ammonia concentrations equal to 435 mg/L, 27.2 mg/L and 400 mg/L, respectively. Considering the similarity, it can be assumed that the February 24, 2017 DDH sample was contaminated with drilling water.

Table 3: Average Saline Groundwater Quality

Source: Groundwater quality data from DDH sample location (Agnico Eagle, December 2018)

Representative Months (average per month)		Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18
Parameters (total metal)	**Units**																							
pH	pH	7.08	6.87	7.11	7.32	7.38	7.27	8.27	7.45	7.33	7.41	7.26	7.18	7.35	7.49	7.80	7.26	7.26	7.79	7.08	7.72	6.99	7.02	7.28
Alkalinity	mg/L	57	61.7	51	64.5	68	68	75	68.2	64	64	69	66	73	73	78	70	62	67	65	85	71	67	57
Conductivity	µmhos/cm	77000	76500	77000	79000	79000	76308	74385	72200	72667	78667	85000	80667	81083	82667	81200	83000	69500	83125	83333	83000	78000	69571	81000
Total Hardness (as $CaCO_3$)	mg/L	13200	18267	12700	18400	12433	12623	12500	12583	11700	12600	14100	12733	13164	14367	12680	13550	13100	13538	13450	13925	13500	11131	16500
Turbidity	NTU	123.75	69	88	90	51	75	61	47.02	104.33	55.00	30.00	53.00	74.83	72.89	27.18	49.33	75.50	27.51	52.00	27.5	83.95	69.43	52
Total Dissolved Solids (TDS)	mg/L	54350	66433	54900	57500	57300	55123	57815	57520	54567	57867	62000	55133	53975	52233	55460	51367	56900	58325	55917	60975	56900	49229	57600
Total Suspended Solids (TSS)	mg/L	45	75.7	63	248.5	102.7	102.2	156	86	102	316.7	30.0	56.0	181.8	108.1	31.0	38.7	37.5	85.4	58.5	50.0	216.0	42.4	46
Aluminum (Al)	mg/L	0.21	0.1	6.02	1.29	0.51	1.45	0.73	0.97	1.75	2.063	0.150	0.250	2.979	1.466	0.270	0.290	0.128	0.798	0.245	0.261	4.145	0.353	0.15
Ammonia Nitrogen (NH_3-NH_4)	mg/L	4.125	7.9	4.5	4.95	5.2	5.508	11.08	4.87	4.7	6.100	4.800	4.700	5.825	4.711	5.180	4.800	4.300	5.250	4.233	6.925	4.550	5.714	6.55
Arsenic (As)	mg/L	0.003	0.005	0.01	0.008	0.004	0.016	0.016	0.102	0.013	0.047	0.006	0.009	0.027	0.057	0.009	0.010	0.004	0.024	0.006	0.005	0.011	0.009	0.0138
Barium (Ba)	mg/L	0.06	0.61	0.1	0.27	0.07	0.09	0.25	0.1	0.07	0.113	0.082	0.094	0.109	0.109	0.098	0.072	0.073	0.100	0.058	0.073	0.170	0.110	0.163
Beryllium (Be)	mg/L	0.003	0.002	0.01	0.002	0.002	0.005	0.008	0.01	0.01	0.008	0.005	0.008	0.010	0.009	0.009	0.007	0.004	0.004	0.006	0.004	0.005	0.009	0.005
Boron (B)	mg/L	1.6	4.98	5	4.9	1.5	2.7	3.97	5	2.5	4.17	2.50	4.17	4.79	4.72	4.50	3.33	2.10	2.28	2.92	2.35	2.80	4.64	3
Total Organic Carbon (TOC)	mg/L	2.23	11.67	2.1	2.95	2.63	3.2	5.3	2.57	2.5	16.27	3.00	2.67	2.50	2.42	2.36	2.47	2.20	3.00	1.97	2.4	2.95	2.73	5.3
Dissolved Organic Carbon	mg/L	1.9	10.17	1.7	2.3	2.37	2.7	4.9	2.32	2.1	13.70	2.80	2.33	2.38	2.27	2.36	2.27	1.90	2.55	1.90	2.4	2.55	2.53	5
Calcium (Ca)	mg/L	1710	3777	1650	3737	1593	1608	1771	1610	1565	1720	1770	1587	1646	1777	1656	1737	1690	1748	1653	1715	2165	1487	2960
Cadmium (Cd)	mg/L	0.0003	0.0002	0.001	0.0003	0.0002	0.0005	0.001	0.001	0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0005
Chloride (Cl - dissolved)	mg/L	31250	38000	31000	31500	32000	31385	31538	32800	29333	32333	34000	33000	33833	34444	34800	34333	32500	33875	33333	36250	33500	27143	35000
Chromium (Cr)	mg/L	0.025	0.017	0.01	0.02	0.017	0.05	0.075	0.1	0.88	0.083	0.050	0.083	0.096	0.094	0.090	0.067	0.035	0.043	0.058	0.043	0.052	0.093	0.05
Copper (Cu)	mg/L	0.01	0.008	0.05	0.01	0.01	0.02	0.04	0.05	0.03	0.042	0.025	0.032	0.048	0.048	0.045	0.028	0.018	0.021	0.029	0.021	0.040	0.046	0.025
Cyanide (Cn)	mg/L	0.005	0.19	0.005	0.028	0.005	0.006	0.01	0.005	0.008	0.005	0.025	0.015	0.017	0.033	0.021	0.012	0.025	0.005	0.005	0.005	0.005	0.005	–
Iron (Fe)	mg/L	4.76	8.96	3.6	8.78	6.19	9.81	6.33	8.24	4.1	10.67	6.46	6.50	14.84	12.79	5.50	5.37	6.36	5.94	7.96	5.36	18.80	5.64	6.81
Lead (Pb)	mg/L	0.005	0.005	0.02	0.004	0.003	0.009	0.015	0.02	0.018	0.017	0.010	0.017	0.020	0.019	0.018	0.013	0.007	0.009	0.012	0.009	0.010	0.019	0.01
Magnesium (Mg)	mg/L	2168	2150	2080	2200	2050	2092	1962	2105	1975	2017	2350	2150	2208	2411	2078	2220	2150	2229	2267	2335	1970	1800	2200
Mercury (Hg)	mg/L	0.00001	0.00001	0.00001	0.000001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Molybdenum (Mo)	mg/L	0.025	0.055	0.01	0.25	0.026	0.047	0.075	0.1	0.17	0.083	0.050	0.083	0.096	0.094	0.090	0.067	0.035	0.043	0.058	0.043	0.050	0.093	0.061
Nickel (Ni)	mg/L	0.025	0.04	0.1	0.07	0.017	0.05	0.08	0.1	0.35	0.083	0.050	0.083	0.096	0.094	0.090	0.067	0.035	0.043	0.058	0.043	0.050	0.093	0.05
Nitrate (NO_3) as N	mg/L	0.5	116.39	0.1	2.58	0.23	0.89	4.35	0.17	0.34	0.293	0.100	0.213	2.015	0.376	0.240	0.297	0.300	0.420	0.517	0.608	0.455	2.929	0.1
Nitrite (NO_2) as N	mg/L	0.05	8.01	0.1	0.125	0.086	0.14	0.391	0.042	0.027	0.032	0.024	0.023	0.120	0.043	0.042	0.028	0.030	0.044	0.052	0.065	0.039	0.109	0.061
Total Kjeldahl Nitrogen (TKN)	mg/L	3.78	8.7	4.6	5.2	7.83	7.4	12	72.02	4.5	9.00	5.60	4.87	6.12	4.97	5.90	5.27	4.95	5.54	4.18	7.5	4.60	6.77	6.5
Phosphorous (P)	mg/L	0.07	0.14	0.04	0.13	0.12	0.08	0.09	0.1	—	0.390	0.080	0.080	0.075	0.083	0.162	0.073	0.200	0.173	0.118	0.175	0.420	0.154	0.1
Potassium (K)	mg/L	496	595	407	609	433	463	518	488	763	502	528	465	490	532	512	479	474	500	491	539	444	391	680
Radium-226 (Ra 226)	mg/L	0.49	0.33	0.3	1.2	1.95	1.8	1.9	2.2	0.29	2.200	2.400	1.673	1.853	3.678	3.880	2.633	2.050	1.938	1.833	2.450	0.670	0.906	1.8
Selenium (Se)	mg/L	0.003	0.002	0.01	0.002	0.002	0.005	0.0075	0.01	0.007	0.008	0.005	0.008	0.010	0.009	0.009	0.007	0.004	0.004	0.006	0.016	0.005	0.009	0.005
Silver (Ag)	mg/L	0.001	0.0003	0.002	0.0009	0.0004	0.0012	0.0018	0.0002	0.018	0.003	0.001	0.002	0.002	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.001
Sodium (Na)	mg/L	14625	14700	13400	15400	13900	14369	14654	14417	9433	14900	17000	15300	15183	16389	14860	14967	14750	15725	15333	16450	13550	12629	16600
Strontium (Sr)	mg/L	43.1	171	38.4	136	40	39	43.5	36.5	23.6	40.03	35.10	35.70	37.24	37.30	37.14	40.10	47.65	43.85	40.00	41.33	61.90	47.40	83.4
Sulphate (SO_4 – dissolved)	mg/L	3125	2700	3100	3100	3233	3169	2969	3120	3067	3200	3500	3433	3367	3500	3320	3367	3350	3250	3467	3625	3200	2829	3200
Thallium (Tl)	mg/L	0.001	0.001	0.001	0.0002	0.0002	0.0005	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.001	0.000	0.001	0.001	0.0005
Uranium (U)	mg/L	0.003	0.002	0.01	0.006	0.002	0.005	0.008	0.01	0.09	0.008	0.005	0.008	0.010	0.009	0.009	0.007	0.004	0.004	0.006	0.006	0.005	0.009	0.005
Vanadium (V)	mg/L	0.13	0.08	0.5	0.1	0.08	0.23	0.38	0.5	0.33	0.417	0.250	0.417	0.479	0.472	0.450	0.333	0.175	0.213	0.292	0.213	0.250	0.464	0.25
Zinc (Zn)	mg/L	0.125	0.1	0.5	0.12	0.08	0.23	0.38	0.5	0.34	0.417	0.250	0.417	0.479	0.472	0.450	0.333	0.175	0.259	0.292	0.213	0.250	0.464	0.25

3.4 Groundwater Management Strategy and Associated Control Structures

Based on the Type A Water Licence 2AM-MEL1631 Terms and Conditions, Part E: Conditions Applying to Water Use and Management, No. 14, Agnico Eagle has reviewed the Mine alternatives to apply to the GWMP. Condition No. 14 specifically states:

> *"The Licensee shall submit a Groundwater Management Plan to the Board for approval in writing, at least six (6) months prior to the discharge of any Groundwater. The Plan shall take into consideration all comments raised and commitments made with respect to submissions received during the technical review of the Application as well as final submissions and issues raised during the Public Hearing Process, where applicable."*

Furthermore, based on the NIRB Project Certificate No. 006 Terms and Conditions: Hydrogeology and Groundwater Quantity and Quality, No. 25, Agnico Eagle has updated the groundwater management strategy sections for submission to NIRB within 90 days of receiving the amended Mine Project Certificate. Condition No. 25 specifically states:

> *"The Proponent shall submit a detailed Groundwater Management Plan to the NIRB which includes mitigation measures designed to address the potential for higher-than-predicted volumes of saline water inflows into the underground mine, treatment and disposal methods, and details of its plan to monitor saline water at site. The plan must identify uncertainties pertaining to predictions for groundwater quality and quantity and inform adaptive management strategies for the site. CIRNAC should be consulted with respect to the contents of the Plan and any required mitigation measures."*

Groundwater management strategies were considered for the Mine based on the potential range of groundwater flows and quality that could be generated (Agnico Eagle 2015a).

Based on the groundwater inflow volume, the following options were considered and form part of the short and long-term management of groundwater inflows to the Underground Mine:

- Short-term Strategy: treat saline groundwater and store/use the brine from the treatment process on-site (Section 3.4.1)
- Current Long-term Strategy: treated discharge to receiving environment in Meliadine Lake (Section 3.4.2) and Discharge to sea (see Section 3.4.3).

The short and long-term groundwater management strategies are described below.

3.4.1 Short-Term Management Strategy - Treat and Store/Use Groundwater On-site

This alternative was considered as part of the Type A Water Licence Application and is currently implemented on site as part of the short-term management of groundwater inflow. It involves storing all excess groundwater in underground sumps and in surface water ponds at the Mine. As outlined in the WMP (Agnico Eagle 2019), a total of ten water containment ponds are planned on Site at the Mine surface (CP1, CP3, CP4, CP5, CP6, the P-Area [P1, P2, and P3], SP1 and SP2), seven of which have been constructed and are in use (CP1, CP3, CP5, P-Area [P1, P2, and P3], and SP1). SP2 is presently being constructed and will be commissioned by the end of Q1 2019. Additional to this are all associated water retention dykes, water diversion berms, channels, and culverts, to manage surface water and underground water (Appendix A).

Five saltwater evaporators have been in-use on site since mid-2017 at P1 to reduce saline groundwater volumes stored in surface water ponds. While evaporators have been used with some success, the combined volumes of realized groundwater inflows with anticipated surface water volumes influenced by underground waste rock to be managed is greater than the available long-term storage at the Mine, and therefore, discharge to environment is required.

3.4.2 Current Long-Term Management Strategy - Treated Groundwater Discharge to Meliadine Lake

Hatch (2013) investigated groundwater treatment options for the site and concluded that a combination chemical reverse osmosis (RO) and mechanical vapour compression evaporator plant would be the most efficient method of treating excess groundwater for discharge. Agnico Eagle has since acquired and constructed a Salt Water Treatment Plant (SWTP) consisting of two evaporator crystallizers (SaltMakers) that will be used to treat groundwater. The SWTP will remove excessive total suspended solids (TSS), calcium chloride ($CaCl_2$), sodium chloride (NaCl), metals, phosphorous (P), and nitrogen compounds from the influent saline water.

The SWTP consists of two parallel units. Each unit can be operated to produce brine or solid by-product. Brine-mode of one unit within the SWTP is expected to operate to the following specifications:

- Inlet capacity of 115 m^3/day with a 95% expected operation availability for a corrected average input capacity of 109 m^3/day.
- With an input capacity of 109 m^3/day the effluent and brine will be discharged as follows:
    - 68 m^3/day to CP1
    - 24 m^3/day to Saline Pond as Brine
    - The 17 m^3/day difference is due to evaporation loss through treatment

Solid-mode of one unit within the SWTP is expected to operate to the following specifications:

- Inlet capacity of 69 m3/day with a 95% expected operation availability for a corrected average input capacity of 66 m3/day. This full inlet capacity will be discharged to CP1 as effluent
- Decisions regarding the management of solid salt by-product are ongoing by Agnico Eagle. One possible option would be use as a dust suppressant on roads as the material is similar to calcium chloride currently approved for such use. Formal approval would be required from the Government of Nunavut Environment Department.

SWTP effluent is currently transferred to CP1 where it will be treated by the EWTP prior to discharge to Meliadine Lake. EWTP effluent discharge to Meliadine Lake was performed in 2018 in accordance with the conditions outlined in Part F, Item 3 of the Water Licence. Discharge to Meliadine Lake is expected to be carried out in 2019. Total discharge to Meliadine Lake, including the treated groundwater, will remain within the permitted daily volume and meet the discharge criteria defined in the License, as well as MDMER discharge limits. Additionally, SSWQOs for EWTP effluent (including treated groundwater) will be met at the edge of the mixing zone in Meliadine Lake. Further details regarding the EWTP are provided in Sections 3.9.4 and Section 4.3 of the WMP.

The saline effluent temperature from the SWTP is expected to be approximately 35 °C, with an approximate pH of 7.5 (Saltworks 2017). According to pilot testing, SWTP effluent meets the required Water Quality Output Requirements defined in Agnico Eagle's Desalination Water Treatment Plan Design Criteria with the exception of ammonia, nitrite, total cyanide, and selenium (Saltworks 2017). However, weekly sample results from the first months of sampling (December 13, 2018 to February 18, 2019) show the SWTP effluent consistently meets the aforementioned requirements for all constituents aside from ammonia and nitrite. Ammonia exceeded the Water Quality Output Requirement of 35 mg/L on three sampling dates (Jan-16, Jan-18, Feb-10), however the mean ammonia concentration over the sampling period is 24 mg/L. Nitrite exceeded the Water Quality Output requirement of 0.2 mg/L on all (n=9) sampling dates with a mean concentration of 1.2 mg/L. The cause for these exceedances is that the SWTP system remains in the commissioning phase, specifically, the chemical RO unit designed to remove constituents such as ammonia and nitrite has not yet been commissioned. Upon commissioning (expected by end of Q1 2019), the SWTP is expected to meet all Water Quality Output Requirements.

SWTP effluent and CP1 water quality will continue to be monitored according to the SWTP Design Report to identify future exceedances and potential impacts to CP1. Pilot testing predicted that TDS concentrations would be approximately 158 mg/L (condensed water after treatment; Saltworks 2017). During commissioning, mean TDS concentration has been 174 mg/L (n=9) to date. As commissioning continues (i.e., process is refined and RO treatment is commissioned), effluent quality will trend towards lower concentrations as the treatment process is refined for optimal treatment quantity and quality. With respect to toxicology, the SWTP effluent passed acute toxicity tests on Rainbow trout, Three-spined stickleback and Daphnia magna (Saltworks 2017).

3.4.3 Current Long-Term Management Strategy - Treated Groundwater Discharge to Melvin Bay at Itivia Harbour

Based on the current standing of saline water stored on site, the rate at which the SWTP can treat saline water (Section 3.4.2) and the forecasted inflows (Section 3.1), it is anticipated that a second discharge location will be required for long-term groundwater management. Agnico Eagle proposed to treat groundwater for TSS, oil and grease, and ammonia and discharge it as saline effluent to the ocean, either as a direct discharge and/or after temporary on-site storage in one or more of the water containment ponds at the Mine. In 2018, Agnico Eagle applied to the NIRB for approval to discharge saline water to the sea (Melvin Bay, Rankin Inlet). Agnico Eagle received approval for discharge of saline water to sea with an amended Mine Project Certificate from NIRB on February 26, 2019.

3.4.3.1 Discharge to Sea Methods for Disposal and Treatment

Treatment, storage and haulage

As discussed in Section 3.4.1, saline water will be stored on surface or underground. Saline water will then be transported to a treatment plant (to be named) for treatment. Initial treatment will be for oil and grease removal via an oil-water separator. The water will then enter a Multiflo system for TSS removal. Next, break-point chlorination treatment will be applied to remove elevated ammonia levels, which are inferred to be the result of the use of emulsion and washing of development faces/muck underground. Excess free chlorine will be removed with activated carbon filters. Following break-point chlorination, water will merge with EWTP effluent prior to entering Saline Pond 3 (SP3) for final settling and storage. Treatment rates and expected treatment performance are currently being assessed and will be provided 30 days prior to operation of the treatment plant.

Treated saline water stored in SP3 will hauled by tanker trucks to Itivia. Truck loads will be up to 50 m^3 per truck and will be unloaded using a flexible 4" HDPE suction pipe. The truck discharge pump will transfer the treated effluent into the 6'' discharge HDPE pipeline and through the diffuser. The truck discharge pump will also be used to transfer effluent into the storage tank until the next day, before it is pumped into sea when necessary.

Pumping and Diffusion Plan

The flow rate to be discharged to Melvin Bay will not exceed 800 m^3/d with a TDS of 39,600 mg/L (Appendix B). The discharge facility will include a 778 m pipeline extending to an engineered diffuser located 20 m below surface in Melvin Bay to ensure proper mixing and prevent interference with traditional activities (See Appendix X for design drawings). Pumping will occur during the open water season from 2019 to 2031. The saline effluent will be discharged in a controlled manner through the diffuser to allow for maximum dilution and minimum environmental impact to the marine environment. Environmental monitoring is discussed in Section 4.3.3.

Agnico Eagle intends to engage with the Kangiqliniq Hunters and Trappers Organization (HTO) and the community of Rankin Inlet to:

- confirm the commencement and end of the open water season for marine effluent discharge each year,
- develop a procedure for monitoring of saline effluent temperature going into the subsea pipeline,
- ice thickness on Melvin Bay in the vicinity of the discharge and determining appropriate communication and safety protocols applicable for travel by community members through Itivia and Melvin Bay.

The effluent discharge system will consist of a truck discharge pump, a back-up discharge truck pump, a 100 000-litre storage tank, as well as suction and discharge pipelines. The 100 000-litre storage tank will only be used to contain the treated effluent until the next day, if the 800 m^3/d discharge limit is attained upon a truck's arrival. The storage tank will be installed on a containment area, built on a geomembrane with underlying and overlying granular materials and surrounded by berms. The construction drawings are shown in the Appendix B.

A pumping station including two pumps will be installed on the containment area. The truck discharge pump will be used to transfer the effluent from the trucks directly into the sea (or to storage tank). A by-pass pipeline will be installed parallel to the main discharge pipe in case the discharge truck pump malfunctions or maintenance is required. The back-up truck discharge pump will be used to pump the effluent into the by-pass pipe, though the 6'' discharge HDPE pipe and out the diffuser, if necessary.

Treated groundwater effluent quality is required to meet the Canadian federal end-of-pipe discharge criteria (per the amended MDMER; GC 2018) and to be non-acutely lethal. Treated groundwater will be discharge into Melvin Bay via an engineered diffuser (refer to Appendix D or Section 3.5 of the FEIS Addendum; Agnico Eagle 2018g) to meet Canadian Surface Water Quality Guidelines (WQG; CCME 2003), or background concentrations for parameters without guidelines, at the edge of the mixing zone. For information regarding background concentrations and expected mixing zone diffusion, refer to Appendix D (the Conceptual Ocean Discharge Monitoring Plan). Sampling will meet MDMER (GC 2018) requirements, and is outlined in Section 4.3.3, and detailed in Appendix D. A modelling assessment of groundwater discharge into the Melvin Bay marine environment was conducted by Golder (2019) and is included within Appendix B).

3.5 Discharge Schedule

Table 4 outlines the timeline for key activities on the Mine related to the management of saline groundwater, including tasks and facilities for the current short-term and long-term management strategies for discharge to Meliadine Lake (Section 3.4.1 and 3.4.2). A detailed Mine schedule for the overall Mine Water Management (e.g., building of culverts, berms and containment ponds) are presented in the 2019 WMP.

Table 4: High Level Mine Schedule

Activity	Timeline	Notes
On-site water storage	Ongoing	—
Update Groundwater Management Plan (Current Document)	Six months prior to discharge	Type A Water Licence 2AM-MEL1631 requirement
Commissioning of Salt Water Treatment Plants (SaltMaker #1 and #2)	Q4-2018 to Q1-2019	—
Discharge saline water to the sea (Melvin Bay, Rankin Inlet)	2019 open water season (Q2)	

Activity	Timeline	Notes
Active Discharge to Meliadine lake	Annually May thru October to 2031	—
Operation of Salt Water Treatment Plant	24 hr. a day / 7 days a week, year round	In-service as required
Inactive Discharge	Annually November thru April to 2031	Water will be stored underground and in surface containment ponds during the winter
Final Effluent Discharge to Meliadine Lake	End of Mine life 2031	—

Source: Agnico Eagle (2017).

3.6 Mitigation Measures regarding Greater than Expected Inflows

It is possible that realized groundwater inflow rates to the underground mine will be greater than modelled inflow rates. Specifically, this would arise from error in hydraulic conductivities assigned to geological units/structures and invalidity of assumptions listed in Section 3.1.1. Furthermore, it is possible that groundwater TDS levels will deviate from the past and current trends and produce greater than expected concentrations of TDS in groundwater to be managed. Considering both the Golder (2015) TDS forecasts agreeing with the realized groundwater TDS concentrations and the multitude (n = 133) of groundwater samples contributing to the to-date mean concentrations of TDS in groundwater surrounding the Mine, it is unlikely that groundwater TDS concentrations will increase as development and stoping progresses. In the unlikely case that TDS does increase, groundwater discharged to sea will be decreased as less raw groundwater will contribute to the saline water volumes being discharged to sea (due to TDS limit in effluent of 39,600 m^3; Section 3.4.3.1). Thus, greater than expected inflow rates and/or greater than expected TDS values would result in greater than expected groundwater volumes to manage. The following sections discuss mitigations under the occurrence of these scenarios.

3.6.1 Mitigation Measures – Contingency Storage Units

Upon the occurrence of greater than expected groundwater inflows to the underground mine, Agnico Eagle will utilize contingency saline water storage units until inflows can be reduced or SWTP treatment rates are increased to reduce required storage (Section 3.6.2). As of March 2019, the collective contingency saline water storage units produce a total potential storage of approximately 131,000 m^3. These storage units and corresponding capacities are listed below and will be filled in the following order, if required:

1. Level 350 West Block (5,766 m^3)
2. Ramp 1 extending from Level 425 to Level 450 (7,216 m^3)
3. Ramp 3 extending from Level 375 to Level 400 (17,298 m^3)
4. Ramp 3 extending from Level 350 to Level 375 (48,576 m^3)

5. Level 425 (50,530 m^3)

The contingency storage features listed above are not intended for long-term storage. The use of these will affect production, as portions of the mine will be unavailable to operations. Thus, if these units are required then adaptive management practices focused on increasing desalination rates will be implemented by Agnico Eagle in order to empty the features and allow production to continue optimally.

3.6.2 Mitigation Measures – Increased Storage and SWTP Treatment Rate

With respect to volumes of infiltrated groundwater to be managed, Agnico Eagle will apply adaptive management practices focused on increasing desalination rates. Prior to implementation of any changes to groundwater management, Agnico Eagle will submit a proposal for an amendment to the Mine Project Certificate or Water License, as applicable. The following are preliminary plans concerning the ability for Agnico Eagle to manage greater than expected saline water volumes stored on site.

In a scenario when modest increases above expected inflows (< 100 m^3/day) occur and are anticipated to persist, Agnico Eagle will assess the feasibility of running the SWTP in brine-mode (Section 3.4.2). Operating the SWTP in brine-mode rather than solid mode would provide an increase in treatment rate of approximately 86 m^3/day. As discussed in Section 3.4.2, brine would be added to the saline water storage system on site and freshwater effluent would be discharged to CP1 to be further treated to removed TSS prior to discharge to Meliadine Lake.

The addition of SP2 (approximately 75,000 m^3) to the saline water storage system provides further mitigation to greater than expected inflows by providing storage for saline water until inflows can be reduced or treatment can be increased. It will be the goal of Agnico Eagle to reduce the amount of saline water stored in SP1, SP2 and underground as much as possible during the open water season (through discharge to sea) in order to maximize storage potential.

3.6.1 Mitigation Measures – Hydraulic monitoring

As a strategy to increase the confidence of groundwater inflow modelling and decrease uncertainty, seven (7) vibrating wire piezometers are currently installed in the rock mass surrounding the underground mine. These piezometers are currently, and will continue to be applied to, assess response of the groundwater pressure (pressure head) to groundwater inflows. The data records produced by these piezometers will be used to approximate recharge rates and changes thereof, which may then be applied to the groundwater inflow model. Going forward, several additional piezometers will be installed in the rock mass (targeting major water bearing structures) to provide further insight into recharge rates and better inform modelling efforts. Agnico Eagle anticipates installing at least three (3) more piezometers over 2019.

3.6.2 Mitigation Measures – Groundwater Quality Monitoring

Raw groundwater and underground mine water in the underground storage system are sampled monthly. The sample analysis results are used to identify trends and improve predictions regarding groundwater inflow chemistry. This information is used to improve operational performance at the SWTP and act as a trigger for revision of the groundwater quality predictions. If raw groundwater samples (i.e., from flushed drillholes) collected indicate that the TDS is more than 20% higher than the estimated 64,000 mg/L (Section 3.3), the water quality predictions for underground will be reviewed and results considered as part of the adaptive management of the groundwater quantity contribution to the WMP.

SECTION 4 • GROUNDWATER MONITORING PROGRAM

4.1 Water Quality and Quantity Monitoring

Water quality monitoring is an important part of the Mine water management to verify the predicted water quality and quantity trends and conduct adaptive management should differing trends be observed. Water quality and quantity monitoring has been initiated and will continue during construction, operations, closure and post-closure. Monitoring will occur at three levels:

- Regulated discharge monitoring that occurs at monitoring points specified in the Licence or regulations.
- Verification monitoring that is carried out for operational and water management purposes by Agnico Eagle. This monitoring data will not be reported to the Regulators in the Annual Water License Report, but can be provided upon request by the Regulators.
- General monitoring that is included in the Licence requirements and is subject to compliance assessment to confirm sampling was carried out using established protocols, including quality assurance/quality control provisions, and addressing identified issues. General monitoring is subject to change as directed by an Inspector, or by the Licensee, subject to approval by the NWB.

All three types of monitoring is used at the Mine. The WMP and Water Quality and Flow Monitoring Plan present the conceptual water quality monitoring plan during construction, operations and closures and more detailed information on monitoring programs.

The groundwater quality monitoring plan summarized in Section 4.4, will be further defined as the Mine advances and will be conducted in agreement with the WMP for the Mine (Agnico Eagle 2019). Required monitoring and frequency for pre- and post- treatment (i.e., monitoring above ground) is presented in the WMP (Agnico Eagle 2019).

4.2 Water Quantity

The volume of groundwater inflow being collected and transferred to surface water management systems is measured using a flow meter installed at the Portal 1 entrance and is fed by Water Stope 75. A second pumping system was commissioned in 2019 to pump directly from Level 300 to surface. Currently this line is used to pump to the SWTP where inflow volumes are tracked via a water level sensor. A flow meter will be installed within this line prior to discharging directly to surface (expected Q2 2019). This data is supplemented by monthly seepage surveys in which visually observed groundwater inflows in the Underground Mine are recorded.

Observed groundwater inflow rates are compared to model predictions (Table 1) on an annual basis. If significant variations from model predictions are observed, the assumptions behind the analysis will be reviewed and the analysis updated if required. In addition, updates to the groundwater model may be required based on operational changes as the Underground Mine advances.

Variations that would be considered significant and would indicate the need to consider recalibrating the model and updating the inflow analysis include:

- Groundwater inflows to the mine, based on a monthly average of inflow over six consecutive months, is 80% of the model predictions while active grouting is being utilized to mitigate groundwater inflows.
- Groundwater inflows to the mine, based on a monthly average of inflow over six consecutive months, is 30% higher than the predicted groundwater inflows once grouting is ceased.

Changes in underground storage were calculated on a daily basis and used to produce monthly net inflow rate estimates. Based on these monthly averages, mean net inflow rate over 2018 was 51 m^3/day. Golder (2016) predicted a gross inflow rate of 300 m^3/day (Table 1).

Identification of a potential long-term effect associated with the groundwater flow is to be conducted and based on a detailed examination of the groundwater data to assess the potential causes of greater than expected groundwater quantity. If the greater than predicted flows could be correlated to a short term effect such as freshet or transient drainage of a high storage feature, then no further action would be required. However, if the greater than predicted flows could not be correlated to a short term effect, than the effect would be considered to be potentially long term. The duration of six months is based on observed seasonal variations in inflow quantities in mines situated permafrost regions.

If model re-calibration is deemed necessary, future groundwater inflow quantity would be predicted using this re-calibrated model and results considered as part of the adaptive management of the groundwater quantity contribution to the WMP. Currently, an update to the numerical model is underway. The update is not the result of either of the two conditions listed above, but rather is intended to provide more accurate estimates to better inform planning of management strategies.

4.2.1 Underground Water Management System

The underground water management system is designed to prevent water from affecting the workings or production. The system contains a series of sumps (generally one at the access of each level) designed to capture groundwater inflows and runoff from mining operations (i.e., drilling). Presently, underground water is managed by pumping from sump to sump from the lower levels to Level 125. Water collected in Level 125 sump is then moved to the Water Stope to be distributed for mining operation requirements or moved to surface (Section 4.2).

Beginning in approximately Q2 2019, a new pumping system will be implemented underground as follows:

- All groundwater inflows and water used for operations from Level 300 to the bottom of the mine will be pumped to storage containers on Level 300.
- All groundwater inflows and water used for operations on Level 275 to surface will be transported to storage tanks on Level 300. Movement will be directed by gravity from sump to sump via boreholes connecting the sumps.
- Water that is stored on Level 300 will be clarified using a Mudwizard (flocculation) system as a means to ensure pumping efficiency and prevent damage to the system.
- Following clarification, water will be fed by gravity to Level 350, where a main pumping station will move the water to Level 200.
- A second main pumping station on Level 200 will move the water to the SWTP or Saline Ponds on surface (Section 4.2).

4.3 Water Quality

4.3.1 Underground Mine Sump Water and Groundwater Inflows

Water accumulating in sumps underground is sampled on a monthly basis at Sump 125, which is the main collection sump prior to recirculation for underground use. Sump water samples are analyzed for the following parameters: conductivity, TDS, pH, temperature, oil and grease, major anions, radium 226, dissolved and total metals, nitrate and nitrite, ammonia, volatile organic compounds (i.e., benzene, xylene, ethylene, and toluene).

Groundwater quality is also monitored at mine seeps and/or diamond drill holes (DDHs) to verify the quality of formation water flowing into the mine prior to contact and potential contamination by mining and drilling fluids. The DDHs consist of underground holes drilled in advance of mining for ore body delineation purposes. These DDHs are sampled if there is sufficient flow to flush the borehole prior to initiation of grouting. Flushing and sampling techniques used to ensure samples are taken without contamination are described in Section 2.2.3 of the Quality Assurance/Quality Control Plan. Samples are collected quarterly at a minimum but actual sampling frequency may be greater depending on rate of progress, frequency of water intersects, and observed trends in groundwater quality with time. Water samples are analyzed for the following parameters: conductivity, TDS, pH, temperature, major anions, radium 226, dissolved and total metals and toxicity testing.

If water samples are collected that indicate that the TDS is more than 20% higher than the estimated 64,000 mg/L, the water quality predictions for underground will be reviewed and results considered as part of the adaptive management of the groundwater quantity contribution to the WMP.

4.3.2 Saline Water Treatment Plant Influent and Effluent

Water samples are currently collected weekly at both the inlet and outlet of the SWTP. The results of the sample analysis are used by SWTP operators to fine-tune the treatment process and ensure its optimal performance. Samples taken at the outlet of the SWTP are analyzed to provide the quality of treated water produced by the SWTP that is transferred to CP1.

Water samples are analyzed for the following parameters: pH, electrical conductivity, temperature, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), chloride, ammonia, nitrite, nitrate, total phosphorus, total metals, total cyanide, and total mercury.

4.3.3 Discharge to Sea

Prior to haulage of saline water from the Meliadine Site to Itivia for discharge to sea, Agnico Eagle will measure pH, electrical conductivity, and temperature of the effluent as a means to continually advise discharge operations and help ensure discharge parameters are met. Agnico Eagle will also collect weekly samples to be analyzed by an accredited laboratory. Samples will be analyzed for the full suite and Group 3 (MDMER) parameters as listed in the Water License and the Water Quality and Flow Monitoring Management Plan appended to the WMP.

Effluent water at the final discharge point (end-of-pipe) will be measured for pH and analyzed for concentrations of deleterious substances listed in MDMER Schedule 4 (GC 2018). End-of-pipe brine effluent will be sampled once per month for acute lethality testing per MDMER requirements. Acute lethality testing will be conducted on Three-spine stickleback in accordance with the procedures set out in sections 5 or 6 of Reference Method EPS 1/RM/10 (ECCC 2018). Effluent characterization samples (Section 4.1.3) will be collected at the same time to aid in interpretation of acute lethality test results.

Effluent characterization will be conducted once per calendar quarter at least one month apart. Effluent will be sampled and analyzed for the following parameters:

- General parameters, including pH, TDS, TSS, hardness, alkalinity, electrical conductivity, salinity, and temperature;
- Anions including sulphate and chloride; and
- Nutrients, including ammonia and nitrate.
- Total metals and dissolved metals including those listed in MDMER Schedule 4 and Schedule 5 paragraph s. 4.

Sublethal toxicity testing of brine effluent will be conducted twice a year at least one month apart, at the beginning and at the end of discharge for three years, and once a year after the third year. The following tests will be conducted:

- Fish early life stage development test on inland silverside (Menidia beryllina) or topsmelt (Atherinops affinis) (US EPA 2002)
- Invertebrate reproduction test on echinoids (sea urchins or sand dollars) (Environment Canada 1992)
- Algae toxicity test on barrel weed (Champia parvula) (US EPA 2002)

These tests will be conducted on aliquots of the same sample collected for effluent characterization.

Agnico Eagle will adhere to MDMER EEM requirements for fish population surveys, water and sediment quality, and benthic invertebrate community assessments. The sampling plan is conceptually outlined in Table 5. Fish tissue monitoring will be conducted if triggered by MDMER conditions. A study design will be provided to ECCC according to the MDMER requirements (GC 2018), which includes all proposed monitoring locations.

Starting March 2019, a monthly under-ice sampling program was initiated in the area anticipated to be influenced by Agnico Eagle discharge to sea. The sampling program will extend to May 2019. The program included three sampling locations selected to correspond with the location of potential exposure to diffuser discharge In Melvin Bay. The purpose of the sampling program is to develop a baseline for water quality parameters within the potential exposure area prior to initiation of discharge. Details are found in Appendix D.

Further information regarding sampling locations, QA/QC, water quality benchmarks, sediment quality benchmarks, and environmental effect thresholds is provided in the Conceptual Ocean Discharge Monitoring Plan (Appendix D).

Table 5: Conceptual Ocean Discharge Monitoring Program Sampling Summary

Monitoring Component	Sampling Frequency	Monitoring Location	Sample Replication and Number of Samples
Deleterious Substances (MDMER Schedule 4)	Every week	FDP (end-of-pipe)	One grab sample
Acute lethality	Every month (sampled concurrently with effluent characterization)	FDP (end-of-pipe)	One grab sample
Effluent characterization	Four times a year, one month apart during discharge	FDP (end-of-pipe)	One grab sample
Sublethal toxicity	Twice a year, one month apart at the start and finish of the discharge	FDP (end-of-pipe)	One grab sample
In situ Water Column Measurements	Four times a year, once a month during discharge	Exposure and reference areas	7 stations in the Exposure Area, 3 stations in each reference area. One vertical profile per station
Water Quality	Four times a year, once a month during discharge	Exposure and reference areas	7 stations in the Exposure Area, 3 stations in each reference area. One sample @1m below the surface and one sample @5 m above the bottom at each station.
Benthic Invertebrate Communities, and sediment quality	Every 3 years in August if triggered by MDMER	Exposure and reference areas	6 stations in the Exposure area and 5 stations in each reference area. Three subsamples per station
Fish population	Every 3 years in August if triggered by MDMER	Exposure and reference areas	20 sexually mature males and 20 sexually mature females of two fish species in each sampling area

Monitoring Component	Sampling Frequency	Monitoring Location	Sample Replication and Number of Samples
Fish tissue	Every 3 years in August if triggered by MDMER	Exposure and reference areas	8 samples of a single species from each sampling area

Notes:

Amended Metal and Diamond Mining Effluent Regulations (MDMER; GC 2018) will be adhered to. Metal Mining Effluent Regulations (MMER) will be adhered to as a minimum while MDMER come into effect.

FDP = Final Discharge Point

4.4 Groundwater Monitoring Plan

Table 6 presents a summary of the underground monitoring plan presented in Sections 4.2 and 4.3. Additional sampling at the surface will be conducted, including pre- and post- SWTP sampling as outlined in the WMP and the Water Quality and Flow Monitoring Plan.

Table 6: Groundwater Monitoring Plan

Monitoring Type	Monitoring Location	Purpose	Frequency
Verification	Portal Water Stope L75	Quantity - Monitor underground water quantity pumped to surface.	Totalized Flow Tabulated Monthly
Verification	Underground Seeps	Quantity - Seepage survey to verify underground flow estimates.	Monthly
Verification	Sump 125	Quality - Monitor underground water quality prior to recirculation for underground use.	Monthly
Verification	Underground seeps/DDHs	Quality – Verify quality of groundwater flowing into underground	Quarterly
Verification	SWTP Inlet and Outlet	Quality – Verify quality of groundwater being treated and monitor final treated effluent prior to continued transfer to CP1	Weekly

Source: Agnico Eagle (2018).

SECTION 5 • QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

Quality Assurance (QA) refers to plans or programs that encompass a wide range of internal and external management and technical practices designed to ensure the collection of data of known quality that matches the intended use of the data. Quality Control (QC) is a specific aspect of QA that refers to the internal techniques used to measure and assess data quality. Specific QA and QC procedures that will be followed during sampling performed for the Groundwater Monitoring Program are described in Section 5.1 and 5.2.

5.1 Quality Assurance

Quality assurance protocols are diligently followed so data are of known, acceptable, and defensible quality. There are three areas of internal and external management, which are described in the following three sections.

5.1.1 Field Staff Training and Operations

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

5.1.2 Laboratory

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

5.1.3 Office Operations

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

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

- appropriate logic checks will be completed to ensure the accuracy of the calculations.

5.2 Quality Control

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

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

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

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

- Field Blank: A sample prepared in the field using laboratory-provided deionized water to fill a set of sample containers, which is then submitted to the laboratory for the same analysis as the field water samples. Field blanks are used to detect potential sample contamination during collection, shipping and analysis.
- Travel Blank: A sample prepared and preserved at the analytical laboratory prior to the sampling trip using laboratory-provided deionized water. The sample remains unopened

throughout the duration of the sampling trip. Travel blanks are used to detect potential sample contamination during transport and storage.

- Duplicate Sample: Two samples collected from a sampling location using identical sampling procedures. They are labelled, preserved individually and submitted for identical analyses. Duplicate samples are used to assess variability in water quality at the sampling site. Duplicates are collected and submitted for analyses at approximately, 10% of sampling locations. For smaller batches of samples (less than 10), at least one duplicate will be collected and submitted for analysis.

REFERENCES

Agnico Eagle. 2014. Final Environmental Impact Statement (FEIS) - Meliadine Gold Project, Nunavut from: ftp://ftp.nirb.ca/02-REVIEWS/ACTIVE%20REVIEWS/11MN034-Agnico Eagle%20MELIADINE/2-REVIEW/09-FINAL%20EIS/FEIS Accessed on November, 2014.

Agnico Eagle. 2015a. Meliadine Gold Project, Type A Water Licence. Water Management Plan. Version 1. Submitted to the Nunavut Water Board. April 2015.

Agnico Eagle. 2015b. Meliadine Gold Project: Environmental Management and Protection Plan (EMPP). Version 4. 6513-MPS-07. April 2015.

Agnico Eagle. 2019. Meliadine Gold Project Water Management Plan. Version 4. 6513-MPS-11. March 2017.

CCME (Canadian Council of Ministers of the Environment). 2003. Canadian Environmental Quality Guidelines – Water Quality Guidelines for the Protection of Aquatic Life.

Golder (Golder Associated Ltd.). 2009. Assess of completeness of geotechnical data for feasibility design Tiriganiaq open pit. Submitted to Comaplex Minerals Corp., 26 May 2009, Doc. 008 Rev. 0

Golder. 2012a. SD 7-2 Aquatic Baseline Studies- Meliadine Gold Project, Nunavut, Canada. A Technical Report Submitted to Agnico Eagle Mines Ltd. by Golder Associates, September 19, 2012.

Golder. 2012b. SD 6-1 Permafrost Thermal Regime Baseline Studies- Meliadine Gold Project, Nunavut, Canada. A Technical Report Submitted to Agnico Eagle Mines Ltd. by Golder Associates, September 25, 2012.

Golder. 2012c. Tailings Storage Facility Preliminary Design – Meliadine Gold Project, Nunavut. A Draft Report Submitted to Agnico Eagle Mines Ltd. by Golder, August 16, 2012.INAC, 1992. Guidelines for ARD Prediction in the North. Department of Indian Affairs and Northern Development, Northern Mine Environment Neutral Drainage Studies No.1, Prepared by Steffen, Robertson and Kirsten (B.C.) Inc.

Golder. 2016. Hydrogeological Assessment in Support of the Underground Mine Development at Tiriganiaq, March 21, 2016.

Golder. 2017. Updated Predictions of groundwater Inflow to Tiriganiaq Underground Mine – V5 Mine Plan, December 18, 2017.

Golder. 2019. Modelling Assessment of Groundwater Discharge into the Melvin Bay Marine Environment, Rev B. February 1, 2019.

GC (Government of Canada). 2017. Regulations Amending the Metal Mining Effluent Regulations (MMER). Canada Gazette Part I, Vol 151, No. 19. May 2017

Hatch. 2013. Agnico Eagle Mines Ltd. - Meliadine Desalination Study - Salt Water Treatment Plant Report. Report No. H350003-000-05-124-002/6505-SSR-01_R82, Rev 2. September 30, 2013.

NWB (Nunavut Water Board). 2016. Type A Water Licence No. 2AM-MEL1631.

Snowden. 2008. Tiriganiaq gold deposit, Nunavut – resource update. Submitted to Comaplex Minerals Corp. January 2008.

APPENDIX A • SITE LOCATION AND MINE SITE LAYOUT

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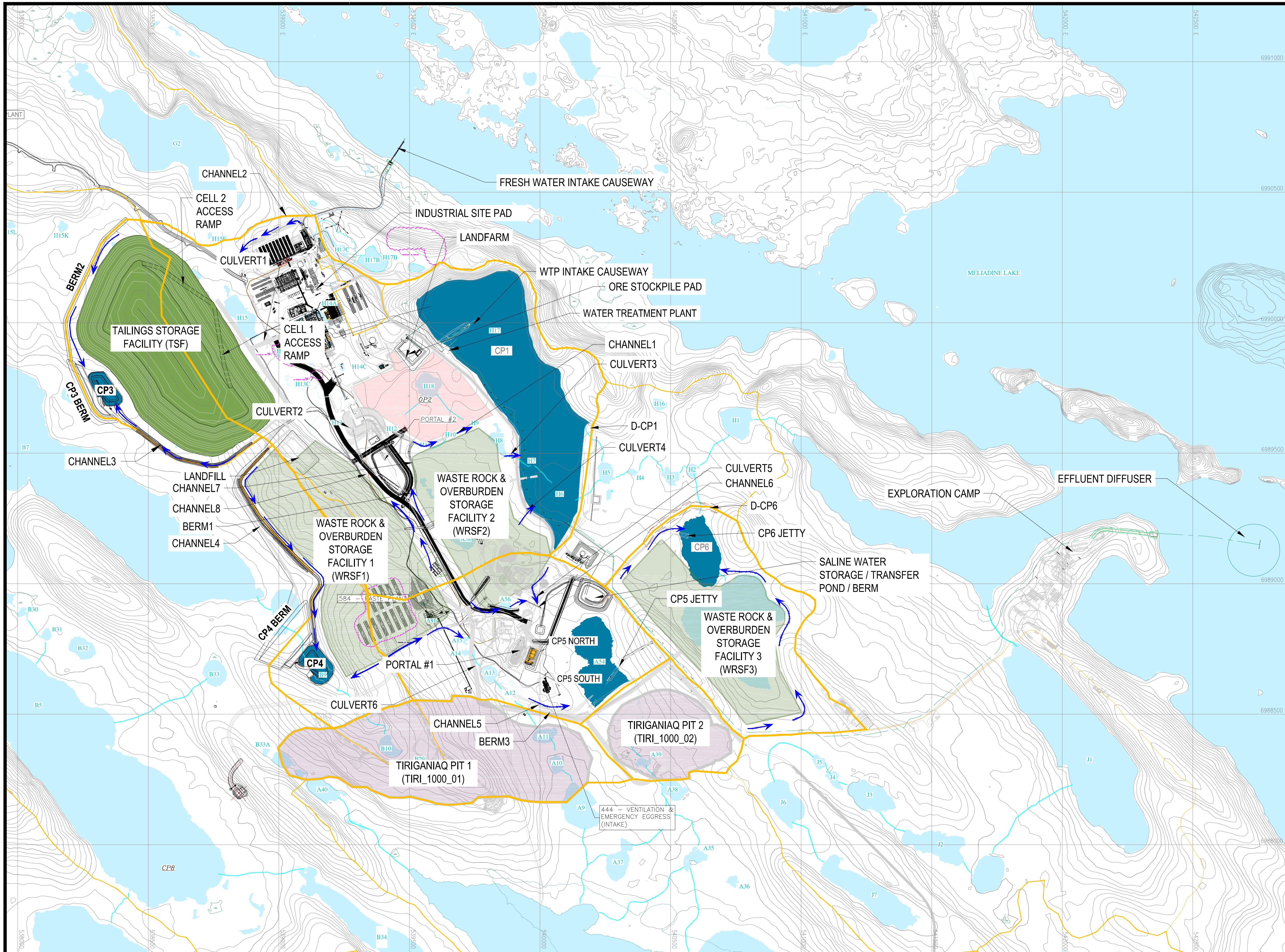
FORMAT ANSI B-11x17



LEGEND

- CATCHMENT BOUNDARY
- WATERBODY
- WATER COLLECTION POND
- OPEN PIT
- WASTE ROCK
- ORE
- CONTACT WATER FLOW DIRECTION

PERMIT TO PRACTICE
TETRA TECH CANADA INC.
Signature
Date Nov. 14, 2018
PERMIT NUMBER: P 018
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
G. ZHANG
LICENSEE
NOV. 14, 2018
NWT/NU

AGNICO EAGLE

TETRA TECH

POUR CONSTRUCTION
FOR CONSTRUCTION
DATE : 11/14/2018

TITRE / TITLE	# DWG
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DESSINS EN RÉFÉRENCE/REFERENCE DRAWINGS

REV	DESCRIPTION	DATE	PAR BY
0	ISSUED FOR CONSTRUCTION	2018-11-14	
B	ISSUED FOR REVIEW	2018-11-06	
A	ISSUED FOR REVIEW	2018-11-05	

REVISIONS

DESSINÉ PAR / DRAWN BY	EL/EP	DATE	2018-11-14
VÉRIFIÉ PAR / CHECKED BY	GZ/WTH		2018-11-14
APPROUVÉ PAR / APPROVED BY			
No. PROJET / PROJECT NO.			
DATE			

TITRE / TITLE
MELIADINE TAILINGS STORAGE FACILITY DESIGN

GENERAL ARRANGEMENT

ÉCHELLE/ SCALE
FICHIER FILE .DWG

No. DESSIN/ DRAWING NO. 6515-583-163-001
REVISION 0
FEUILLE/SHT 1 / 8

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APPENDIX B • DESIGN REPORT SALINE EFFLUENT DISCHARGE TO MARINE ENVIRONMENT

February 2019

Design Report
Saline Effluent Discharge to Marine Environment

6528-680-132-REP-001

In accordance with NIRB Project No.006 Condition 128

Prepared by:
WSP Canada Inc.

AGNICO EAGLE
MELIADINE

February 2019

DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
0	2019-02-15			Design report

Prepared By: Phillip Sidorenko, ing. #5063140

Phillip Sidorenko, P. Eng.

Verified by:

Ugo Banville, P. Eng.

Approved by:

Manon Turmel

TABLE OF CONTENTS

LIST OF APPENDICES

1 INTRODUCTION

1.1 SITE LOCATION AND ACCESS

WSP Canada Inc. (WSP) was retained by Agnico Eagle Mines Limited (Agnico Eagle) to prepare the Design Report of the proposed saline effluent discharge to the marine environment near Rankin Inlet, Nunavut. As part of their long-term groundwater management strategy, Agnico Eagle is planning to collect groundwater from the Meliadine underground mine, treat the influent with respect to quality standards and discharge the treated groundwater effluent into Melvin Bay.

The Meliadine Mine is located approximately 25 km North of Rankin Inlet (63°1’23.8’’ N, 92°13’6.42’’ W), Nunavut.

The proposed discharge point for the saline groundwater effluent is in Melvin Bay just west of Rankin Inlet. Agnico Eagle will access the area using a bypass road. The area is also accessible by Itivia Street, a gravel road linking the Agnico Eagle Fuel Storage Facility at the Itivia Harbour and Rankin Inlet.

1.2 EXISTING AND FUTURE SITE FACILITIES

Agnico Eagle owns and operates the existing Fuel Storage Facility and plans to use this property to install the saline effluent discharge system. This projected effluent discharge system consists of truck discharge pump, a back-up discharge truck pump, a 100 000-litre storage tank, as well as suction and discharge pipelines. The 100 000-litre storage tank will only be used to contain the treated effluent until the next day, if the 800 m^3/d discharge limit is attained upon a truck’s arrival. The storage tank will be installed on a containment area, built on a geomembrane with underlying and overlying granular materials and surrounded by berms. The construction drawings are shown in the Appendix A.

A pumping station including two pumps will be installed on the containment area. The truck discharge pump will be used to transfer the effluent from the trucks directly into the sea (or to storage tank). A back-up truck discharge pump will be installed to by-pass the first pump, if necessary. The truck-discharge pump is connected to a 778 m long HDPE pipeline to pump the effluent from the trucks to 20m below sea level in Melvin Bay. A diffuser is connected at the end of the pipe to ensure effective dilution of the saline effluent into the marine environment. The ballast weights will be attached to the pipe to sink and hold it onto the seabed.

For more detailed information, refer to the construction drawings shown in the Appendix A.

1.3 PURPOSE OF THE DOCUMENT

The purpose of the report is to outline the final design and construction drawings for the saline effluent discharge system which includes the storage tank, the pumping station, the discharge pipe as well as the diffuser that will release the treated groundwater effluent into Melvin Bay.

This report has been prepared in accordance with Condition 128 of NIRB Project Certificate No.006:

‘’The Proponent shall provide the NIRB with a detailed design for the system that includes the location of the pipeline in relation to the saline effluent storage tank at Itivia, the location of submerged collars supporting the pipeline and the design of the diffuser.’’

The final design was presented to the local stakeholders including the Kangiqliniq Hunters and Trappers Organization (KHTO), the Hamlet of Rankin Inlet and the Government of Nunavut - Nunavut Airports Division and Community and Government Services Department on January 24th, 2019 for final review.

This design report refers to Golder’s Report which assessed the environmental guidelines characterizing Melvin Bay at the location of the proposed diffuser and conducted the numerical modelling to design the diffuser. Golder’s Report was published in February 2019 and is shown in Appendix D.

1.4 SCOPE OF WORK

WSP was retained by Agnico Eagle to design the pumping station and pipeline while Golder was responsible for the assessment of the groundwater effluent plume with respect to environmental guidelines. This report describes the design of the pumping station, the pipeline and the diffuser.

2 GENERAL SITE CONDITIONS AND OTHER DATA INPUT FOR DESIGN

2.1 MODELLING FOR DIFFUSER DESIGN

The model calculates numerical simulations of the treated groundwater effluent mixing in the proposed marine environment. The modelling of the groundwater effluent plume dispersion allows the user to assess the dilution behaviour.

The ambient environmental conditions (e.g. winds, currents, etc.) and treated groundwater effluent characteristics are necessary to calculate numerical simulations of the mixing.

The proposed diffuser pipeline is to extend from the storage tank to be located south of the Aginco Eagle’s Fuel Storage Facility, to south-south-west in Melvin Bay. The diffuser port will be installed on the seabed at a depth of 20 m, to ensure proper mixing and prevent interference with traditional activities.

Refer to section 2.1.3 of Golder’s Report: Modelling Assessment of Groundwater Discharge into the Melvin Bay Marine Environment, Rev B, for detailed information (Golder, 2019).

2.2 ENVIRONMENTAL DATA

For detailed information on the environmental data used, refer to section 2.1.1 of Golder’s Report.

2.3 CHARACTERISTICS OF THE EFFLUENT

For detailed information on the characteristics of the effluent, refer to Appendix B of Golder's Report.

3 DESIGN OF THE STORAGE AND PUMPING STATIONS

3.1 GENERAL

After treatment, the excess groundwater will be stored on site at the Meliadine Mine, before being hauled by tanker trucks to Itivia Harbour. Trucks will unload their treated groundwater effluent by connecting on a flexible 4'' HDPE suction pipe. The truck discharge pump will transfer the treated effluent into the 6'' discharge HDPE pipeline and through the diffuser. The truck discharge pump will also be used to transfer effluent into the storage tank until the next day, before it is pumped into sea when necessary.

A by-pass pipeline will be installed parallel to the main discharge pipe in case the discharge truck pump malfunctions or maintenance is required. The back-up truck discharge pump (spare) will be used to pump the effluent into by-pass pipe, though the 6'' discharge HDPE pipe and out the diffuser, if necessary.

3.2 PUMP NARRATIVE

The flow rate to be discharged to Melvin Bay will not exceed 800 m^3/d with a TDS of 39 600 mg/L (Golder, 2019). The discharge will only occur during open water season. For more detailed information on the modelling scenarios and the input parameters, refer to section 2.1.2 of Golder's Report.

3.3 PUMPING STATION ENCLOSURES

The pumping station will be enclosed inside a heated container to protect the mechanical and electrical equipment from cold temperatures before Winter and at freshet. This precaution will decrease the risks of malfunctions in the system.

3.4 STORAGE TANKS

A 100 000-litre horizontal double wall storage tank will only be used to store the treated groundwater effluent until the next day if the daily discharge limit is attained upon a truck's arrival.

3.5 PIPING

The piping manifold for pumping stations within the container will be made of chlorinated polyvinyl chloride (CPVC) with Victaulic connections to facilitate the dismantlement during maintenance operations.

The 4'' suction and 6'' discharge pipelines outside of the heated container will be made of HDPE DR-9 pipe.

3.6 CONTROLS

The pumping station was designed to control the high and low water levels in the storage tank. The water level in the storage tank will be regulated with an ultrasonic transmitter located in the storage tank. When the water reaches the high level, the pump will automatically start to discharge the treated effluent to Melvin Bay.

A flow meter will be installed downstream of the pumping station to measure the flow rate before discharging into the marine environment. The pH, conductivity and the temperature levels of the effluent will be measured at the Chlorination Treatment Plant before arrival to Agnico Eagle Fuel Storage Facility. This equipment will allow Agnico Eagle to control the discharge operations and to respect the base parameters. This is in accordance with the commitments during the Final Environmental Impact Statement (FEIS) process.

A valve will be installed downstream of the storage tank to allow the sampling according to the Metal and Diamond Effluent Regulation.

The pumping station is designed to facilitate the user's operations and maintenance. The design allows a local control at the pumping station.

4 DESIGN OF THE HDPE PIPELINES

4.1 GENERAL

The present section of the report describes the main components of the effluent discharge pipeline and provides the reader with further details on its design and functionalities.

The groundwater effluent pipeline was designed to prevent interference with local transportation including snowmobiling, boating and ATV's. Our design proposes an ATV and snowmobile crossing constructed over a section of the onshore pipeline and parallel to the laydown area fence line. Furthermore, drawing 65-100-210-200 illustrates the location of the proposed ATV and snowmobile crossing.

The design will not affect the use of traditional land during construction and operation.

4.2 ABOVE-GROUND PIPELINE

4.2.1 ONSHORE

The onshore pipe will be installed permanently on the undisturbed natural ground. Signage will be installed in both directions of the traffic near the onshore pipe to indicate the obstacle and the crossing to motorized vehicles.

4.2.2 SUBMARINE PIPELINE

Unlike the conceptual design presented during the FEIS process, Agnico Eagle is proposing not to bury the pipeline located in the intertidal zone. This proposed design will result in reducing the impacts on the environment and community (i.e. eliminate need to re-open the Itivia quarry, reduce risk of erosion and sedimentation into Melvin Bay during pipe installation and reduce risk of pipe being moved by ice during winter).

The submarine pipeline is segmented into two sections, a temporary (removable) and a permanent section. The first 150 m long section located south of the crossing must be removed from the Melvin Bay before Winter since the formation of ice could damage the pipe. The temporary section will be re-installed at freshet once the ice has broken up. The temporary pipe is removable by its flanges located at the extremities of the 150 m section.

On the other hand, the permanent section of the submarine pipeline will be at least 6 m below sea level and will stay in place year-round. A diffuser is connected at the end of the pipe.

4.3 MATERIAL

4.3.1 PIPELINES

The effluent discharge pipeline will be made of Sclairpipe HDPE DR-9 PE4710. Also, the pipeline will be welded using a fusion welding machine except at it's flanges. The pipe's dimension ratio was selected based on the need for high rigidity. The chemical properties of HDPE pipes make it highly resistant to saline water. Finally, HDPE pipelines are easier to install in a marine environment compared to other materials (e.g. steel).

4.3.2 FLANGES, VALVES AND ACCESSORIES

The pipeline's temporary section has two HDPE flanges at its extremities to enable it to be removed and installed again, when necessary. A back-up ring will be inserted in-between each flange connections and then mechanically fastened to ensure tightness. The ring will be designed to resist low water temperatures as well as salinity.

4.3.3 BALLAST WEIGHTS

The ballast weights will be installed at a 1.52 m interval along the submarine pipeline. The ballast weights must weigh 67.6 pounds to keep the pipeline floating when filled with air, until it is in the projected alignment. Once the pipeline is filled with water, the ballast weights will sink and hold the pipeline onto the seabed. The ballast weight will allow the installation of the pipeline underwater.

4.4 EQUIPMENT

4.4.1 FLOWMETER

As mentioned in section 3.6, a flowmeter will be installed downstream of the pumping station to measure the flow rate before discharge into the marine environment.

5 DESIGN OF DIFFUSER AND MODELLING RESULTS

5.1 DIFFUSER CONFIGURATION

The optimized diffuser has the following configuration:

- Diffuser connection with outfall through a 6’’ five-way cross;
- Length of the diffuser: 0.9 m;
- Diameter of the diffuser: 150 mm, DR-9 (nominal);
- Diffuser depth: 20 m (based in 2017 bathymetry survey of Melvin Bay);
- Discharge type: single port;
- Horizontal angle of discharge: Perpendicular to bathymetric contours;
- Vertical angle of discharge: 90°;
- Port diameter: 75 mm, DR-9 (nominal);
- Port height from seabed: 1 m.

For more detailed information, refer to construction drawing 65-100-210-200 in Appendix A.

6 CONSTRUCTION

6.1 GENERAL

Construction is expected to begin in May 2019 and end in August 2019.

6.1.1 PIPELINE

The pipeline sections will be welded on shore into three major segments; the onshore segment as well as the temporary and permanent submarine segments.

The ballast weights will be installed onshore only when the submarine segments are welded together. Initially, the ballast weights will be stockpiled adjacent to the work station. Then, a ramp or skid way, including railroad tracks or steel beams, will be placed to facilitate moving the weights along with the pipe.

The pipeline is ready for launching when all the ballast weights are fixed to the pipeline. To keep the pipeline floating until the sinking operation, the pipe ends are blocked to prevent water from entering the pipe. This will be accomplished by installing a flange assembly with a blind flange at each end.

Before the launch, the ramp of the skidway will extend deep enough into the water so that the weights can be supported by the floating pipe. In case of high currents, an anchorage system will be installed to hold the pipe while it is being launched. A boat with a winch and cable system will be used to move the pipeline into the water. It may be necessary to install guide cables and shore anchors to hold the system over the alignment when it is being sunk.

The sinking process consists of filling the pipe with water at one end and evacuating the air out of the other end.

The construction of the pipeline onshore and under water will not interfere with the local community activities. During construction, vertical lighting signs will be installed onshore to alert incoming traffic at Itivia Harbor. The lighting will be oriented with caution, towards the working area and away from the airstrip take off and landing area.

6.1.2 STORAGE TANK

The installation of the storage tank will require the use of a lifting mobile equipment. The storage tank measures 12.2 m long x 3.3 m wide and weighs 15 m.t. It will be set in place with the M & T KoneCrane ReachStacker Model SMV 4531. Its maximum vertical extension is 18.2 m but just to lift the storage tank off a flat bed and set in place, it would be extended about two thirds that height.

6.1.3 CONTAINMENT PAD (NEAR ITIVIA FUEL STORAGE FACILITY)

The Containment pad will be built to minimize land disturbance and environmental risks. Therefore, the pad is to be built 31 m away from the Highest High Water Large Tide (HHWLT).

Once the subgrade is prepared, an HDPE geomembrane is installed with underlying and overlying granular material. Also, berms are to be constructed around and higher than the containment pad. This gives the pad the capacity to contain the volume of effluent inside the storage tank in case of spillage.

The pad will facilitate daily operations such as maneuvering the tanker trucks to unload the groundwater effluent into the storage tank.

The construction of the containment pad will require an excavator, tandem trucks, a spread dozer and a compactor. The tallest heavy equipment on site will be the CAT 330 excavator. It has a maximum vertical reach of 10.7 m but will not be deployed to this height since the work will occur at ground level only.

6.2 MATERIAL SPECIFICATIONS

All the materials used to fabricate the facility are non-potentially acid generating (NPAG) materials. The granular materials that will be used for building the containment pad will be sourced from a nearby borrow pit.

6.3 CONSTRUCTION QUALITY CONTROL AND SURVEY

Agnico Eagle is responsible for conducting quality control and surveying during construction.

6.4 TESTING AND INSPECTION

Agnico Eagle is responsible for testing and inspecting the saline discharge effluent system according to the manufacturer's recommendations before its start-up. After the pipeline installation, diver's will verify that the ballasts holding the pipeline are all properly sitting on the bottom contours and that the pipeline is not resting on any rocks, debris or material that could cause damage.

7 OPERATIONS

7.1 REMOVABLE AND PERMANENT PIPE

As stated in section 4.2.2, operation of the saline effluent discharge requires installing and removing a temporary segment of the pipeline at freshet and Winter, respectively. The temporary segment will be removed and stored away before the bay freezes up.

The temporary section of pipe can be disconnected from the system at its flanges and will have to be pulled out using heavy equipment. Agnico Eagle is responsible for storing this pipeline segment on their property during Winter.

7.2 MAINTENANCE PROGRAM

Agnico Eagle will have in place a maintenance program based on manufacturer's recommendations. The system will be inspected according to the manufacturer's recommendations and repaired when needed to keep the system in good working condition.

8 REFERENCES

Agnico Eagle. 2018a. Meliadine Gold Project Groundwater Management Plan. Version 1. February 2018.

Golder. 2019. Modelling Assessment of Groundwater Discharge into the Melvin Bay Marine Environment, Rev B. February 2019.

Agnico Eagle (Agnico Eagle Mines Limited). 2014. Final Environmental Impact Statement (FEIS) - Meliadine Gold Project, Nunavut from: ftp://ftp.nirb.ca/02REVIEWS/ACTIVE%20REVIEWS/11MN034-AgnicoEagle%20MELIADINE/2-REVIEW/09-FINAL%20EIS/FEIS Accessed on November 2014.

Agnico Eagle. 2018b. Meliadine Gold Project Water Management Plan. Version 3. 6513-MPS-11. March 2018.

Appendix A: Construction drawings

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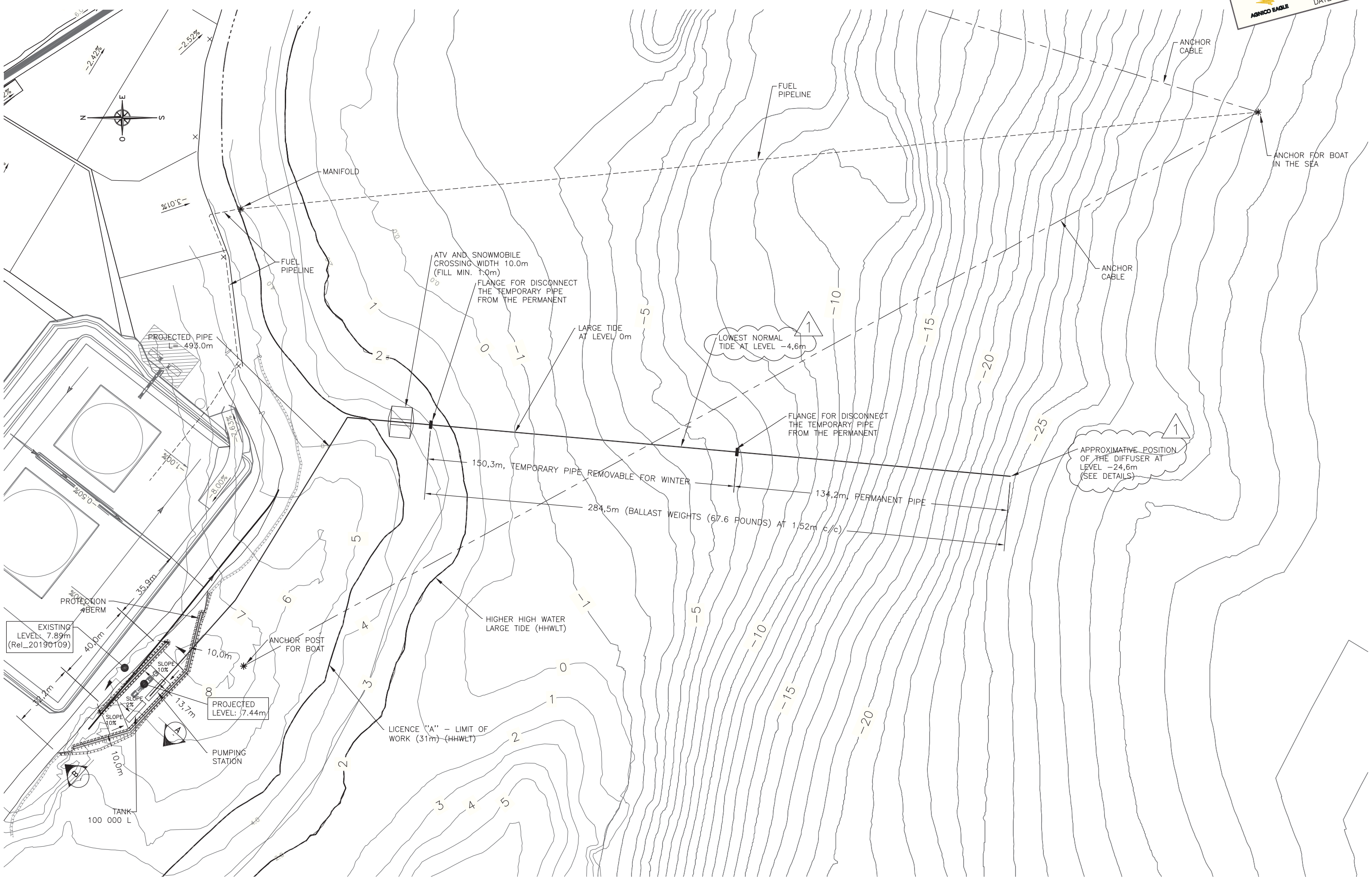

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PLAN CLÉ
KEY PLAN

wsp
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Ref. 181-15686-00

NOTES GÉNÉRALES / GENERAL NOTES

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AGNICO EAGLE

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0	2019-02-06	ISSUED FOR CONSTRUCTION	J.C.	S.D.	

REVISIONS

Stéphan Dupuis 139569 QUÉBEC
2019-02-14
REGISTERED PROFESSIONAL ENGINEER S. DUPUIS LICENSEE NT/NU

TITRE / TITLE
AGNICO EAGLE - MELIADINE DIVISION
180 - SALINE EFFLUENT DISCHARGE SYSTEM
230 - GENERAL EARTH WORKS
SALINE WATER STORAGE FACILITY
RANKIN INLET
PLAN VIEW

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VERIFIÉ PAR / CHECKED BY	YOUSSEF HESSANI, Ing.	2019-02-06
APPROUVÉ PAR / APPROVED BY	STEPHAN DUPUIS, P. Eng.	2019-02-14
ÉCHELLE / SCALE: INDICATED	DATE 2018-12-12	

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DRAWING NO. 65-180-230-200-1

NO. PROJET / PROJECT NO.	REVISION	FEUILLE / SHT
6528	1	1 / 2

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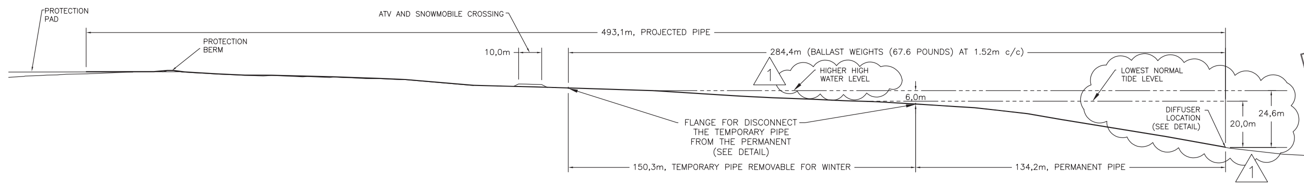

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POUR CONSTRUCTION
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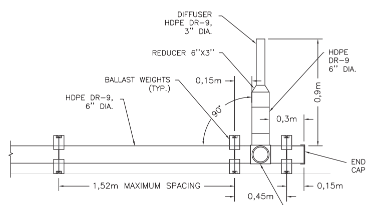
DATE : 2019-02-14



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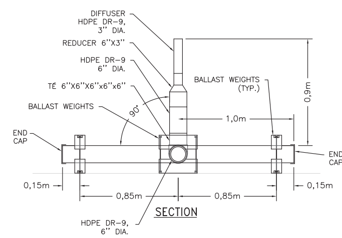

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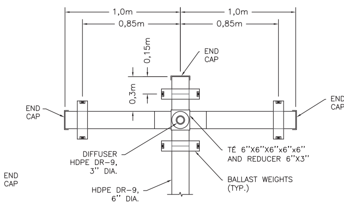

PLAN VIEW

DETAILS – DIFFUSER
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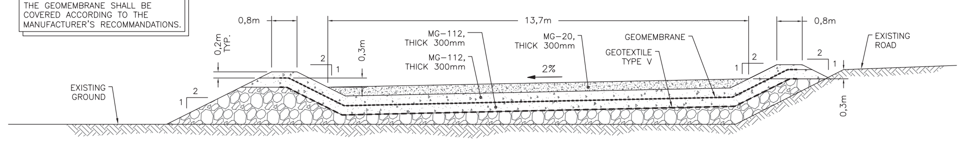
NOTE:
THE GEOMEMBRANE SHALL BE COVERED ACCORDING TO THE MANUFACTURER'S RECOMMANDATIONS.



SECTION "A"– PAD
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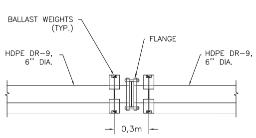
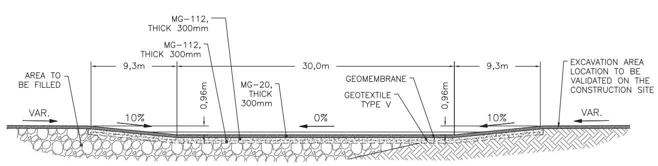


DETAIL – FLANGE
Scale: 1: 20



SECTION "B" – PAD
Scale: 1: 250

NOTES:

1) FOR THE INSTALLATION, THE CONTRACTOR NEED TO REFER TO THE HANDBOOK OF PE PIPE CHAPTER 10, MARINE INSTALLATION. EACH SECTION OF PIPE MUST BE JOINT BY FUSION, EXCEPT FOR THE TEMPORATY PIPE REMOVABLE FOR WINTER THEY ARE CONNECTING TO THE PERMANENT PIPES WITH FLANGE FUSED AT EACH END BACK-UP RING.

2) POST-INSTALLATION SURVEY

UPON COMPLETION OF THE INSTALLATION OF A SUBMERGED PIPELINE, IT IS ADVISABLE TO HAVE THE COMPLETE LINE SURVEYED BY A COMPETENT DIVER TO ENSURE THAT:

- THE PIPELINE IS LOCATED WITHIN THE PRESCRIBED RIGHT-OF-WAY;
- THE BALLASTS HOLDING THE PIPELINE ARE ALL PROPERLY SITTING ON THE BOTTOM CONTOUR AND THAT THE LINE IS NOT FORCED TO BRIDGE ANY CHANGES IN ELEVATION;
- THE PIPE IS NOT RESTING ON ANY ROCKS, DEBRIS OR MATERIAL THAT COULD CAUSE DAMAGE;
- ANY AUXILIARY LINES, SUCH AS HOSES, ROPES, BUOYANCY BLOCKS OR ANY OTHER EQUIPMENT USED DURING THE INSTALLATION HAS BEEN REMOVED;
- WHERE REQUIRED, THE PIPE HAS BEEN BACKFILLED AND THE BACKFILLING WAS DONE PROPERLY;
- ALL OTHER INSTALLATION REQUIREMENTS ESTABLISED BY THE DESIGNER FOR THE SUBJECT APPLCATION HAVE BEEN COMPLIED WITH.

PLAN CLÉ / KEY PLAN

wsp

1075, 3e AVENUE E. VAL-D'OR (QUÉBEC) CANADA J9P 6M1 TÉL.: 1-819-825-4711 | TÉLÉC.: 1-819-825-4715 | WWW.WSP.COM

Réf. 181-15686-00

NOTES GÉNÉRALES / GENERAL NOTES

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

TITRE / TITLE	# DWG
INDUSTRIAL SITE – GROUND LEVELING / FINISHED GRADE ELEVATION	65-000-230-207_R0

AGNICO EAGLE

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT
1	2019-02-14	ISSUED FOR CONSTRUCTION	J.C.	S.D.	
0	2019-02-06	ISSUED FOR CONSTRUCTION	J.C.	S.D.	

REVISIONS

Stéphan Dupuis 139686 QUÉBEC
2019-02-14

TITRE / TITLE
AGNICO EAGLE – MELIADINE DIVISION
180 – SALINE EFFLUENT DISCHARGE SYSTEM
230 – GENERAL EARTH WORKS
SALINE WATER STORAGE FACILITY
RANKIN INLET
DETAILS

DESSINÉ PAR / DRAWN BY	JULIE.CROTEAU, tech.	DATE 2018-12-12
VÉRIFIÉ PAR / CHECKED BY	YOUSSEF HESSANI, Ing.	2019-02-06
APPROUVÉ PAR / APPROVED BY	STEPHAN DUPUIS, P. Eng.	2019-02-14
ÉCHELLE / SCALE	INDICATED	DATE 2018-12-12

NO. DESSIN / DRAWING NO. 65-180-230-200-2

NO. PROJET / PROJECT NO.	REVISION	FEUILLE / SHT
6528	1	2 / 2

AE-CART-ARCH D

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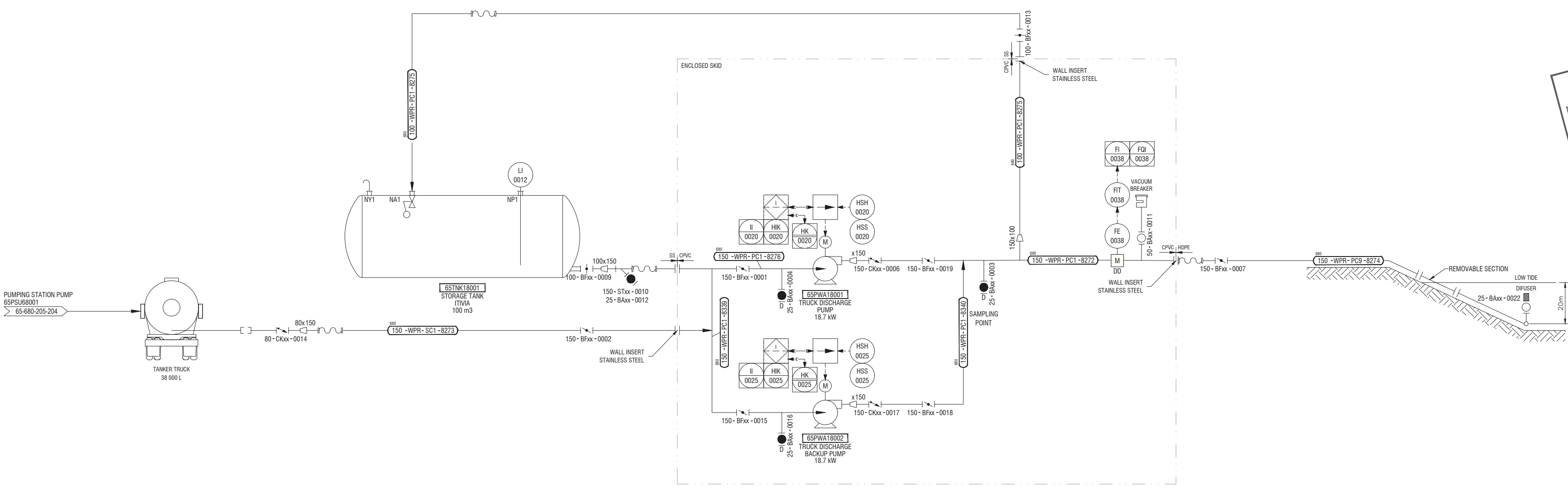
FILE NO. 65-180-230-200-2_R1.dwg

NO. DESSIN
DRAWING NO. 65-180-205-200_R0

FORMAT ARCHD



PLAN CLÉ
KEY PLAN

NOTES GÉNÉRALES / GENERAL NOTES

NE PAS UTILISER POUR CONSTRUCTION
NOT FOR CONSTRUCTION
AGNICO EAGLE
DATE : 19-02-07

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

TITRE / TITLE	# DWG
–	–
–	–
–	–
–	–
–	–

AGNICO EAGLE

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT
0	2019-02-07	ISSUED FOR TENDER	S.P.	E.L.	

REVISIONS

L2899
E. LAVOIE
LICENSEE
08/02/2019

TITRE / TITLE
AGNICO EAGLE – MELIADINE DIVISION
180 – SALINE EFFLUENT DISCHARGE SYSTEM
205 – PIPING & INSTRUMENTATION DIAGRAM
RANKIN INLET
ITIVIA

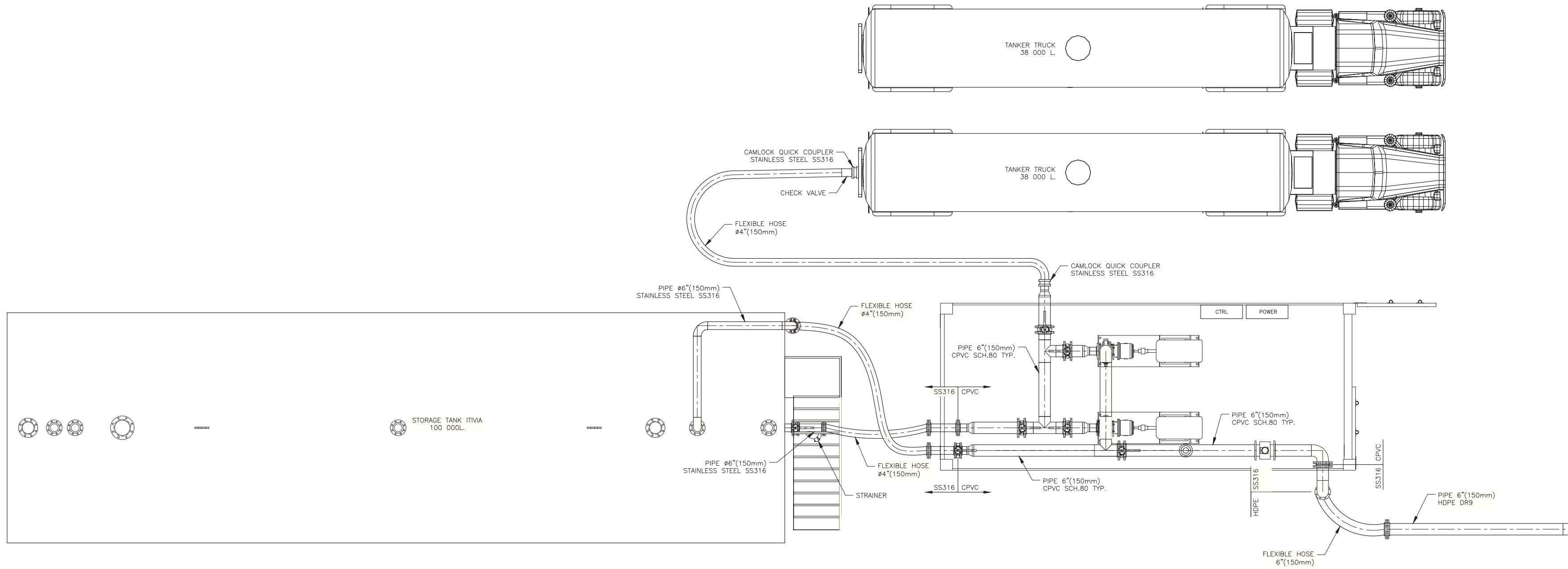
DESSINÉ PAR / DRAWN BY	JONATHAN LAVOIE	DATE 2019-01-17
VÉRIFIÉ PAR / CHECKED BY	SÉBASTIEN PERRON	2019-02-07
APPROUVÉ PAR / APPROVED BY	ÉRIC LAVOIE, P. Eng.	2019-02-07
ÉCHELLE / SCALE	NO SCALE	DATE 2019-01-23
NO. DESSIN / DRAWING NO.	65-180-205-200	
NO. PROJET / PROJECT NO. 6528	REVISION 0	FEUILLE / SHT 1 / 1

AE-CART-ARCH D

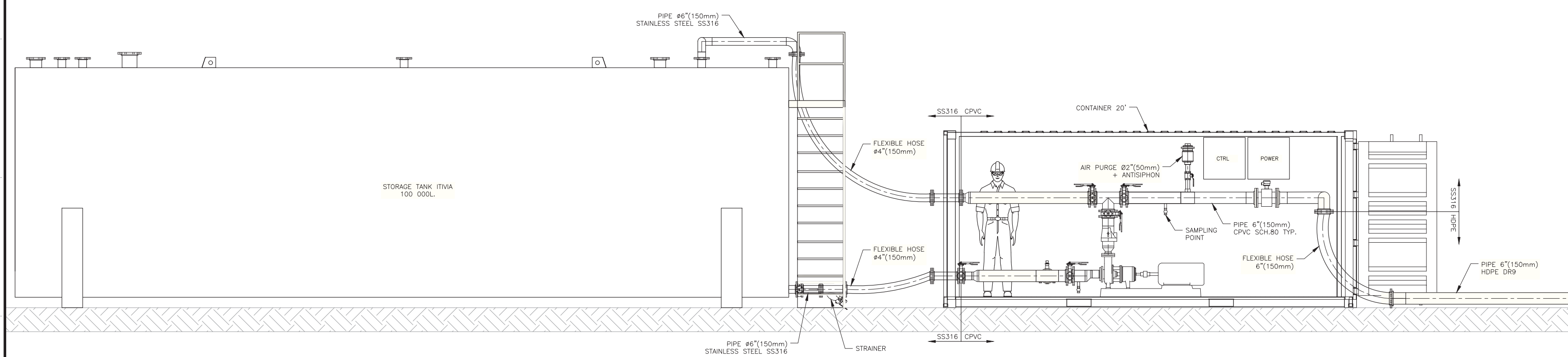
FILE NO. 65-180-205-200_R0.dwg

NO. DESSIN
DRAWING NO. 65–180–210–200_R0

FORMAT ARCHD



PLAN VIEW – SALINE EFFLUENT DISCHARGE SYSTEM
SCL: 1:30



ELEVATION VIEW – SALINE EFFLUENT DISCHARGE SYSTEM
SCL: 1:30

PLAN CLÉ
KEY PLAN

1075, 3e AVENUE EST
VAL-D'OR (QUÉBEC) CANADA J9P 0J7
TÉL. : 819 825-4274 | TÉLÉC. : 819 824-1514 | WWW.WSPGROUP.COM

Ref. 181–15686–00

NOTES GÉNÉRALES / GENERAL NOTES

POUR SOUMISSION
FOR TENDER
DATE : 2019–02–05

NE PAS UTILISER
POUR CONSTRUCTION
NOT FOR CONSTRUCTION
DATE : 2019–02–05

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

TITRE / TITLE	# DWG
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–	–
–	–
–	–
–	–
–	–

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT
0	2019–02–06	ISSUED FOR TENDER	C.G.	D.R	

REVISIONS

INGÉNIEUR - ENGINEER
Dominique Richard
5034681
QUÉBEC

REGISTERED PROFESSIONAL ENGINEER
D. RICHARD
NT/NU
L4044

TITRE / TITLE
AGNICO EAGLE – MELIADINE DIVISION
180 – SALINE EFFLUENT DISCHARGE SYSTEM
210 – GENERAL ARRANGEMENT
RANKIN INLET
ITIVIA

DESSINÉ PAR / DRAWN BY	CLAUDIA GILBERT	DATE 2019–01–30
VERIFIÉ PAR / CHECKED BY	SYLVAIN DÉFOSSÉ	2019–02–05
APPROUVÉ PAR / APPROVED BY	DOMINIQUE RICHARD, Eng.	2019–02–05
ÉCHELLE / SCALE	INDICATED	DATE 2019–01–30

NO. DESSIN
DRAWING NO. 65–180–210–200

NO. PROJET / PROJECT NO.	REVISION	FEUILLE / SHT
6515	0	1 / 1

AE-CART-ARCH D

\\cavdo1dat01\Projet_18X-XXXX-XX\181-15686-00\01-COMM\Envoyé_AEM\WSP-AEM-181-15686-00-074 (Saline Effluent Discharge System for Tender)\65-180-210-200_R0.dwg-2019-02-05 17:12:58

FILE NO. 65–180–210–200_R0.dwg

Appendix B: Pumping Station Functional Description

Functional Description

Saline Effluent Discharge at Sea

6528-680-132-REP-001 – Appendix 2

			Sébastien Perron Instrumentation 2019.02.13 17:12:45 -06'00'	Alain Corriveau Signature numérique de Alain Corriveau DN : cn=Alain Corriveau Date : 2019.02.13 18:04:58 -05'00'	Eric Lavoie 2019.02.14 08:24:33 -05'00'
2019-02-14	R0	Design Report	Sébastien Perron	Alain Corriveau	Éric Lavoie
Date	**Rev.**	**Status**	**Prepared By**	**Checked By**	**Accepted By**

Table of Contents

1. Document objective

This document describes the programming of the control logic to be implemented for the control system of the discharging at sea of the treated saline effluent water coming from Meliadine site. The system will be installed close to the existing fuel deposit in Rankin Inlet, near the shore of Melvin Bay. The project is for Agnico Eagle's Meliadine mine.

2. Description

2.1 System description – Saline water truck unloading, storage and discharge at sea

Truck loaded with up to 50 000 liters of treated water ready to discharge at the sea will connect their load to a flexible pipe 150mm in diameter. Once connected, the operator will turn on the pump for about 15 to 30 minutes to transfer the water into a 100 000 liters storage tank or by changing the manual valves, directly to the diffuser in the sea. Overflow of the tank will be prevented by a float valve on the filling port. A mechanical level indicator will be installed on the tank. A flowmeter/totalizer will be installed on the sea discharge line in order to double check the volume of water discharged in sea.

The system will be powered by the existing electrical room at the fuel deposit.

2.2 Control description – Saline water truck unloading pump

Start/Emergency Stop button stations will be installed near the pumps.

Operator will open and close the valves in order to choose:

1. Main Pump or Back up Pump
2. Unload truck to tank, unload truck to sea or unload tank to sea

END OF SECTION

Appendix C: Sclairpipe Technical Specification

Sclairpipe®

VERSATILE HIGH DENSITY
POLYETHYLENE PIPE

Sclairpipe

Sclairpipe® high density polyethylene (HDPE) pipe represents the latest advances in both material and manufacturing techniques. Since 1968, Sclairpipe has been proven in a wide range of municipal and industrial piping applications. It has been used extensively in the municipal market for gravity sewers, sewage forcemains, and pressure water systems. Uponor Infra has special expertise in marine installations of Sclairpipe, including river and lake crossings; and river, lake and deep ocean intakes and outfalls.

Lighter. Stronger. Chemical Resistant.

Sclairpipe is a tough, lightweight, solid wall pipe with a smooth internal surface. Available in various diameters from 4″ to 48″ it can handle internal pressures of up to 380 psi (PE 4710). It is a well suited alternative to copper, PVC, ductile iron and concrete pipe in a variety of applications.

Sclairpipe weighs approximately 1/10 that of a similar sized concrete pipe. Handling requires a minimum of heavy equipment and Sclairpipe can easily be assembled on ice or through wet marshy areas. It will not corrode, tuberculate or support biological growth, making it the material of choice in harsh environments. Sclairpipe is inert to salt water and to chemicals likely to be present in sanitary sewage effluent.

Sclairpipe has a smooth ID and maintains its flow capability over time - Hazen Williams C Factor remains 150, even after years of use.

Easier to Transport and Install. Leak Proof.

Sclairpipe is much easier to handle and install than heavier, rigid concrete pipe, offering potential cost savings during the construction process. It is structurally designed to withstand impact, especially in cold weather installations when other pipes are prone to cracks and breaks. Sclairpipe will float even when full of water. For marine applications long lengths of pipe can be assembled on shore and then floated into position.

Thermal butt fusion provides an economical and fast method of delivering a complete, long, continuous length of pipe. Thermal fusion eliminates potential leak points every 8-20 feet commonly found with gasketed (or bell or spigot) pipe materials. The fused joints provide a continuous leak proof system that eliminates the risk of joint leakage due to ground shifting. Fused joints are fully restrained and as such may reduce or eliminate the need for expensive thrust blocks. With Sclairpipe infiltration and exfiltration problems are eliminated.

Sclairpipe Advantages

- Leak Proof
- Corrosion Resistant
- Chemical Resistant
- Long Life
- Fatigue Resistant
- Impact Resistant
- Lightweight
- Flexible
- UV Resistant
- Environmentally Friendly

Cost Effective. Permanent.

Sclairpipe offers distinct advantages. It can be cold bent to a radius as small as 25 times the pipe's nominal pipe diameter, and the installed bend radius can be as small as 50 times the nominal pipe diameter. Scalirpipe, installed on a radius, eliminates many of the fittings that would be required for directional changes when using other pipe materials. In addition, the flexibility of Sclairpipe allows it to adapt to uneven ground, unconsolidated river bottoms and excavated underwater trenches without the need for expensive foundations or minor degree elbows. It is well suited for dynamic soils and areas prone to earthquake.

Sclairpipe is cost effective in both the short and long term. The fact that it is lightweight makes it easier to transport and install. It is leak proof and fatigue resistant means there will be years of maintenance free use. The Plastics Pipe Institute estimates the service life for HDPE pipe to conservatively be 50-100 years.

Proven performance in a wide range of applications

Since its development in 1955, large diameter HDPE pipe has been successfully used in many installations worldwide. In North America, Sclairpipe high density polyethylene pipe was first introduced in 1968. Since then it has been installed for river, lake and salt water crossings, municipal and industrial fresh and salt water intakes and effluent outfalls. Sclairpipe has also been used extensively for pipeline repair and rehabilitation.

Some popular applications of Sclairpipe include:

- Potable Water Distribution
- Pressure Water Systems
- Sewage Systems
- Water Mains
- Sliplining
- Fire Mains
- Directional Drilling
- Trenchless Technologies
- Slurry Pipe
- Mining
- Marine Pipelines & Crossings
- Deep Water Intakes
- Deep Water Outfalls
- Irrigation Lines
- Biofilters
- Gas Gathering

Potable Water

Sclairpipe is used for both new water main installations and to rehabilitate deteriorated piping systems made from other materials. It can accept repetitive pressure surges that far exceed the static pressure rating of the pipe. Sclairpipe is easy to handle and is available in long lengths that cut down on jointing time. Thermal fusion on site reduces installation time and ensures leakproof joints that eliminate infiltration and exfiltration problems. Sclairpipe is well suited for dynamic soils and areas prone to earthquake.

Sewage Systems

After more than 35 years of use in municipal and industrial sewer applications, Sclairpipe has proven to be a reliable, cost effective, long-term solution for sewer and wastewater systems. It offers resistance to corrosion and chemicals with durability and strength that rigid concrete, PVC or ductile iron pipes can't duplicate. Lightweight Sclairpipe is easy-to-install, extremely flexible and does not corrode or tuberculate over time.

Industry

Long-term reliable piping solutions are always in demand by industry. Sclairpipe offers resistance to corrosion, abrasion and chemicals resulting in a durable, strong and cost-effective installation.

Mining

Sclairpipe solid wall HDPE pipe is commonly used in mining applications for tailings disposal and water management including: river water diversion, reclamation lines, culvert, sewer and sub-drainage systems and slurry pipe. It is lightweight, flexible, durable and abrasion resistant. It is virtually leak proof, and can withstand corrosive chemicals, acids or salts commonly found in mines. Sclairpipe combines strength and durability in above ground applications and is UV resistant.

Irrigation

Sclairpipe is a cost effective solution for irrigation and agricultural drainage applications such as river and canal diversion, agricultural irrigation systems and pipelines, and water conservation. It is lightweight, flexible and leak proof, resistant to corrosion and salt water, and joints can be heat-fused on site for ease of installation. A Sclairpipe irrigation system will withstand the test of time.

Heating & Cooling

Sclairpipe has proven to be a strong, leak proof and chemically inert solution for district cooling applications including dual-purpose projects providing cooling and potable water. It can be assembled on shore in a continuous flexible length, floated on the water's surface and then sunk by a controlled process. The pipe can also be manufactured in specific lengths and connected on site by flanges with the aid of marine divers. Sclairpipe's resistance to both corrosion and zebra mussel fouling makes it an ideal solution.

Choose the size that's right for you

Sclairpipe is available in standard Dimensional Ratio's (DR's), in sizes ranging from 4″ to 48″ in diameter. Sclairpipe is available in PE 3608 and PE 4710. With the higher allowable stress rating of PE 4710, the pipe wall can be thinner for the same pressure rating (higher DR).

The Dimensional Ratio relates the minimum wall thickness of the pipe to its outside diameter, and is important to define the pressure rating of a particular pipe. The maximum continuous operating pressure stated is based on the allowable hydrostatic design stress of each specific material (per ASTM D3350 and PPI's TR-3), and the pipe wall thickness (DR), at a service temperature of 73.4°F.

Uponor, Sclairpipe Product Range, IPS Size, PE3608

	PE3608			DR32.5 (50 psi)			DR26 (64 psi)			DR21 (80 psi)		
Nominal Pipe Size	Minimum Outside Diameter *(inches)*	Maximum Outside Diameter *(inches)*	Average Outside Diameter *(inches)*	Average Inside Diameter *(inches)*	Minimum Wall Thickness *(inches)*	Average Weight *(lbs/ft)*	Average Inside Diameter *(inches)*	Minimum Wall Thickness *(inches)*	Average Weight *(lbs/ft)*	Average Inside Diameter *(inches)*	Minimum Wall Thickness *(inches)*	Average Weight *(lbs/ft)*
4	4.48	4.52	4.50	4.21	0.138	0.83	4.13	0.173	1.03	4.05	0.214	1.26
5	5.54	5.59	5.56	5.20	0.171	1.27	5.11	0.214	1.57	5.00	0.265	1.93
6	6.60	6.65	6.63	6.19	0.204	1.80	6.08	0.255	2.23	5.96	0.315	2.73
7	7.09	7.16	7.13	6.66	0.219	2.08	6.54	0.274	2.58	6.41	0.339	3.16
8	8.59	8.66	8.63	8.06	0.265	3.05	7.92	0.332	3.78	7.75	0.411	4.63
10	10.70	10.80	10.75	10.05	0.331	4.74	9.87	0.413	5.87	9.66	0.512	7.19
12	12.69	12.81	12.75	11.92	0.392	6.66	11.71	0.490	8.26	11.46	0.607	10.12
13	13.31	13.44	13.38	12.50	0.412	7.33	12.28	0.514	9.09	12.02	0.637	11.14
14	13.94	14.06	14.00	13.09	0.431	8.03	12.86	0.538	9.95	12.59	0.667	12.20
16	15.93	16.07	16.00	14.96	0.492	10.49	14.70	0.615	13.00	14.38	0.762	15.94
18	17.92	18.08	18.00	16.83	0.554	13.28	16.53	0.692	16.46	16.18	0.857	20.17
20	19.91	20.09	20.00	18.70	0.615	16.39	18.37	0.769	20.32	17.98	0.952	24.90
22	21.90	22.10	22.00	20.56	0.677	19.83	20.21	0.846	24.58	19.78	1.048	30.13
24	23.89	24.11	24.00	22.43	0.738	23.60	22.04	0.923	29.25	21.58	1.143	35.85
26	25.88	26.12	26.00	24.30	0.800	27.70	23.88	1.000	34.33	23.38	1.238	42.08
28	27.87	28.13	28.00	26.17	0.862	32.13	25.72	1.077	39.82	25.17	1.333	48.80
30	29.87	30.14	30.00	28.04	0.923	36.88	27.55	1.154	45.71	26.97	1.429	56.02
32	31.86	32.14	32.00	29.91	0.985	41.96	29.39	1.231	52.01	28.77	1.524	63.74
36	35.84	36.16	36.00	33.65	1.108	53.11	33.06	1.385	65.82	32.37	1.714	80.67
40	39.82	40.18	40.00	37.39	1.231	65.56	36.74	1.538	81.26	35.96	1.905	99.59
42	41.81	42.19	42.00	39.26	1.292	72.28	38.58	1.615	89.59	37.76	2.000	109.80
48	47.78	48.22	48.00	44.87	1.477	94.41	44.09	1.846	117.02	43.15	2.286	143.42

Pipe dimensions are in accordance with ASTM F714 and AWWA C906
Pressure Ratings are for water at 73.4 deg F.
Some of the pipe sizes and DR's above are available only on request. Check with your representative for availability.
Other dimensions and DR's not listed may be available upon special request.
All dimensions are in inches unless otherwise noted.
Weights are calculated by the methodology established in PPI's TR-7 and are applicable to PE 3608.

The standard stocked length of Sclairpipe pipe is 50 feet, in sizes above 4" in diameter with longer lengths available on request.

Please visit our web site (www.uponor.ca) and use our online design tools to determine the pipe size best suited to your specific application.

DR17 (100 psi)			DR13.5 (128 psi)			DR11 (160 psi)			DR9 (200 psi)			DR7.3 (254 psi)		
Average Inside Diameter *(inches)*	Minimum Wall Thickness *(inches)*	Average Weight *(lbs/ft)*	Average Inside Diameter *(inches)*	Minimum Wall Thickness *(inches)*	Average Weight *(lbs/ft)*	Average Inside Diameter *(inches)*	Minimum Wall Thickness *(inches)*	Average Weight *(lbs/ft)*	Average Inside Diameter *(inches)*	Minimum Wall Thickness *(inches)*	Average Weight *(lbs/ft)*	Average Inside Diameter *(inches)*	Minimum Wall Thickness *(inches)*	Average Weight *(lbs/ft)*
3.94	0.265	1.54	3.79	0.333	1.90	3.63	0.409	2.29	3.44	0.500	2.73	3.19	0.616	3.26
4.87	0.327	2.35	4.69	0.412	2.91	4.49	0.506	3.50	4.25	0.618	4.18	3.95	0.762	4.99
5.80	0.390	3.33	5.58	0.491	4.12	5.35	0.602	4.96	5.06	0.736	5.92	4.70	0.908	7.08
6.24	0.419	3.85	6.01	0.528	4.77	5.75	0.648	5.74	5.45	0.792	6.85	5.06	0.976	8.18
7.55	0.507	5.65	7.27	0.639	6.99	6.96	0.784	8.41	6.59	0.958	10.04	6.12	1.182	11.99
9.41	0.632	8.77	9.06	0.796	10.86	8.68	0.977	13.07	8.22	1.194	15.59	7.63	1.473	18.63
11.16	0.750	12.34	10.75	0.944	15.28	10.29	1.159	18.38	9.75	1.417	21.94	9.05	1.747	26.21
11.71	0.787	13.58	11.27	0.991	16.81	10.80	1.216	20.23	10.22	1.486	24.14	9.49	1.832	28.84
12.25	0.824	14.88	11.80	1.037	18.42	11.30	1.273	22.17	10.70	1.556	26.45	9.93	1.918	31.60
14.00	0.941	19.44	13.49	1.185	24.06	12.92	1.455	28.95	12.23	1.778	34.55	11.35	2.192	41.27
15.76	1.059	24.60	15.17	1.333	30.45	14.53	1.636	36.64	13.76	2.000	43.72	12.77	2.466	52.23
17.51	1.176	30.37	16.86	1.481	37.59	16.15	1.818	45.24	15.29	2.222	53.98	14.19	2.740	64.48
19.26	1.294	36.75	18.55	1.630	45.48	17.76	2.000	54.74	16.82	2.444	65.31	15.61	3.014	78.02
21.01	1.412	43.74	20.23	1.778	54.13	19.37	2.182	65.14	18.35	2.667	77.73	17.03	3.288	92.85
22.76	1.529	51.33	21.92	1.926	63.52	20.99	2.364	76.45	19.88	2.889	91.22	18.45	3.562	108.97
24.51	1.647	59.53	23.60	2.074	73.67	22.60	2.545	88.66	21.40	3.111	105.80	19.87	3.836	126.38
26.26	1.765	68.34	25.29	2.222	84.57	24.22	2.727	101.78	22.93	3.333	121.45			
28.01	1.882	77.75	26.97	2.370	96.22	25.83	2.909	115.80	24.46	3.556	138.19			
31.51	2.118	98.41	30.35	2.667	121.78	29.06	3.273	146.57						
35.01	2.353	121.49	33.72	2.963	150.35	32.29	3.636	180.95						
36.76	2.471	133.94	35.40	3.111	165.76	33.91	3.818	199.49						
42.01	2.824	174.94	40.46	3.556	216.50									

Sclair IPS Cut Sheet_PE3608_r201407

- All dimensions are in inches unless otherwise specified.
- Pressure ratings are based on load durations of 50 years at a service temperature of 73.4F. The HDS (pipe wall allowable stress) for PE 3608 and PE 4710 are 800 psi and 1,000 psi respectively.
- Dimensions and tolerances per ASTM F714. Pipe weights calculated using PPI TR-7 using PE3608 density of 0.953 gm/cc and 0.958 gm/cc for PE4710 materials.
- The ASTM D3350 cell classifications conform to the requirements of the applicable pipe specification (ASTM F714, AWWA C906, etc.).
- Contact Uponor Infra for sizes, DR's and DIPS offering not shown.

Uponor, Sclairpipe Product Range, IPS Size, PE4710

Nominal Pipe Size	PE4710 Minimum Outside Diameter *(inches)*	PE4710 Maximum Outside Diameter *(inches)*	PE4710 Average Outside Diameter *(inches)*	DR32.5 (64 psi) Average Inside Diameter *(inches)*	DR32.5 (64 psi) Minimum Wall Thickness *(inches)*	DR32.5 (64 psi) Average Weight *(lbs/ft)*	DR26 (80 psi) Average Inside Diameter *(inches)*	DR26 (80 psi) Minimum Wall Thickness *(inches)*	DR26 (80 psi) Average Weight *(lbs/ft)*	DR21 (100 psi) Average Inside Diameter *(inches)*	DR21 (100 psi) Minimum Wall Thickness *(inches)*	DR21 (100 psi) Average Weight *(lbs/ft)*
4	4.48	4.52	4.50	4.21	0.138	0.840	4.13	0.173	1.030	4.05	0.214	1.27
5	5.54	5.59	5.56	5.20	0.171	1.280	5.11	0.214	1.580	5.00	0.265	1.94
6	6.60	6.65	6.63	6.19	0.204	1.81	6.08	0.255	2.24	5.96	0.315	2.75
7	7.09	7.16	7.13	6.66	0.219	2.09	6.54	0.274	2.59	6.41	0.339	3.18
8	8.59	8.66	8.63	8.06	0.265	3.07	7.92	0.332	3.80	7.75	0.411	4.66
10	10.70	10.80	10.75	10.05	0.331	4.77	9.87	0.413	5.91	9.66	0.512	7.24
12	12.69	12.81	12.75	11.92	0.392	6.70	11.71	0.490	8.31	11.46	0.607	10.18
13	13.31	13.44	13.38	12.50	0.412	7.38	12.28	0.514	9.14	12.02	0.637	11.21
14	13.94	14.06	14.00	13.09	0.431	8.08	12.86	0.538	10.02	12.59	0.667	12.28
16	15.93	16.07	16.00	14.96	0.492	10.56	14.70	0.615	13.08	14.38	0.762	16.04
18	17.92	18.08	18.00	16.83	0.554	13.36	16.53	0.692	16.56	16.18	0.857	20.29
20	19.91	20.09	20.00	18.70	0.615	16.49	18.37	0.769	20.44	17.98	0.952	25.06
22	21.90	22.10	22.00	20.56	0.677	19.96	20.21	0.846	24.74	19.78	1.048	30.32
24	23.89	24.11	24.00	22.43	0.738	23.75	22.04	0.923	29.44	21.58	1.143	36.08
26	25.88	26.12	26.00	24.30	0.800	27.87	23.88	1.000	34.55	23.38	1.238	42.34
28	27.87	28.13	28.00	26.17	0.862	32.33	25.72	1.077	40.07	25.17	1.333	49.11
30	29.87	30.14	30.00	28.04	0.923	37.11	27.55	1.154	46.00	26.97	1.429	56.37
32	31.86	32.14	32.00	29.91	0.985	42.22	29.39	1.231	52.34	28.77	1.524	64.14
36	35.84	36.16	36.00	33.65	1.108	53.44	33.06	1.385	66.24	32.37	1.714	81.18
40	39.82	40.18	40.00	37.39	1.231	65.98	36.74	1.538	81.77	35.96	1.905	100.22
42	41.81	42.19	42.00	39.26	1.292	72.74	38.58	1.615	90.16	37.76	2.000	110.49
48	47.78	48.22	48.00	44.87	1.477	95.01	44.09	1.846	117.76	43.15	2.286	144.32

Pipe dimensions are in accordance with ASTM F714 and AWWA C906
Pressure Ratings are for water at 73.4 deg F.
Some of the pipe sizes and DR's above are available only on request. Check with your representative for availability.
Other dimensions and DR's not listed may be available upon special request.
All dimensions are in inches unless otherwise noted.
Weights are calculated by the methodology established in PPI's TR-7 and are applicable to PE4710

Product innovation and quality assurance

For 50 years Uponor Infra has been a leader in the design, development, manufacture and support of polyethylene piping systems. Uponor Infra's experienced engineers can offer design and engineering assistance, assuring you of a dependable piping system designed to meet your needs. Visit our website (www.uponor.ca) and see how our innovative online calculator can assist you. Extensive R&D in the early 1960's led us to produce 16" diameter polyethylene pipe at a time when many considered large diameter polyethylene pipes a technical impossibility. Today Uponor Infra produces solid wall Sclairpipe in sizes up to 48".

All Uponor Infra products are manufactured from special, high strength resins with complete quality control maintained from raw material to finished pipe product. Uponor Infra was the first North American manufacturer of polyethylene pipe and fittings to have its Quality Management System registered to the ISO 9001:2008 level.

Our strict manufacturing specifications are verified daily, using precise dimensional controls and accelerated long term hydrostatic testing. A continuous quality control process assures you of long-term pipe performance. We certify that the pipe resin used to extrude Sclairpipe has a minimum cell classification of PE 345464C or PE445474C respectively, when classified in accordance with ASTM D3350. Sclairpipe's material classification is based on PPI's (Plastic Pipe Institute) method of determining and validating the Long-Term Hydrostatic Stress (LTHS) of polyethylene pipe.

DR17 (125 psi)			DR13.5 (160 psi)			DR11 (200 psi)			DR9 (250 psi)			DR7.3 (317 psi)		
Average Inside Diameter *(inches)*	Minimum Wall Thickness *(inches)*	Average Weight *(lbs/ft)*	Average Inside Diameter *(inches)*	Minimum Wall Thickness *(inches)*	Average Weight *(lbs/ft)*	Average Inside Diameter *(inches)*	Minimum Wall Thickness *(inches)*	Average Weight *(lbs/ft)*	Average Inside Diameter *(inches)*	Minimum Wall Thickness *(inches)*	Average Weight *(lbs/ft)*	Average Inside Diameter *(inches)*	Minimum Wall Thickness *(inches)*	Average Weight *(lbs/ft)*
3.94	0.265	1.55	3.79	0.333	1.91	3.63	0.409	2.30	3.44	0.500	2.75	3.19	0.616	3.28
4.87	0.327	2.36	4.69	0.412	2.93	4.49	0.506	3.52	4.25	0.618	4.20	3.95	0.762	5.02
5.80	0.390	3.35	5.58	0.491	4.15	5.35	0.602	4.99	5.06	0.736	5.96	4.70	0.908	7.12
6.24	0.419	3.88	6.01	0.528	4.80	5.75	0.648	5.78	5.45	0.792	6.89	5.06	0.976	8.23
7.55	0.507	5.68	7.27	0.639	7.03	6.96	0.784	8.47	6.59	0.958	10.10	6.12	1.182	12.07
9.41	0.632	8.83	9.06	0.796	10.93	8.68	0.977	13.15	8.22	1.194	15.69	7.63	1.473	18.75
11.16	0.750	12.42	10.75	0.944	15.37	10.29	1.159	18.50	9.75	1.417	22.08	9.05	1.747	26.37
11.71	0.787	13.67	11.27	0.991	16.92	10.80	1.216	20.36	10.22	1.486	24.29	9.49	1.832	29.02
12.25	0.824	14.98	11.80	1.037	18.53	11.30	1.273	22.31	10.70	1.556	26.62	9.93	1.918	31.79
14.00	0.941	19.56	13.49	1.185	24.21	12.92	1.455	29.13	12.23	1.778	34.76	11.35	2.192	41.53
15.76	1.059	24.76	15.17	1.333	30.64	14.53	1.636	36.87	13.76	2.000	44.00	12.77	2.466	52.56
17.51	1.176	30.56	16.86	1.481	37.82	16.15	1.818	45.52	15.29	2.222	54.32	14.19	2.740	64.89
19.26	1.294	36.98	18.55	1.630	45.77	17.76	2.000	55.08	16.82	2.444	65.72	15.61	3.014	78.51
21.01	1.412	44.01	20.23	1.778	54.47	19.37	2.182	65.55	18.35	2.667	78.22	17.03	3.288	93.44
22.76	1.529	51.65	21.92	1.926	63.92	20.99	2.364	76.93	19.88	2.889	91.80			
24.51	1.647	59.90	23.60	2.074	74.13	22.60	2.545	89.22	21.40	3.111	106.46			
26.26	1.765	68.77	25.29	2.222	85.10	24.22	2.727	102.42	22.93	3.333	122.22			
28.01	1.882	78.24	26.97	2.370	96.83	25.83	2.909	116.53						
31.51	2.118	99.02	30.35	2.667	122.55	29.06	3.273	147.49						
35.01	2.353	122.25	33.72	2.963	151.29									
36.76	2.471	134.78	35.40	3.111	166.80									
42.01	2.824	176.04												

Uponor_Sclair_IPS_PE4710_r201407

Innovative joining methods and equipment

Sclairpipe piping systems can be assembled by heat fusion (butt, electrofusion, socket and saddle fusion), flanged connections, compression couplings and various mechanical couplings. The superior performance of Sclairpipe results from the combination of pipe and fittings designed to work together as a complete system. A full range of pressure rated fittings is available to suit any application.

The most popular method of joining Sclairpipe is thermal butt fusion. This fast and economical technique permits the quick assembly of long continuous lengths and the joining of fittings to the pipe. The fused joints are as reliable and strong as the pipe itself, fully restrained, providing continuous leak proof systems.

Ordering & shipping information

Uponor Infra welcomes your inquiries for non-standard sizes, lengths and pressure ratings of Sclairpipe pipe.

We can meet most special packaging requirements and provide custom pipe fittings. Please contact your local Uponor Infra representative or visit our web site.

The charts below outline standard shipment sizes for straight length and coiled pipe.

Standard Shipments - Straight Lengths

IPS PIPE				
PIPE SIZE	AVG OD	BUNDLE QTY	TRUCK LOAD QTY	CONTAINER QTY
4"	4.50	38	380	480
5"	5.563	23	276	320
6"	6.625	20	200	208
7"	7.125	17	136	180
8"	8.625	14	112	120
10"	10.750	11	66	80
12"	12.750	4	56	52
13"	13.375	42		48
14"	14.000	42		42
16"	16.000	30		30
18"	18.000	25		25
20"	20.000	20		20
22"	22.000	16		16
24"	24.000	16		14
26"	26.000	9		9
28"	28.000	9		9
30"	30.000	9		9
800mm	31.594	9		9
32"	32.000	9*		8
36"	36.000	4		6
1000mm	39.469	4		4
42"	42.000	4		4
1200mm	47.382	4		3
48"	48.000	4*		3

Notes:
* Bunks required
** Drop deck trailer - maximum 42' length
Pipe lengths range from 40 to 50 feet in size

Sclairpipe general specifications & material standards

Pipe and Fittings

REFERENCE SPECIFICATIONS

ASTM F714: Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR). Based on outside diameter.
CSA B137.1: Polyethylene Pipe, Tubing and Fittings for Cold Water Pressure Services.
ASTM D3350: Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
AWWA C901: Polyethylene (PE) Pressure Pipe and Tubing, 1/2 in. Through 3 in. for Water Service.
ASTM D3035: Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR). Based on Controlled Outside Diameter
ISO 9001:2008: Model for Quality Assurance in Production and Installation.
AWWA C906: Standard for Polyethylene (PE) Pressure Pipe and Fittings 4 in. Through 63 in., for Water Distribution.NSF 14, 61

MATERIAL

The pipe shall be made from polyethylene resin compound with a minimum cell classification of PE 345464C for PE 3608 materials and PE445474C for PE 4710 materials in accordance with ASTM D3350. This material shall have a Long Term Hydrostatic Strength of 1600 psi when tested and analyzed by ASTM D2837, and shall be a Plastic Pipe Institute (PPI) TR4 listed compound. The raw materialshall contain a minimum of 2%, well dispersed, carbon black. Additives, which can be conclusively proven not to be detrimental to the pipe may also be used, provided that the pipe produced meets the requirements of this standard. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification and from the same raw material supplier. Compliance with the requirements of this paragraph shall be certified in writing by the pipe supplier, upon request. Manufacturer's Quality System shall be certified by an appropriate independent body to meet the requirements of the ISO 9001:2008 Quality Management Program.

PIPE DESIGN

The pipe shall be designed in accordance with the relationships of the ISO-modified formula (see ASTM F714).

$$P = \frac{2S}{(D°/t) - 1}$$

where,
S = Hydrostatic Design Stress (psi)
P = Design Pressure Rating (psi)
D° = ODavg for IPS Pipe
ODmin for ISO Pipe
t = Minimum Wall Thickness
D°/t = Dimension Ratio

The design pressure rating P shall be derived using the formula above, expressed in pounds per square inch.
The Hydrostatic Design Stress for PE 3608 materials is 800 psi and for the PE4710 materials is 1000 psi.
The pipe dimensions shall be as specified in manufacturer's literature.

MARKING

The following shall be continuously printed on the pipe or spaced at intervals not exceeding 5 feet:
Name and/or trademark of the pipe manufacturer.
Nominal pipe size.
Dimension ratio.
The letters PE followed by the polyethylene grade per ASTM D3350, followed by the Hydrostatic Design stress in 100's of psi e.g. PE 3608.
Manufacturing Standard Reference e.g. ASTM F 714
A production code from which the date and place of manufacture can be determined.

JOINING METHODS

Whenever possible, polyethylene pipe should be joined by the method of thermal butt fusion as outlined in ASTM F2620, Standard Practice for Heat Fusion Joining of PE Pipe and Fittings. Butt fusion joining of pipe and fittings shall be performed in accordance with the procedures recommended by the manufacturer. The temperature of the heater plate should be between 400°F and 450°F. Follow the recommendations of ASTM F2620 regarding interfacial pressures for pipe wall thickness less than or equal to 1.5". Follow the manufacturer's recommendations regarding interfacial pressures for pipe walls thicker than 1.5".

Polyethylene pipe may be connected to fittings or other piping systems by means of a flanged assembly consisting of a polyethylene flange adapter or stub end, and a metal backup ring that has a bolting pattern meeting the dimensional requirements of Class 150, ANSI B16.1/B16.5 in sizes up through 24", and meeting Class 150 Series A, ANSI B16.47 or AWWA C207 Class B for larger sizes. Follow the manufacturer's recommendations regarding bolting techniques and the use of gaskets. Pipe or fittings may be joined by butt fusion only by technicians who have been trained and qualified in the use of the equipment.

GENERAL REQUIREMENTS

The pipe manufacturer shall provide, upon request, an outline of quality control procedures performed on polyethylene system components.

Uponor Infra Ltd.
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Mississauga ON L5N 1A6
Canada
Tel: 1-866-594- 7473
Fax: (905)-858-0208
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E-mail: nainfra-sales@uponor.com

uponor

Appendix D: Modelling Assessment of Groundwater Discharge into Melvin Bay Marine Environment, Rev B (Golder, 2019)

GOLDER

TECHNICAL MEMORANDUM

DATE February 1, 2019 **Project No.** Doc718_1773384 _Rev0

TO Manon Turmel
Agnico Eagle Mines Ltd.

CC Ryan Vanengen, Carolina Leseigneur Torres

FROM Shouhong Wu and Bruce Dean, Golder Associates Ltd. **EMAIL bruce_dean@golder.com**

MODELLING ASSESSMENT OF GROUNDWATER DISCHARGE INTO THE MELVIN BAY MARINE ENVIRONMENT, REV B

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by Agnico Eagle Mines Limited (Agnico Eagle) to undertake a modelling assessment of groundwater discharge into the marine environment near Rankin Inlet. This modelling assessment consisted of nearshore oceanographic modelling of the discharge. The study did not include geotechnical, structural or hydraulic engineering assessments of the outfall. This technical memorandum was updated to account for an additional modelling scenario and updated baseline data collected by Golder from Melvin Bay in September 2018 as well as to account for increased discharge velocity resulting from a change to the diffuser port size. This memorandum should be read in conjunction with "Important Information and Limitations of this Report".

1.1 Scope of Work

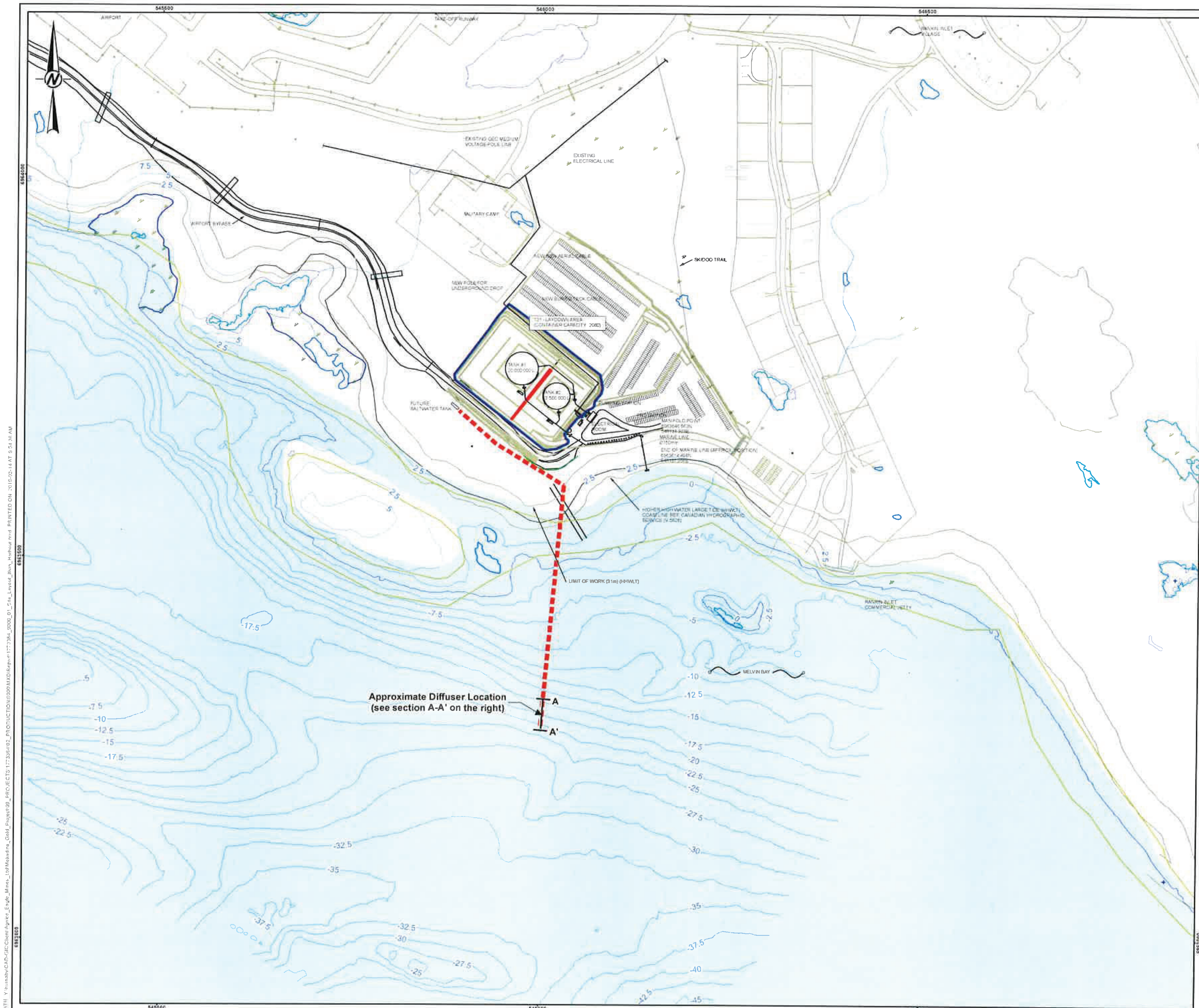
The objective of this work is to assess the near field mixing of the treated groundwater effluent disposal with respect to relevant environmental guidelines. The scope of the work includes:

- Near field modelling of dispersion of treated groundwater effluent plume using CORMIX (Doneker and Jirka 2007).
- Assess the plume dilution behavior.

For the purpose of this scope of this work, it is assumed that the discharges will consists of only pumped water at quantities and qualities per the estimated underground inflow volumes (Golder 2016) and estimated groundwater inputs to surface storage for management (Agnico Eagle 2017). Section 2.1 describes the modelling conditions.

1.2 Physical Setting

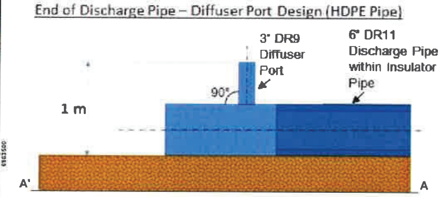
In September 2018, a field program was conducted by Golder in Melvin Bay. Field parameters measured included temperature, conductivity, pH, dissolved oxygen, salinity, and oxidation-reduction potential. The measurement depth ranged from 0.3 m to 26.7 m at three different locations in Melvin Bay (i.e., the exposure area and two new reference areas). The field measurement results are summarized in Appendix A. Nearshore bathymetry (Agnico Eagle 2017 data) and the approximate discharge location is shown in Figure 1, to the south of the Tank Farm at the Itivia Fuel Storage Facility. Based on the bathymetry of Melvin Bay at Itivia Harbour, the diffuser would be placed on the seabed at a depth of approximately 20 m, to ensure an unconstrained mixing zone and to avoid interference with use of Itivia Harbour by ships and boats at high and low tide.



LEGEND

- GENERAL AREA FOR THE DIFFUSER LOCATION
- CROSS SECTION LOCATION
- WATERCOURSE
- WATERBODY
- REEF

End of Discharge Pipe – Diffuser Port Design (HDPE Pipe)



NOT FOR CONSTRUCTION

0 100 200

1:5,000 METRES

REFERENCE(S)
BASE DATA OBTAINED FROM AGNICO EAGLE MINES LIMITED.
DATUM: NAD 83 PROJECTION: UTM ZONE 15

CLIENT
AGNICO EAGLE
AGNICO EAGLE MINES LIMITED

PROJECT
MELIADINE GOLD MINE
NUNAVUT

TITLE
SITE LAYOUT
ITIVIA HARBOUR SITE

CONSULTANT
GOLDER

YYYY-MM-DD	2019-02-14
DESIGNED	CLT
PREPARED	CDB/MH
REVIEWED	BD
APPROVED	MT

PROJECT NO	CONTROL	REV	FIGURE
1773384	9000	0	1

2.0 NEAR FIELD MODELLING

The Cornell Mixing Zone Expert System (CORMIX; Doneker and Jirka 2007) was applied to calculate numerical simulations of the near-field mixing and dilution behavior of treated groundwater effluent entering the nearshore coastal receiving environment in Melvin Bay. CORMIX is one of the most extensively applied models for predicting near-field discharge plume mixing and dilution of both conservative and non-conservative substances in surface water bodies. CORMIX calculates plume boundary interactions to estimate plume fate in terms of dilution and geometry relative to mixing zone regulations (Doneker and Jirka 2007). Nearshore ambient and treated groundwater effluent characteristics required to implement the mixing model are presented in the sections that follow.

2.1 Conditions for Modelling

2.1.1 Ambient Conditions

Assumptions made to characterize the ambient conditions of the receiving marine waters are as follows:

- Weak current: Ambient current velocity of 0.01 m/s and zero wind velocity were considered for this scenario which represented a slack tide condition during ice covered season.
- Mean current: Current speed of 0.2 m/s with no wind was used for this scenario.
- Open water condition: The water temperature and TDS (salinity) were considered to be 0°C (to account for the start and end of the open water season) and 33,300 mg/L, respectively.
- Water depth at discharge location is 20 m.

2.1.2 Discharge Conditions

Following discharge conditions based on estimated underground inflows were used for the near field mixing analysis:

- Flow rate of 800 m^3/d discharged over a 12 hour period (for an equivalent flow rate of 1,600 m^3/day), with TDS of 39,600 mg/L.
- Treated groundwater effluent temperature: 0°C.
- Outfall length: 230 m from the shoreline as shown.
- A single nozzle for discharge which has inside diameter of 68.07 mm (standard 3.0 inch port, DR9 (PE 4710), 252 psi) was used.
- Nozzle elevation from seabed: 1 m.
- Direction of discharge is perpendicular to the bathymetry contour and 90° vertical angle (upward port).

2.1.3 Modelling Scenarios

Table 1 lists the combination of effluent flow rate and ambient current speed in two simulation scenarios. Table 2 lists the CORMIX model input parameters. The target dilution at the edge of the near-field mixing zone is 11 as per analysis presented in Appendix B.

Table 1: Modelling Scenarios

Parameter	Scenario	
	1	2
Treated Groundwater Effluent Rate (m^3/d)[1]	1,600	1,600
Ambient Current Speed (m/s)	0.01	0.20
Discharge Velocity (m/s)	5.1	5.1

Note: 1. Daily flow rate is 800 m^3/day but this volume will be discharged over 12 hours for an equivalent flow rate of 1,600 m^3/day.

Table 2: CORMIX Model Input Parameters

Parameter	Value	Source
Depth at Discharge	20 m	Based on 2017 bathymetry survey completed by Agnico Eagle
Coastal Current (Velocity)	Low = 0.01 m/s Mean = 0.2 m/s	Based on CCG (2008) and assumed
Roughness Value	0.020	Assumed (equivalent to minimum roughness value of similar seabed). This value does not affect vertical jet results.
Wind Speed	0 m/s	Assumed
Water Condition	Saline, non-stratified	Based on Agnico Eagle (2014) and confirmed through Sep. 2018 sampling
Ambient water temperature	Open water season (start and end condition): 0°C	Conservative estimate to capture the start and end of the open water season for discharge
Effluent Flow Rate	1,600 m^3/d[1]	Per underground inflow and storage estimates (Agnico Eagle 2014; Golder 2016)
Effluent Temperature	0°C	Based on Diamond Drill Hole groundwater data (Agnico Eagle 2017)
Effluent Concentration	100%	Assumed
Discharge Type	Single Port	Assumed
Distance from Nearest Bank	230 m	Assumed
Horizontal Angle of Discharge	Perpendicular to bathymetric contour	Assumed
Vertical Angle of Discharge	90°	Assumed
Port Height above Seabed	1.0 m	Assumed
Port Diameter	0.0681 m	Assumed (3.0" port, DR 9, 252 psi)

Note: 1. Daily flow rate is 800 m^3/day but this volume will be discharged over 12 hours for an equivalent flow rate of 1,600 m^3/day.

3.0 RESULTS

Figures 2 and 3 present the near-field treated groundwater effluent plume dilution for a discharge of 800 m^3/day (an effective effluent rate of 1,600 m^3/d) in weak and mean ambient current conditions respectively, via the diffuser. For weak ambient current conditions, the maximum plume (centreline) height is 11.1 m from the seabed. For mean current conditions, the maximum plume (centreline) height is 5.6 m above the seabed. After reaching the maximum height, the negatively buoyant plumes settle towards the bottom as gravity starts to dominate over the initial jet momentum, and this is illustrated by the plume centrelines of Figures 2 and 3. For both scenarios, the plume centreline dilution factor reaches 11 within 1 m horizontal distance and 6 m vertical distance above the port. At

100 m distance from the diffuser, the dilution factors are 70 and 470 for scenarios 1 and 2 respectively, which are much higher than the required dilution of 11.

Figure 4 shows the changes in chloride concentration along the centrelines of the plumes, illustrating that at less than 5 m distance from the diffuser, the chloride concentration meets the required criteria. Figure 5 shows the changes in TDS concentration along the centrelines of the plumes, illustrating that at less than 1 m distance from the diffuser, the TDS concentration meets the required criteria.

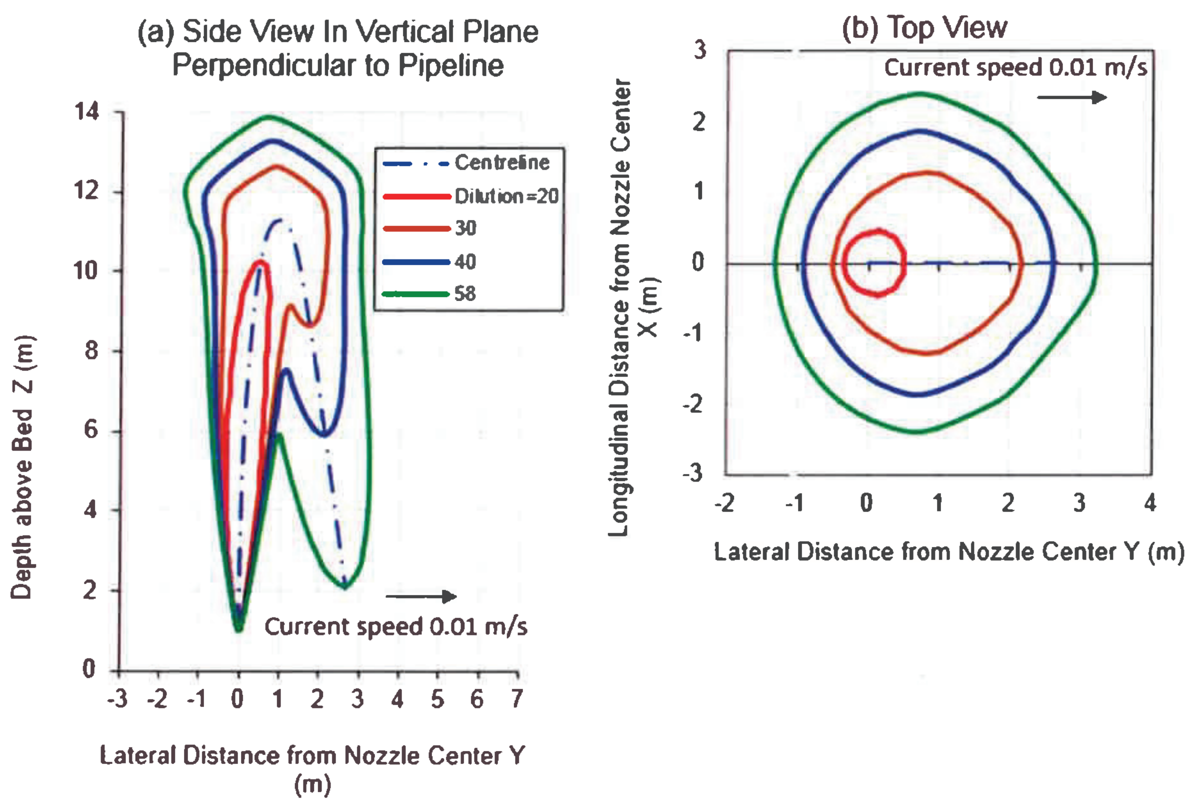


Figure 2: Dilution contours for a flow rate of 800 m³/day (effective effluent flow rate of 1,600 m³/d) in weak ambient current

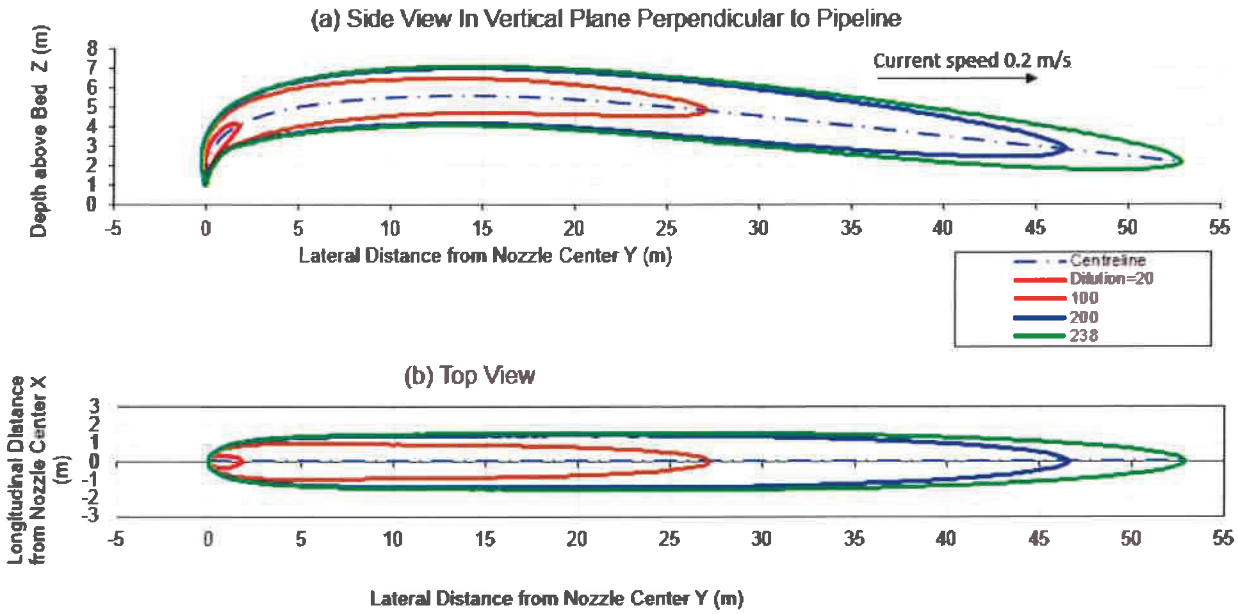


Figure 3: Dilution contours for a flow rate of 800 m³/day (effective effluent flow rate of 1,600 m³/d) in mean ambient current

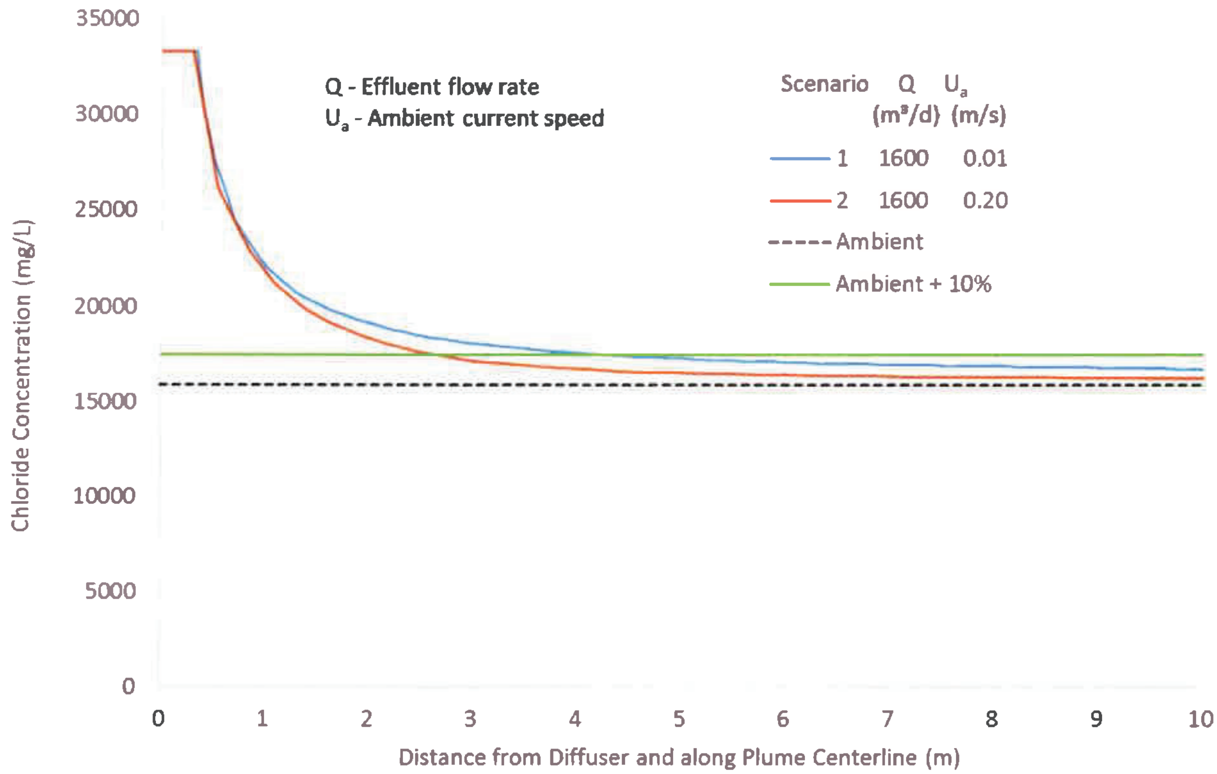


Figure 4: Chloride concentration along the plume centreline for both scenarios

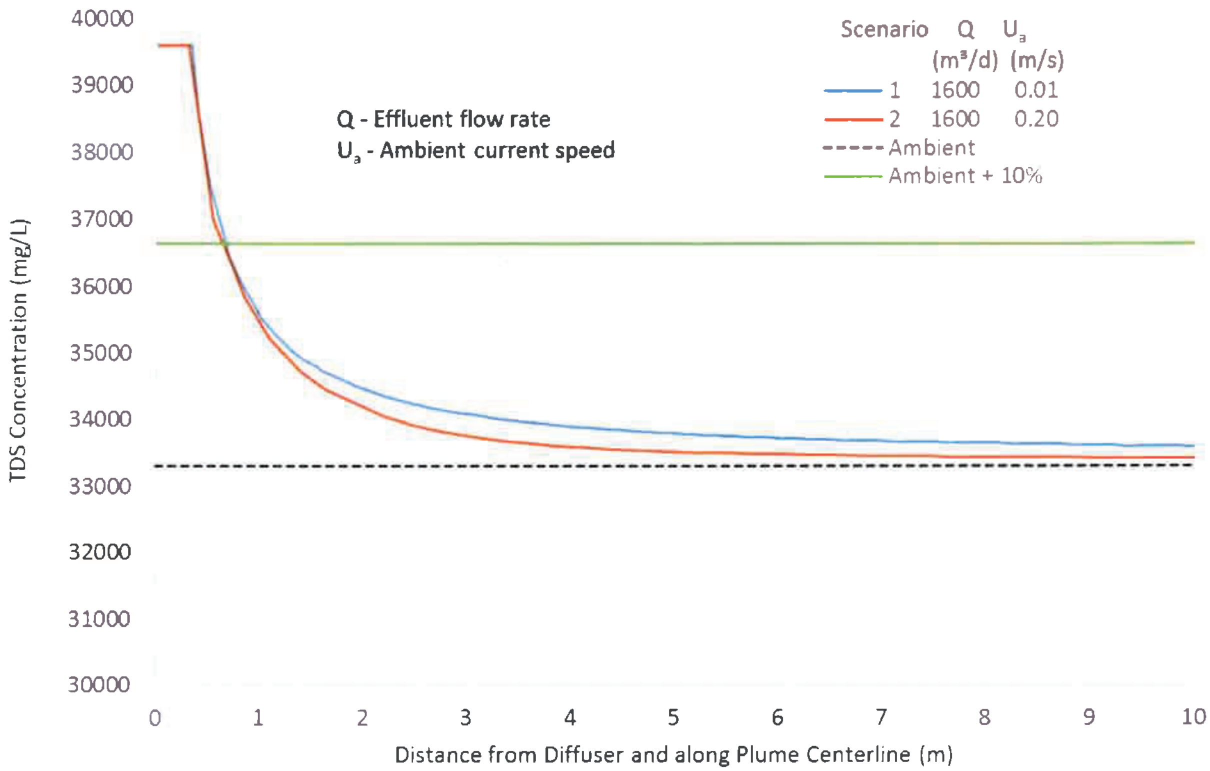


Figure 5: TDS concentration along the plume centreline for both scenarios

3.1 Temperature Sensitivity Analysis

For the simulated scenarios (800 m^3/day discharged over 12 hours for an effective flow rate of 1,600 m^3/day under weak and mean ambient current conditions), a sensitivity analysis simulation was conducted to review the effect of effluent and ambient temperature changes. The simulation conditions were otherwise identical to those for scenarios 1 and 2 except that the effluent temperature was increased to 20°C, and the ambient water temperature was increased to 8.5°C. The 20°C effluent temperature is understood to be the highest (though not expected) possible effluent temperature, as communicated by Agnico Eagle in November 2018. The 8.5°C was the water temperature measured in August 2011 at depth of 13 m below water surface (Stantec 2012).

The effluent temperature change results in effluent density change from 1031.85 kg/m^3 to 1028.30 kg/m^3, and the ambient water temperature change results in ambient water density change from 1026.76 kg/m^3 to 1025.89 kg/m^3. The temperature changes result in a slight change of the density difference between effluent and ambient water from 5.09 kg/m^3 to 2.41 kg/m^3. The plumes remain negatively buoyant with this temperature change, but not as strongly negative as under the original temperature assumptions for the ambient and effluent temperatures (both 0°C).

Table 3 summarizes the simulation results for sensitivity analysis on temperature change for the two scenarios. This table illustrates the following:

- The plumes rise to higher elevations than the plumes with the originally assumed temperature of 0°C due to reduced negative buoyancy.
- Similar to the original discharge plumes, the required dilution is met at less than 1 m distance from the diffuser.
- At an effective flow rate of 1,600 m³/day, the dilution factors at 100 m from the diffuser are increased due to accelerated plume mixing.

Table 3: Summary of simulation results for effluent temperatures of 20°C and ambient temperature of 8.5°C

Parameter	Scenario	
	1	2
Effluent flow rate (m³/d)[1]	1,600	1,600
Ambient current velocity (m/s)	0.01	0.2
Horizontal distance (m) from diffuser where required dilution of 11 is met	<1	<1
Maximum plume (centerline) height (m)	16.2	6.3
Dilution factor at 100 m from diffuser	163	563
Simulation results for originally assumed temperatures of 0°C		
Maximum plume (centerline) height (m)	11.1	5.6
Dilution factor at 100 m from diffuser	70	470

Note: 1. Daily flow rate is 800 m³/day but this volume will be discharged over 12 hours for an equivalent flow rate of 1,600 m³/day.

4.0 CONCLUSIONS

Mixing analysis was conducted for a diffuser designed for Melvin Bay, Rankin Inlet NWT. The simulation results show the following:

1) Dilution of the treated groundwater effluent plume is achieved within 5 m of the diffuser under the assumed conditions for the ambient and discharge conditions tested under assumed and increased temperatures.

2) After initial mixing, the plume migrates along the seabed under gravity and achieves further dilution and mixing with ambient water; concentrations within the 100 m regulatory mixing zone will thus meet discharge criteria per regulatory requirements and/or background concentrations for non-regulated parameters per the modelled conditions.

3) The results are valid for placement of the diffuser in Melvin Bay in water depths of at least 20 m.

4) Sensitivity analysis was performed for increased effluent and ambient temperatures. The required dilution of 11 is met within 1 m of the diffuser and dilution factors at 100 m from the diffuser were increased from the base case.

CLOSURE

Should you require any further information, please contact the undersigned.

Golder Associates Ltd.

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https://golderassociates.sharepoint.com/sites/17491g/deliverables/diffuser memo/modelling assessment draft/doc718_1773384_modelling assessment of groundwater discharge_final.docx

PERMIT TO PRACTICE
GOLDER ASSOCIATES LTD.
Signature
Date 8 Feb 2019
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REFERENCES

Agnico Eagle (Agnico Eagle Mines Limited). 2014. Final Environmental Impact Statement (FEIS) - Meliadine Gold Project, Nunavut from: ftp://ftp.nirb.ca/02-REVIEWS/ACTIVE%20REVIEWS/11MN034-Agnico Eagle%20MELIADINE/2-REVIEW/09-FINAL%20EIS/FEIS Accessed on November, 2014.

Agnico Eagle. 2018a. Meliadine Gold Project Groundwater Management Plan. Version 1. February 2018.

Agnico Eagle. 2018b. Meliadine Gold Project Water Management Plan. Version 3. 6513-MPS-11. March 2018.

Agnico Eagle. 2018c. Meliadine Gold Mine Final Environmental Impact Statement Addendum – Environmental Assessment of Treated Groundwater Effluent Discharge into Marine Environment, Rankin Inlet. Submitted to the Nunavut Impact Review Board in June 2018.

BC MOE (British Columbia Ministry of the Environment). 2017a. Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture.

BC MOE (British Columbia Ministry of the Environment). 2017b. Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture.

CCME (Canadian Council of Ministers of the Environment). 2003. Canadian Environmental Quality Guidelines – Water Quality Guidelines for the Protection of Aquatic Life.

CCG (Canadian Coast Guard). 2008. Regional Response Plan. Central and Arctic Region.

DFO (Fisheries and Oceans Canada). 2013. Measures to Avoid Causing Harm to Fish and Fish Habitat.

Doneker, R. L., and Jirka, G. H., 2007, "Cormix User Manual – A Hydrodynamic Mixing Zone Model and Decision Support System for Pollutant Discharges into Surface Water", U. S. Environmental Protection Agency, 1200 Pennsylvania Avenue, N. W. (4305T), Washington, D. C. 20460.

GC (Government of Canada). 2017. Regulations Amending the Metal Mining Effluent Regulations (MMER). Canada Gazette Part I, Vol 151, No. 19. May 2017.

Golder (Golder Associates Ltd.). 2016. Updated Predictions of Groundwater Inflow to Tiriginiaq Underground Mine – V5 Mine Plan, Technical Memorandum. November 2016.

Golder (Golder Associates Ltd.). 2018. Meliadine Gold Mine Ocean Discharge Monitoring Plan – Marine Reconnaissance and Baseline Programs: 2018 Marine Reconnaissance Survey Data Report - DRAFT.

Stantec (Nunami Stantec). 2012. Meliadine Gold Project: Marine Baseline Report, Itivia Harbour, Rankin Inlet, NU – Final Report.

NWB (Nunavut Water Board). 2016. Type A Water Licence No. 2AM-MEL1631 for Agnico-Eagle Mines Ltd.'s Meliadine Gold Project.

NWT (Northwest Territories). 1992. Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories.

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APPENDIX A

Field Measurements

Table A1: Results for September 2018 Measurements

Parameter	Minimum	Maximum	Average
pH (pH)	7.96	7.98	7.97
Salinity (psu)	29.7	30.5	30.0
TSS (mg/L)	<2	3.8	2.4
TDS (mg/L)	33,300	36,000	34,727
Hardness (as (CaCO3) (mg/L)	4,890	5,180	5,000
Conductivity (uS/cm)	45,400	46,500	45,782
Temperature (°C)	5.80	6.13	5.92
Chloride (mg/L)	15,900	17,400	16,655

Source: Golder (2018)

APPENDIX B

Environmental Guidelines

The intention of the treated groundwater effluent discharge objectives is to set the allowable effluent concentrations at the end-of-pipe and edge of a regulatory mixing zone. These allowable concentrations can then be used to design the diffuser to achieve the required dilution within the mixing zone. There is no specific definition for size of a mixing zone for discharges to Canadian coastal and estuarine waters. However, a radius of 100 m from the point of discharge is widely used for environmental compliance assessments. For example, the Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories (NWT 1992) provide guidance that the limits of initial mixing zone are 100 m from all points of discharge. For the current study, a 100 m regulatory mixing zone was applied.

Final effluent quality included in the model and assessment was based on measured groundwater quality from the borehole samples (see Section 3.4.2, Table 3 of the FEIS Addendum) and constrained by various regulations and guidelines to achieve non-acutely lethal effluent that will meet chronic guidelines or background concentrations at the edge of the regulatory mixing zone. The regulations and guidelines considered included:

- The proposed Metal and Diamond Mining Effluent Regulations (MDMER; GC 2017).
- Acute water quality guidelines for protection of marine aquatic life (CCME 2003; BC MOE 2017a, b).
- Fisheries and Oceans Canada Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2013).

Table B1: Meliadine Mine – Assumed Treated Groundwater Effluent Discharge Criteria

Parameter	Units	Discharge Criteria	
		Standard Based [1]	95 UCLM [2]
pH (pH units)	pH units	-	7.634
Alkalinity (as $CaCO_3$)	mg/L	-	71.35
Total Hardness (as $CaCO_3$)	mg/L	-	14101
Turbidity	NTU	-	90.54
Total Dissolved Solids (TDS)	mg/L	-	58,165
Total Suspended Solids (TSS)	mg/L	15	159.4
Aluminium	mg/L	-	1.832
Ammonia (as N)	mg/L	5.91	35.47
Antimony	mg/L	-	0.0047
Arsenic	mg/L	0.0125	0.0193
Barium	mg/L	-	0.299
Beryllium	mg/L	-	0.00165
Bicarbonate (as $CaCO_3$)	mg/L	-	69.09
Boron	mg/L	-	2.389
Total Organic Carbon (TOC)	mg/L	-	6.448
Dissolved Organic Carbon (DOC)	mg/L	-	5.69
Cadmium	mg/L	-	5.83E-04
Calcium	mg/L	-	2164
Chloride (dissolved)	mg/L	-	33274
Chromium	mg/L	-	<0.1[3]
Copper	mg/L	0.003	0.113

Table B1: Meliadine Mine – Assumed Treated Groundwater Effluent Discharge Criteria

Parameter	Units	Discharge Criteria	
		Standard Based (1)	95 UCLM (2)
Cyanide (free)	mg/L	0.001	0.0494
Iron	mg/L	-	13.37
Lead	mg/L	0.14	0.00369
Lithium	mg/L	-	3.33
Magnesium	mg/L	-	2129
Manganese	mg/L	-	1.076
Mercury	mg/L	-	4.01E-05
Molybdenum	mg/L	-	0.0181
Nickel	mg/L	0.5	0.0208
Nitrate (as N)	mg/L	1500	35.65
Nitrite (as N)	mg/L	-	2.156
Total Kjeldahl Nitrogen (TKN)	mg/L	-	55.4
Phosphorus	mg/L	-	0.069
Potassium	mg/L	-	514.2
Radium-226 (Ra 226)	Bq/L	0.37	2.498
Selenium	mg/L	-	0.0457
Silica (reactive)	mg/L	-	19.77
Silver	mg/L	0.003	8.10E-04
Sodium	mg/L	-	14784
Strontium	mg/L	-	65.21
Sulfate	mg/L	-	3160
Thallium	mg/L	-	3.57E-04
Tin	mg/L	-	<0.5(3)
Titanium	mg/L	-	0.187
Uranium	mg/L	-	0.00168
Vanadium	mg/L	-	<0.5(3)
Zinc	mg/L	0.055	0.133

Notes:
"<" Concentration is below the reported detection limit (RDL).
(1) End of pipe discharge criteria is based on the minimum of the following (refer to Tables 8 and 9 of the FEIS Addendum):
Amended Metal and Diamond Mining Effluent Regulations (MDMER; GC 2017) Schedule 4 Authorized Limits of Deleterious Substances - Maximum Authorized Monthly Mean Concentration.
Canadian Council of Ministers of the Environment (CCME 2003) Short-term Water Quality Guidelines (WQG) for the Protection of Aquatic Life - Marine.
British Columbia Ministry of Environment (BC MOE 2017a) Approved Water Quality Guidelines for Marine Aquatic Life (Short-Term).
BC MOE Working Water Quality Guidelines for Marine Aquatic Life (BC MOE 2017b).
(2) 95% Upper Confidence Level of the Mean (UCLM) of the August 2016 to September 2017 diamond drillhole groundwater data provided by Agnico Eagle. 95% UCLM calculated using the US EPA ProUCL Version 5.1 software. Agnico Eagle will monitor groundwater quality and criteria will be updated as necessary based on observed changes.
(3) A 95% UCLM could not be calculated due to low detection rates within the dataset. The maximum concentration has been used for conservative purposes.

In addition to the above and since chloride ions mainly constitute the salt content in the marine water and ultimately the treated groundwater effluent plume, chloride guidelines are used to assess the near-field mixing zone. No local or federal guideline was available for chloride discharges in the marine environment, and therefore, the guideline published by the BC MOE (2017a) was used for the analysis. The guideline states:

> *"Human activities should not cause the chloride of marine and estuarine waters to fluctuate by more than 10% of the natural chloride expected at that time and depth".*

This indicates that the chloride concentration at the mixing zone boundary should not exceed the ambient chloride concentration of 15,900 mg/L by 1,590 mg/L (10%). The behavior of the discharge in the marine environment is influenced by density. For the purposes of this assessment, it is assumed that treatment of the groundwater will be such as to achieve a TDS concentration of the treated groundwater effluent that is +/- 10% (in line with the BC MOE 2017a guideline) of the maximum TDS concentration of 36,000 mg/L measured in September 2018 at Melvin Bay. Therefore, the assumed effluent TDS concentration will be up to approximately 39,600 mg/L. It is conservatively assumed that the chloride concentration of 33,300 mg/L remains unchanged in the treated groundwater effluent.

To reach a chloride concentration difference of no more than 10% at the edge of regulatory mixing zone, the required plume dilution factor via the diffuser is 11, per the equation below:

$$S = \frac{C_{eff} - C_a}{C_{edg} - C_a} = \frac{C_{eff} - C_a}{110\% C_a - C_a} = \frac{33,300 - 15,900}{110\% * 15,900 - 15,900} = 11$$

where S is required dilution factor, C_{eff} is effluent chloride concentration (33,300 mg/L), C_a is ambient chloride concentration (15,900 mg/L), and C_{edg} is chloride concentration at the edge of regulatory mixing zone. Per the BC MOE (2017a) guideline, the upper bound of C_{edg} is 10% greater than ambient chloride concentration.

There are also no federal or provincial specific criteria for mixing zone discharges regarding thermal changes to the marine environment. However, per the BC MOE (2017a) guideline:

> *"Temperature at the mixing zone boundary should not change by more or less than 1°C from natural ambient background temperatures, and the hourly rate of change should not exceed 0.5°C."*

This is taken into consideration for the model, which conservatively assumes treated groundwater effluent discharge and ambient ocean temperatures of 0°C, to account for start and end of temperatures for the open water season.

APPENDIX C • SPECIFIC WORK INSTRUCTIONS FOR UNDER-ICE MARINE WATER QUALITY SAMPLING PROGRAM – WINTER 2019

Specific Work Instructions	SWI-001
Project:	Meliadine Gold Mine
Client:	Agnico Eagle Mines Ltd.
Project No.	1773384
Dates for Field Work:	March, April and May 2019
Author:	Arman Ospan
Technical Review by:	K. Bruce Dean
To:	Manon Turmel

SPECIFIC WORK INSTRUCTIONS FOR UNDER-ICE MARINE WATER QUALITY SAMPLING PROGRAM - WINTER 2019 - MELIADINE GOLD MINE

1.0 PURPOSE

The purpose of this document is to provide Specific Work Instructions (SWI) for water quality sample collection at the Meliadine Project Area in Melvin Bay, Rankin Inlet, NWT during under-ice conditions in March, April, and May 2019.

2.0 FIELD PROGRAM

2.1 Marine Environment

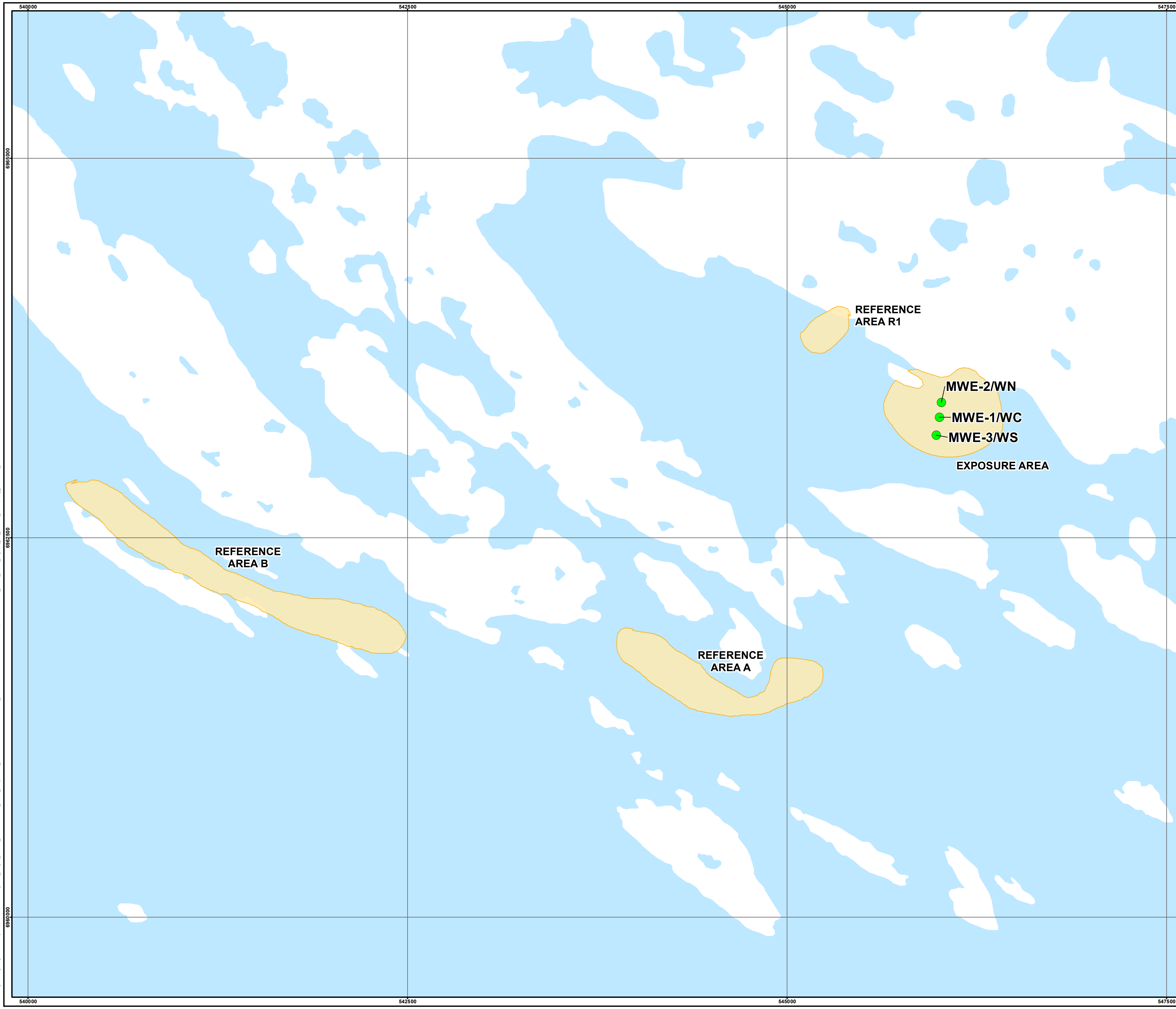
The marine monitoring study area for the under-ice marine water quality survey includes the area anticipated to be potentially influenced by Project activities. The exposure stations to be monitored were selected to correspond with the location of potential exposure to diffuser discharge In Melvin Bay. The exposure area will be monitored at three sampling stations. Station MWE-1/WC, MWE-2/WN and MWE-3/WS are located at, north (offshore) and south (inshore) of the location of the proposed diffuser discharge.

Detailed information on the sampling station locations and sampling parameters is provided in Table 1. Maps illustrating the location of the sampling locations are provided in Figure 1.

Table 1: Sampling Stations and Sampling Parameters for Under-Ice Marine Water Quality Sampling Program

Station ID	NAD 83, 15 V		Expected Water Depth (m)	Sample Depth (m)	No. of Samples by Sample Type	
	Easting (m)	Northing (m)			Discrete Water Quality [(a)]	In situ profiles
MWE-1/WC	546002	6963295	20	1 at 1 m; 1 at 5 m above the bottom	2	1
MWE-2/WN	546014	6963391	10	1 at 1 m; 1 at 5 m above the bottom	2	1
MWE-3/WS	545981	6963176	25	1 at 1 m; 1 at 5 m above the bottom	2	1

(a) Includes 10% blind duplicates for QA/QC.



LEGEND

- SAMPLE LOCATION
- STUDY AREA
- WATERCOURSE
- WATERBODY

DRAFT

0 0.5 1

1:25,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM AGNICO EAGLE MINES LIMITED.
2. DATUM: NAD83 PROJECTION UTM ZONE 15

CLIENT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED

PROJECT

MELIADINE GOLD MINE
UNDER-ICE MARINE WATER QUALITY SAMPLING PROGRAM - WINTER 2019

TITLE

WINTER SAMPLING STATIONS

CONSULTANT

GOLDER

YYYY-MM-DD	2019-02-25
DESIGNED	AO
PREPARED	CN
REVIEWED	
APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
18103567	5000/5001	A	1

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

The following data will be collected at each sampling station (Table 1):

- Measurements of snow cover (m), ice-thickness (m), total water depth (m), and the height of the water head in the augered hole (m).
- In situ vertical physico-chemical profiles at 0.5 m depth intervals throughout the water column.
- Winkler test for confirmation of dissolved oxygen (DO) concentrations if YSI readings fall outside the acceptable ranges.
- Collection and processing of discrete water quality samples at targeted depths for detailed water chemistry analyses.

Standard QC samples (including field duplicates, field blanks, trip blanks, and equipment blanks) will be collected in accordance with established quality assurance (QA) procedures (see Section 3.3).

3.0 PROCEDURES

Each sampling area will be accessed by snowmobile.

Specific sampling stations will be located using a Global Positioning System (GPS) device loaded with Universal Transverse Mercator (UTM) coordinates for each station (North American Datum [NAD] 83, Zone 13V).

At each sampling station, a hole will be drilled through the ice using an ice auger. The diameter of the hole should be wide enough to allow deployment of the sampling equipment. All snow and loose ice will be cleared from the hole with a slotted spoon prior to commencement of sampling.

3.1 Physico-Chemical Profile Measurements

In situ parameters measured at each location included water depth, temperature, conductivity (salinity), dissolved oxygen, turbidity, and chlorophyll concentration (optional). Vertical profiles will be collected using a conductivity / temperature / depth (CTD) probe (e.g. RBR XR-620) or multi-meter probe (e.g. YSI) equipped with dissolved oxygen, turbidity and fluorometer sensors.

Maintenance and calibration of a CTD profiler and associated sensors are normally performed by the instrument provider and are usually completed immediately prior to the reconnaissance program. No field quality checks of any of the parameters are required beyond the cast acceptability check and range checks.

Multi-meter probes, such as YSI, may require calibration on-site.

Multi-meter Calibration

A YSI multi-parameter water quality meter (multi-meter) will be used for conducting in-situ water quality field sampling. This multi-meter is factory-calibrated once per year for pH, water temperature, specific conductivity, and DO concentrations. Calibration records must be maintained.

Prior to collecting field samples, the multi-meter should be tested indoor in a stable environment for DO, pH, and specific conductivity. The multi-meter should be calibrated every four days or if readings are outside of the acceptable ranges, as determined by the parameter headings on the field datasheet (Appendix A). Refer to the YSI manual for further information on calibration.

Calibrate the multi-meter according to accepted protocols and record all necessary data in the multi-meter calibration log and/or field book. Note all out-of-range data in the field notebook and provide this information to the project field coordinators as soon as possible.

Under-ice Physico-chemical Water Column Profiling

Water quality profile measurements will be collected at each sampling station using the procedure below:

- Record exact coordinates where measurements were taken on the field datasheet (Appendix A).
- Record snow cover depth (m).
- Drill hole and record ice thickness (m) and height of water head in augered hole (m).
- Measure and record water depth using a hand-held depth sounder.
- Collect water column profile measurements (pH, temperature [°C], DO [mg/L and % saturation], and specific conductivity [µS/cm with the reading corrected to 25°C]) before collecting water samples. Record measurements at the following depths:
  - First measurement just beneath ice bottom (0.1 m).
  - Second measurement at 0.5 m below ice bottom.
  - Third measurement at 1.0 m below the ice bottom.
  - All subsequent measurements taken every 0.5 m depth interval until just above (0.5 m) seafloor.
- At each sampling depth, allow the sensors on the multi-meter to stabilize prior to recording the measurements. This will help to avoid hysteresis (differences in readings during downcast and upcast) and will result in more accurate readings. Record measurements on the field datasheet and log all data with the multi-meter.
- If using a CTD, measurements will be taken throughout the water column by lowering the probe from the surface to the bottom at a vertical speed of approximately 0.5 m/sec while the probe is recording measurements at a frequency of 6 Hz (6 measurements per second).
- Immediately following data collection, all data will be checked for erroneous values, outliers and to be certain that all data and configuration files are present and properly named. If the instrument software allows, all data should be reviewed graphically for outliers as well as trends, and to confirm that all sensors are functioning properly during the deployment. All profile data, datasheets and field notes will be saved to a computer and backed up on an external hard drive.

IMPORTANT: Verify that the multi-meter is calibrated and working properly before starting work for the day, and that calibration procedures and schedule are followed during the course of the program.

3.2 Discrete Water Quality Samples

Discrete water quality samples collected w analyzed for a suite of parameters, including:

- conventional parameters (i.e., conductivity, hardness, laboratory pH, total dissolved solids [TDS], total suspended solids [TSS], total organic carbon [TOC], dissolved organic carbon [DOC], and turbidity)
- major ions (i.e., bicarbonate, calcium, carbonate, chloride, fluoride, hydroxide, magnesium, potassium, sodium, sulphate, sulphide, and silicate)
- nutrients (i.e., nitrate, nitrite, total Kjeldahl nitrogen [TKN], total ammonia, total phosphorus [TP], total dissolved phosphorus [TDP], and orthophosphate)
- total and dissolved metals and metalloids (i.e., aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, cesium, chromium, cobalt, copper, gallium, iron, lead, lithium, manganese, mercury, molybdenum, nickel,

rhenium, rubidium, selenium, silicon, silver, strontium, tellurium, thallium, thorium, tin, titanium, tungsten, uranium, vanadium, yttrium, zinc, and zirconium)

- total and dissolved mercury

3.2.1 Sample Collection

For the marine environment, collect a water sample at the following target depths:

- At deeper (offshore) stations (water depth > 5 m), collect at 1 m below base of ice layer and in mid-column (5 m above the bottom), unless a pycnocline is present, in which case collect the sample below the pycnocline. Note that stratification is not expected during winter.
- Collect in situ readings (multi-meter) at the sample collection depth.

Water quality sampler (e.g. Niskin bottle or Kemmerer) samplers will be used to collect water samples at each station after the water column profiling is completed.

A few basic protocols should be followed when collecting the samples:

- Wear nitrile gloves when using samplers, and when rinsing and filling all bottles and jugs.
- Do not touch the inside of the bottles or the inside of the caps.
- Keep bottles in a clean environment (e.g., clean cooler) while collecting samples.
- Remember to check that the screws at the top and bottom of the Kemmerer samplers are tightened each time they are used.
- All water quality samples collected must have corresponding multi-meter profile measurements.

Follow these steps to collect the water quality samples:

- Triple-rinse the samplers with sea water.
- Collect a water sample from the required depth using the sampler.
- Record the sampling depth on the field datasheet.
- Fill the laboratory provided bottles (See Table 2) following instructions from the laboratory.
- Label the samples as “Station ID” (Table 1)[1] and depth at which the sample was taken.
- Verify that there are field readings for temperature, pH, specific conductivity, and dissolved oxygen at depths corresponding to the water sample collection.
- Make sure that samples do not freeze after collection (e.g., use coolers, heat packs).

The laboratory-provided bottles (Table 2) will be filled directly in the field from the sampler. Be sure to take the complete set of bottles for each station in the field.

ALS bottles do not need to be triple-rinsed with sample water before filling. The only time rinsing is required is if a sample is being transferred from one bottle to another, or if a bottle will be re-used to hold the filtered sample (e.g., dissolved metals). Information on filtering samples is provided in Section 3.2.2. Alternatively, filtration for dissolved metals can be

[1] Pre-printed labels were created for the bottle sets.

done in the laboratory conditions. In this case no preservatives should be added into the sample bottle and appropriate note should be made on the bottle and chain of custody (COC) form.

Table 2: Bottle Sets for Discrete Water Quality Samples

Bottle Type	Numbers of Bottles in Set	Filter	Preserve	Preservative	Number of Vials for Preservative
Nutrients-total: 120-mL amber glass bottle	1	-	Yes	1 mL H_2S0_4 (sulphuric acid)	1
Nutrients-dissolved: 120-mL amber glass bottle	1	Yes	Yes	1 mL H_2S0_4 (sulphuric acid)	1
Routine: 1-L polyethylene	1	-	-	-	-
Sulfide: 125-Ml HDPE bottle	1	-	Yes	2 mL Zn Acetate	1
Metals-total: 60-mL HDPE bottle	1	-	Yes	3 mL ultra-pure HNO_3 (nitric acid)	1
Metals-dissolved: 60-mL HDPE bottle	1	Yes	Yes	3 mL ultra-pure HNO_3 (nitric acid)	1
TOTAL	**8**	-	-	-	**5**

3.2.2 Sample Processing

At the end of each sampling day, the field and laboratory crew members will process (filter and/or preserve) the samples. Samples that require filtering can be processed at the end of the field day[2].

For samples that do not require filtering, but require preservative, the following protocols apply:

- Always wear nitrile gloves and safety glasses when working with preservatives.
- Add the required preservative (Table 2) and invert the bottle numerous times to mix the preservative with the sample.
- Store water samples in the refrigerators (between 4 and 10°C) at the Camp until ready to ship (see Section 3.4 for packing and shipping instructions). Do not allow the samples to freeze.

Samples that may require filtering are dissolved metals. Dissolved metals samples will be filtered into their respective sample bottles using the Millipore vacuum pump or Nalgene hand pumps, and Millipore 0.45 µm membrane filter. Whatman GF/C filters may be useful for pre-filtering of samples with a large amount of suspended solids, which may have difficulty passing through the Millipore filters; after the sample has been passed through a GF/C filter, follow with a 0.45 µm membrane filter. Take extreme care when handling the filter assembly and when processing the samples to avoid the potential for contamination of the filtered sample.

Alternatively, samples for dissolved metal can be filtered in the laboratory. In this case, no preservatives should be added in the sample bottles and respective notes should be made on sample bottles and COCs.

[2] Note that it is preferable for the field crew to filter and process samples at the end of the sampling day. However depending on the length of the field day, in some cases samples may need to be filtered and processed first thing the next morning. If this is the case samples must be kept cold (not frozen) and in the dark – especially chlorophyll a samples.

When filtering, the following considerations apply:

- Always wear nitrile gloves and safety glasses when working with preservatives.
- Use deionized water to rinse the pump and filter apparatus before use.
- Use a new filter for each sample bottle.
- Fill bottles in the following order: dissolved ultra-low metals and then nutrients.
  - As the filtered water will be added to back to the original bottles, triple rinse the bottles with the filtered water before filling the bottles with the filtered water.
- Add the required preservative (Table 2) and invert the bottle numerous times to mix the preservative with the sample.
- Store water samples in the refrigerators at camp until ready to ship (see Section 3.4 for packing and shipping instructions).

Generate a chain of custody (CoC) record after each day of sampling. See example of CoC in Appendix B.

3.3 Quality Assurance and Quality Control

3.3.1 Water Quality QC Samples

As general objective, the number of QC samples to be collected should represent approximately 10% of the total number of planned field samples. The target of QC samples collected during the under-ice program is one set at MLA [e.g., field duplicate, field blank, trip blank and equipment blank]). These are described as follows:

- **Field duplicate**: A second sample will be collected at a randomly selected station and treated as a separate field sample with regards to filtering and preserving.
- **Field blank**: Sample bottles are filled in the field with de-ionized water provided by the laboratory. These samples are therefore exposed to the sampling environment at the sample site and handled in the same manner as the surface water samples collected during the field program (e.g., preserved, filtered).
- **Trip blank**: These sample bottles come from the laboratory pre-filled with deionized water. Take the bottle set out into the field with you; DO NOT open the bottles. Submit bottles as is with the rest of the field samples.
- **Equipment blanks**:
  - For **total analytes**: Run laboratory-provided deionized water through the Kemmerer sampler as you would for regular field samples and use to fill sample bottles. Preserve as per requirements for that parameter.
  - For **dissolved analytes**: Pour deionized water into the filter tower and fill the dissolved ultra-low metals and dissolved nutrient bottles with the filtered blank water.

Use unique sample ID to identify the QC samples. It is best practice to submit QC samples to the lab as blind samples, but clearly note them in the field notebook.

3.3.2 Other QA/QC Protocols

- Record detailed field notes in waterproof field books and field datasheets, and ensure any critical information (e.g., QC type, location, date and time, etc.) is available at the de-brief meeting after the program.
- Have a second person check data sheets and CoCs at the end of each field day for completeness and accuracy.

- Keep track of station name and date sampled in the field binder/field note book.
- At the end of each day, record all data and when possible save all data (database, CoCs, multi-meter data, shipping memos, etc.) to a computer file and/or external USB device.
- Take photos at each station and download photos daily.
- Do not use any laboratory-supplied bottles that you suspect have been used or contaminated.
- Discard used bottles into a garbage bag; at end of field program put these bottles in coolers and include in shipment back to lab for disposal. Clearly label the cooler as having no samples, and include what it does contain (e.g., used bottles). Unused and unopened bottles can be left in the bottle prep area for the next program.

3.4 Sample Shipping

To ship samples:

- Make sure that the CoC forms are filled out correctly; confirm that Arman Ospan is included on the CoC distribution list. Please see the example CoC in Appendix B.
  - Assign a CoC number: Meliadine-WQ-#.
  - Take a photo of the CoC for our records. E-mail a copy of the photo to Arman Ospan.
- All samples for the water quality program (i.e., discrete samples) will be placed in one set of coolers and shipped together.
- Place the CoC in a Ziploc bag inside each cooler corresponding to the samples included in the cooler. Each COC must match the contents of the cooler in which it is placed.
- Mark “CoC enclosed” on the shipping label of the cooler containing the CoC.
- Mark shipping label for each cooler (i.e., “1 of 1”, or in the case of multiple coolers, “1 of 3”, “2 of 3”, etc.)
- Place shipping labels in Ziploc bags and tape to each cooler.
- Place lots of ice packs and padding in each cooler. Glass bottles should be individually wrapped in bubble wrap.
- Each cooler should not exceed 40 lbs (18 kg) in weight.
- Bind each cooler with tape and add “do not freeze” and “keep cool” stickers.
- Arman Ospan will notify laboratory contacts of sample shipments by e-mail and request confirmation when samples are received; please include Arman on all communications.
- Laboratory samples collected as part of the water quality program are to be shipped to ALS in Yellowknife, where the samples will be logged and shipped to their respective analysis locations (i.e., Edmonton or Burnaby). Ensure that ALS Yellowknife is informed that samples are on their way, when they should arrive, and provide them the location where need to be picked up from.
- Check sample receipt confirmations when received from the laboratory to make sure sample integrity has been preserved (e.g. temperature on receipt, damaged samples) and that the correct analysis has been scheduled by the laboratory (correct analytical package and number of samples). Arman Ospan will check these.
- Ship samples to ALS Yellowknife:

Jessica.Spira@ALSGlobal.com

ALS Environmental
#116 - 314 Old Airport Road
Yellowknife, NWT
Canada X1A 3T3
TEL: 867-873-5593

4.0 LIST OF APPENDICES:

Appendix A: Field Datasheet

Appendix B: Chain of Custody Form (ALS)

APPENDIX A: Field Datasheet

Golder Associates	GROUP		DATE:	
	Water Quality Record (Form #1, Version 4)		**TIME:**	
	16820 - 107 Ave, Edmonton, AB, T5P 4C3		**STATION:**	

Project Title: **Project #:** **Phase:** **Page: ___ of ___**

Personnel: ______________________ GPS or Waypoint (13V NAD83): __________ __________

Weather: ______________ Water Colour: ______________ Total Depth (m): __________

Secchi Depth (m): ________ Pressure (mm Hg): __________ Field Meter(s): __________

WQ Sample	Depth (m)	Sample ID
Mid		

Winkler taken:		Yes / No	
Collection depth (m)			
Winkler DO 1 (mg/L)		Winkler DO Tap (mg/L)	
Winkler DO 2 (mg/L)		YSI DO Tap (mg/L)	

Zooplankton

Haul 1 Depth (m): __________

Phytoplankton

Sample Depths: __________

Phytoplankton Collected? Y N

Chlorophyll-a Y N

Rep 1 Volume Filtered (mL): ________

Rep 2 Volume Filtered (mL): ________

Rep 3 Volume Filtered (mL):

Notes:

Depth (m)	Temperature (°C)	Conductivity (µS/cm)[c] expected range 17,000 to 35,000	Dissolved Oxygen (%) expected range 95 to 105 (acceptable 60 to110)	Dissolved Oxygen (mg/L)[§] expected range 12 to 15	pH expected 6.7 to 8.5
0.1					
0.5					
1.0					
1.5					
2.0					
2.5					
3.0					
3.5					
4.0					
4.5					
5.0					
5.5					

c temperature corrected to 25 °C; § Should not be more than 15 mg/L (supersaturation)

Project Title: **Project #:** **Phase:** **Page: ___ of ___**

Depth (m)	Temperature (°C)				

c temperature corrected to 25 °C; § Should not be more than 15 (supersaturation)

QA check completed by: ______________ Date: ______________ Photo #: ______________

APPENDIX B: Chain of Custody Form (ALS)

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here
(lab use only)

COC Number: 17 -

Page of

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

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

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS														SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)	SAMPLE CONDITION AS RECEIVED (lab use only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO		Frozen ☐ SIF Observations Yes ☐ No ☐
		Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Are samples for human consumption/ use? ☐ YES ☐ NO		Cooling Initiated ☐
		INIITIAL COOLER TEMPERATURES ºC / FINAL COOLER TEMPERATURES ºC

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY

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

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

APPENDIX D • CONCEPTUAL OCEAN DISCHARGE MONITORING PLAN

AGNICO EAGLE

MELIADINE MINE

Conceptual Ocean Discharge Monitoring Plan

JUNE 2018
VERSION 1

EXECUTIVE SUMMARY

Agnico Eagle Mines Limited (Agnico Eagle) is developing the Meliadine Gold Project (the Project), located approximately 25 kilometres (km) north of Rankin Inlet, and 80 km southwest of Chesterfield Inlet in the Kivalliq Region of Nunavut. The mine plan proposes open pit and underground mining methods for the development of the Tiriganiaq gold deposit, with two open pits (Tiriganiaq Pit 1 and Tiriganiaq Pit 2) and one underground mine.

There are four phases to the development of the Mine; just over 4 years of construction (Q4 2015 to 2019), 8 years of Mine operation (2020 to 2027), 3 years of closure (2028 to 2030), and post-closure (2031 forwards). The underground mine is planned to extend to approximately 625 m below the ground surface; therefore, part of the underground mine will operate below the base of the continuous permafrost. The underground excavations will act as a sink for groundwater flow during operation, with water induced to flow through the bedrock to the underground mine workings once the Mine has advanced below the base of the permafrost.

Groundwater from the underground mine workings will be collected and pumped for storage on the surface in the water containment ponds to manage surface and groundwater, as described in the Meliadine Mine Water Management Plan (WMP; Agnico Eagle 2017a). The management of groundwater is further described in the Meliadine Mine Groundwater Management Plan (GWMP; Agnico Eagle 2018), which entails for the discharge of saline groundwater to Meliadine Lake after treatment, in compliance with Agnico Eagle's Type A Water Licence 2AM-MEL1631, Part E, Item 14. As part of long-term water management, excess groundwater will be treated to meet, as applicable, Metal and Diamond Mining Effluent Regulations (MDMER), Canadian Council of Ministers of the Environment Water Quality Guidelines for the Protection of Aquatic Life (Marine; CCME) and/or background conditions at the edge of the mixing zone for discharge into Melvin Bay via an engineered diffuser.

This document presents the conceptual Meliadine Mine Ocean Discharge Monitoring Plan for discharge of treated groundwater effluent into the marine environment. It summarizes the field sampling study design strategy, methods, laboratory requirements, quality assurance and quality control, and reporting.

TABLE OF CONTENTS

TABLES AND FIGURES

DOCUMENT CONTROL

Version	Date	Section	Page	Revision	Author
1	June 2018	All	All	Conceptual Plan developed for the Treated Groundwater Effluent Discharge into Melvin Bay	Golder Associates Ltd.

ACRONYMS

Agnico Eagle	Agnico Eagle Mines Limited
ANOVA	Analysis of variance
CCME	Canadian Council of Ministers of the Environment
CES	Critical effect size
EEM	Environmental Effects Monitoring
FEIS	Final Environmental Impact Statements
FDP	Final discharge point
Golder	Golder Associates Ltd.
GWMP	Groundwater Management Plan
MDMER	Metal and Diamond Mining Effluent Regulations
Mine or Project	Proposed Meliadine Gold Mine
MMER	Metal Mining Effluent Regulations
NIRB	Nunavut Impact Review Board
NWB	Nunavut Water Board
ODMP	Ocean Discharge Monitoring Plan
QA/QC	Quality Assurance and Quality Control
TDS	Total dissolved solid
WMP	Water Management Plan
WQG	Water Quality Guidelines

SECTION 1 • INTRODUCTION

This document presents the conceptual Ocean Discharge Monitoring Plan (ODMP) for the proposed discharge of excess treated groundwater into the marine environment at Itivia Harbour in Melvin Bay.

The overall water management for the life of the Mine and post-closure is described in the Agnico Eagle Meliadine Gold Mine Water Management Plan (WMP; Agnico Eagle 2018b) and the Groundwater Management Plan (GWMP; Agnico Eagle 2018e). The WMP provides descriptions of the Mine water control structures and associated design criteria, while the GWMP describes management of groundwater for discharge to Meliadine Lake.

This conceptual ODMP outlines objectives, rationale, and details of the data collection strategy, analytical methods and ecological thresholds for protection of water/sediment quality and biological components on the marine environment in Melvin Bay. The conceptual ODMP will be updated pending the necessary approvals and authorizations to include any regulatory conditions, as applicable, and further refine methods and/or thresholds.

1.1 Background

Agnico Eagle Mines Limited (Agnico Eagle) is developing the Meliadine Mine, located approximately 25 kilometres (km) north of Rankin Inlet, and 80 km southwest of Chesterfield Inlet in the Kivalliq Region of Nunavut, on Inuit Owned Lands. The Meliadine Mine is located within the Meliadine Lake watershed of the Wilson Water Management Area (Nunavut Water Regulations Schedule 4).

Agnico Eagle has previously completed the environmental assessment for the construction and operation of an All-Weather Access Road (Agnico Eagle 2013) and the Meliadine FEIS (Agnico Eagle 2014), which included nearshore barge operations in Itivia Harbour and seasonal shipping activities in Hudson Bay and Hudson Strait. The projected life of the Meliadine Mine is anticipated to be 13 years but may be extended as exploration continues. This includes an estimated 3 years of construction, 13 years of operations, and 3 years of decommissioning.

The Meliadine Mine proposes mining methods for the development of the Tiriganiaq gold deposit, which includes an underground mine. The underground mine will extend to approximately 625 m below the ground surface, therefore, part of the underground mine will operate below the base of the continuous permafrost. The underground excavations will act as a sink for groundwater flow during operation, with water induced to flow through the bedrock to the underground mine workings once the Mine has advanced below the base of the permafrost. Inflow of groundwater is expected from 2018 until the end of mine life in 2032. The management of groundwater is further described in the Meliadine Mine GWMP (Agnico Eagle 2018e), which entails for the discharge of saline groundwater to Meliadine Lake after treatment, in compliance with Agnico Eagle's Type A Water Licence 2AM-MEL1631, Part E, Item 14.

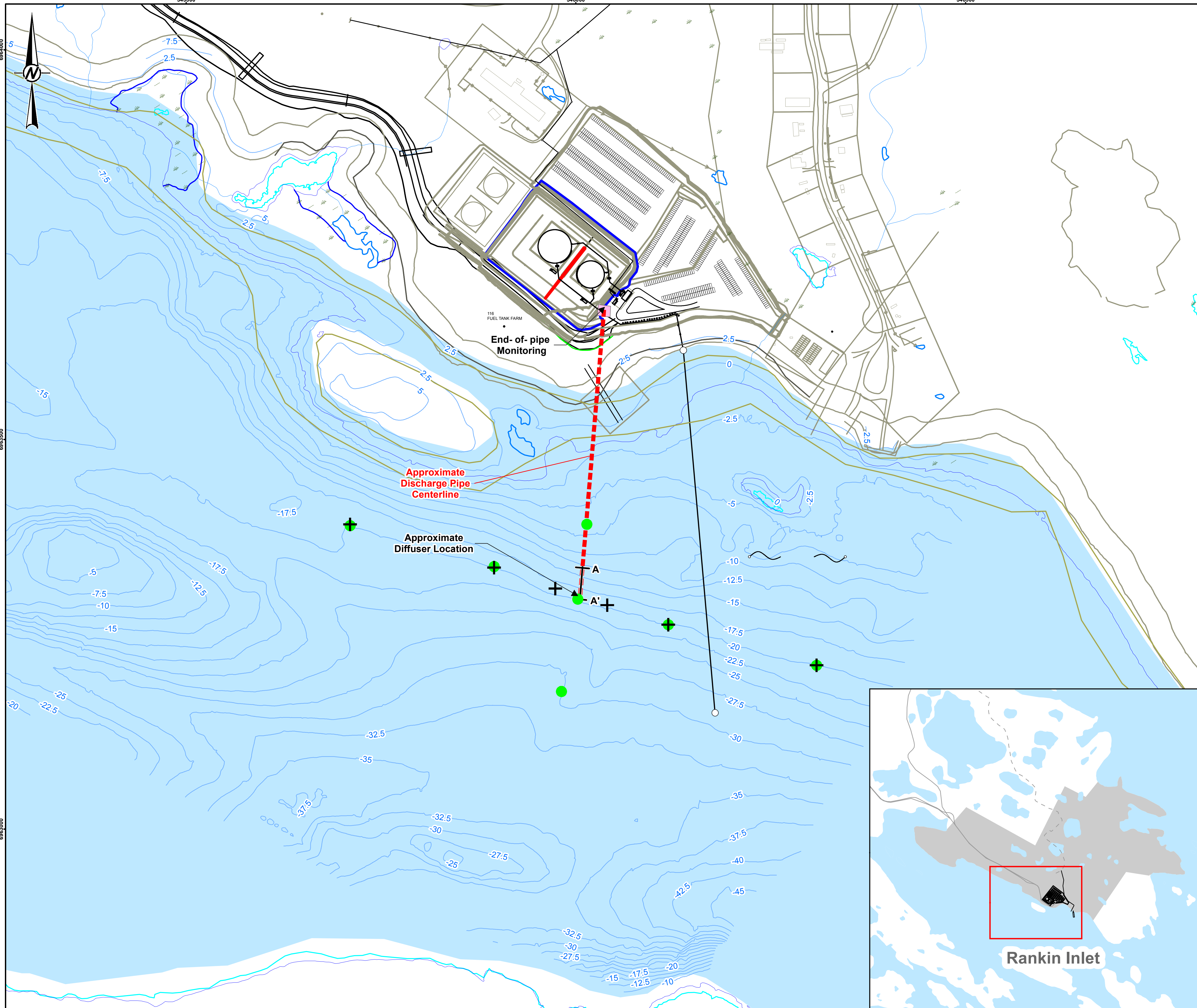
To support long-term groundwater management for the Mine, Agnico Eagle has proposed to directly discharge excess groundwater effluent into Melvin Bay at Itivia Harbour after treatment of the saline underground inflows to meet discharge water quality criteria for Melvin Bay and/or background conditions.

This conceptual ODMP is submitted along with the Final Environmental Impact Statement Addendum (FEIS Addendum) for the proposed discharge of treated groundwater effluent from the underground mine of the Tiriganiaq deposit at the Meliadine Mine into the marine environment at Melvin Bay. The ODMP includes a description on additional requirements to define triggers and threshold for adaptive management, including additional baseline data collection at Melvin Bay ahead of installation of the engineered marine outfall, as required. This plan was developed to fulfil the NIRB Guidelines received for the FEIS Addendum, for stand-alone management and monitoring plans (EIS Guidelines sections 9.3 and 9.4; NIRB 2018). While the ODMP has been developed as a separate and stand-alone plan, the intent is to align it with Environmental Effects Monitoring (EEM) study design requirements to avoid multiple monitoring plans. The components of the ODMP that are not captured in an EEM study design will be incorporated into existing management plans for the Meliadine Mine (for example, as part of the GWMP [Agnico Eagle 2018e]).

1.2 Objectives and Scope

The ODMP has the purpose of assessing the potential effects of the treated groundwater effluent discharge to the marine environment in Melvin Bay. The ODMP will identify potential changes to water and sediment quality caused by the effluent discharge and the effect of these changes to aquatic life, fish habitat, and fish health. To achieve its purpose, the ODMP has the following objectives:

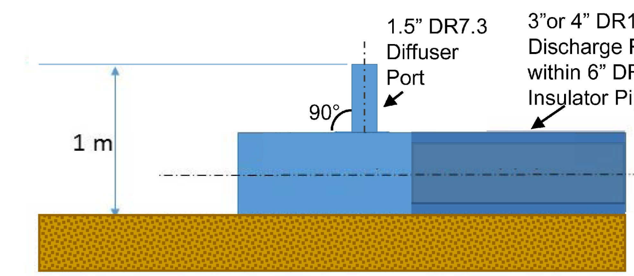
- To detect short- and long-term effects of the discharge on the receiving environment
- To address the NIRB FEIS Addendum Guidelines, the federal Metal and Diamond Mining Effluent Regulations (MDMER, once they come into effect), Canadian Council of Ministers of the Environment (CCME) Guidelines for the Protection of Aquatic Life, as well as requirements that may be requested from regulators during the permit processes
- Identify unforeseen adverse effects and provide early warnings of undesirable changes in the environment
- To inform mitigation



LEGEND

- WATER QUALITY SAMPLING STATION
- BENTHIC INVERTEBRATES AND SEDIMENT QUALITY SAMPLING STATION
- END OF PIPE MONITORING
- GENERAL AREA FOR THE PROPOSED DIFFUSER LOCATION
- CROSS SECTION LOCATION
- WATERBODY

End of Discharge Pipe – Diffuser Port Design (HDPE Pipe)



NOT FOR CONSTRUCTION

0 100 200

1:5,000 METRES

NOTE(S)

AGNICO EAGLE IS CONSIDERING TREATMENT AND MANAGEMENT OPTIONS TO MEET APPLICABLE DISCHARGE CRITERIA AND/OR SITE SPECIFIC WATER QUALITY OBJECTIVES, AS REQUIRED. ACTIVITIES AND FACILITIES PRESENTED HEREIN ARE FOR PLANNING PURPOSES ONLY AND SHOULD NOT BE CONSIDERED FINAL DESIGN.

REFERENCE(S)

BASE DATA OBTAINED FROM AGNICO EAGLE MINES LIMITED.
DATUM: NAD 83 PROJECTION: UTM ZONE 15

CLIENT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED

PROJECT

MELIADINE MINE
NUNAVUT

TITLE

**CONCEPTUAL MARINE MONITORING PLAN
PROPOSED SAMPLING STATIONS**

CONSULTANT

GOLDER

YYYY-MM-DD	2018-05-24
DESIGNED	CLT
PREPARED	CDB/JZ
REVIEWED	
APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
1773384	1100	A	A-1

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

SECTION 2 • REGULATORY FRAMEWORK

The Meliadine Mine is located within the Nunavut Territory and is subject to the regulatory approvals established under the applicable laws and regulations of Canada and of Nunavut.

As per the MMER, including the amended MDMER (GC 2017; anticipated to come into effect in 2018-2019), any discharge exceeding 50 cubic metres (m^3) should conduct EEM studies. The studies include effluent characterization and water quality monitoring accompanied by biological studies, which may include benthic invertebrate community, fish population and fish tissue components.

In consultation with the NIRB, Agnico Eagle has prepared the Final Environmental Impact Statement Addendum (FEIS Addendum) for the authorization to carry out discharge of treated groundwater effluent from the underground mine to the marine environment, in accordance with the Guidance for Final Environmental Impact Statement Addendum for the “Saline Effluent Discharge to Marine Environment, Rankin Inlet, Meliadine Gold Mine” (“project proposal” or “proposed Project activities” in this report; NIRB 2018).

The discharge of the treated groundwater effluent into the marine environment is also subject to authorization under the Section 5 of the *Environmental Protection Act* of Nunavut (GN 1988). In addition, other conditions and/or mitigations outlined by regulatory agencies under the following Acts (or applicable licence requirements) should be adhered to:

- *Federal Fisheries Act* (GC 1985a)
- *Navigation Protection Act* (GC 1985b)
- *Species at Risk Act* (GC 2007)

SECTION 3 • RATIONALE

3.1 Discharge Overview

The ODMP concerns management of the discharge of excess groundwater from the underground mine to the marine environment after treatment during the life of the Project to support long-term water management.

Supplemental hydrogeological investigations were undertaken in 2015 and 2016 to provide additional information on potential volumes and quality of saline groundwater inflows to the underground mine to be managed. Per the results obtained, the total volume of the groundwater inflow in the mine is expected to be up to 420 m^3/day (Golder 2016). Adding to the maximum anticipated groundwater volume to be stored at the Meliadine Mine, this will result in a need to discharge up to 800 m^3/day (Agnico Eagle 2018e). Groundwater inflows to the underground mine since 2015 have not been discharged to the environment and are being stored underground, in the Saline Pond, in the P-Area, or actively evaporated during the open water season (Agnico Eagle 2018b).

Total dissolved solid (TDS) concentrations in groundwater are naturally high, expected to range from 50,000 to 64,000 mg/L per groundwater data collected by Agnico Eagle in 2017 (a summary of the groundwater quality is presented in Table 3, Section 3.4.2 of the FEIS Addendum; Agnico Eagle 2018g). Since mining operations include drill-and-blast excavation, certain parameters of groundwater quality are expected to be influenced by explosives (particularly ammonia and nitrate due to ammonium nitrate, fuel oil [ANFO] and emulsion explosives). Chloride, sodium and calcium are also naturally high in concentration in the untreated groundwater, averaging at higher concentrations than those recorded in Melvin Bay (Table 1 and Table 2). Therefore, to minimize effects to the environment, and to comply with the effluent discharge criteria (GC 2017; CCME 2003; BC MOE 2017a; BC MOE 2017b) and objectives, groundwater will be treated prior to discharge.

Table 1: Summary of Melvin Bay Background Marine Water Temperature and Salinity taken in August 2011 and Average Untreated Groundwater Concentrations taken in 2017

	Melvin Bay		Untreated Groundwater
Parameter	Surface	Bottom	
Temperature (°C; n=3)	8.5 to 9.45	7.93 to 9.07	-3.4°C - +3.8°C(1)
Salinity (ppt; n=3)	29.29 to 29.35(2)	29.30 to 29.38(2)	55 to 56(3)

Source: Melvin Bay - Nunami Stantec 2012. Meliadine Mine Groundwater – Agnico Eagle 2017 data.

(1) Average temperatures per observations of DDH samples, as provided by Agnico Eagle. This does not account for the influence of ambient temperature for groundwater stored in containment ponds at the Meliadine Mine.

(2) *In situ* average salinity measured at Melvin Bay. Average Total Dissolved Solids (TDS) measured at Melvin Bay = 34,300 mg/L.

(3) Estimated average groundwater salinity based on average TDS groundwater concentrations presented in FEIS Addendum, Section 3.4.2, Table 3 (55,700 mg/L average TDS; Agnico Eagle 2018g). Salinity from groundwater has not been measured. TDS values are comparable to salinity as TDS represents an estimate of the level of ions, typically salt ions, that are present in the water. This may however overestimate the salinity of the untreated groundwater, as TDS also includes organic solutes (for example, hydrocarbons and urea) in addition to salt ions.

Table 2: Summary of Select Melvin Bay Background Marine Ion Concentrations taken in August 2011 and Average Untreated Groundwater Concentrations taken in 2017

	Melvin Bay			Untreated Groundwater(1)
Ion	I1	R1	R2	
Chloride (mg/L)	20,000	20,100	20,300	32,315
Sodium (Na) - Total (mg/L)	11,000	10,800	10,800	14,365
Calcium (Ca) - Total (mg/L)	411	399	402	2,032

Source: Melvin Bay - Nunami Stantec 2012; averages from 3 sampling locations (I1, R1 and R2). Meliadine Mine Groundwater – Agnico Eagle 2017 data (Agnico Eagle 2018g).

(1) Averages per untreated groundwater concentrations presented in FEIS Addendum, Section 3.4.2, Table 3; Agnico Eagle 2018g).

Treated groundwater effluent will be trucked to the discharge facility at the Itivia Fuel Storage Facility for discharge during the open water season (May to October). The discharge facility, located at the Itivia Fuel Storage Facility, will include a storage tank and a pipeline outflow extending to an engineered diffuser located in Melvin Bay. The treated groundwater effluent will be discharged seasonally in a controlled manner through a diffuser to allow for maximum dilution and minimum impact on the marine environment. The Final Discharge Point (FDP) is estimated at a distance of approximately 230 m from the shoreline and a depth of approximately 20 m. Facility layout and diffuser specifications are shown in Figure 1.

Treated groundwater effluent quality is required to meet the Canadian federal end-of-pipe discharge criteria (per the amended MDMER; GC 2017) and to be non-acutely lethal. Treated groundwater will be discharge into Melvin Bay via an engineered diffuser (refer to Section 3.5 of the FEIS Addendum; Agnico Eagle 2018g) to meet Canadian Surface Water Quality Guidelines (WQG; CCME 2003), or background concentrations for parameters without guidelines, at the edge of the mixing zone.

3.2 Environmental Conditions

The receiving environment for the effluent discharge is located in Melvin Bay, northwest Hudson Bay at Rankin Inlet. Hudson Bay, and particularly the area including Melvin Bay, is usually ice-covered from November to June and ice-free from July to October (Stewart and Lockhart 2004; Cohen et al. 1994).

- At Rankin Inlet, the tidal range varies between 2.0 and 4.6 m and mean currents flow southward at around 0.22 m/s. Isobath lines are nearly parallel to coastline and depth rapidly increases reaching more than 20 m within 230 m off the coast.
- Marine environmental baseline studies in the Melvin Bay area were conducted in August 2011 by Nunami Stantec (2012; see Appendix B of the FEIS Addendum, Agnico Eagle 2018g).
- Surveys were conducted at three areas in Melvin Bay: near the effluent discharge location (Impact Area 1 [I1]) and two reference areas, one (Reference Area 1 [R1]) located approximately 0.9 km northeast of Itivia Harbour, and the other (Reference Area 2 [R2]) on the southern shore of Melvin Bay, 1.5 m south from Itivia Harbour.

- Water quality measurements conducted by Nunami Stantec (2012) showed no water column stratification with the mean temperature ranging from 8.9^o C at the surface to 8.5^{o}C at the bottom (up to approximately 13 m depth), and the mean salinity ranging from 29.32 ppt at the surface to 29.33 ppt at the bottom. Water was well oxygenated with dissolved oxygen saturation ranging from 113.6 to 115.6% (10.8 to 11.2 mg/L). Nutrients and metals were mostly below detection limits and lower than CCME WQG for the Protection of Aquatic Life (Marine; CCME 2003).
- Sediments in the areas with water depths of up to 6.6 m were dominated by coarse material (cobble and gravel) in most samples (Nunami Stantec 2012).
- Sediment chemistry analysis of the fine substrate fraction revealed concentrations below CCME Interim Sediment Quality Guidelines (CCME 2001) for all parameters except chromium. Chromium concentrations slightly exceeded the CCME ISQG of 52.3 mg/kg for this element at all sample stations with mean concentrations (plus/minus standard deviation) ranging from 55.8 ± 5.89 mg/kg at I1 to 60.2 ± 6.12 mg/kg at R2.
- Phytoplankton abundance, richness, and diversity were similar across all sites within the marine local study area, and a total of 33 taxa were recorded. Dinoflagellates, mainly represented by *Peridinium/Gonyaulax* spp. and *Dinophysis* spp., were the dominant taxonomic group at all sampled locations. Ciliates of order Tintinnida were present at low percentages at two of the sampled locations.
- Zooplankton abundance, richness, and diversity varied among sites, and a total of 44 taxa were recorded. Zooplankton were mostly rotifers and calanoid copepods. An unidentified rotifer species, possibly in the family Notommatidae, was the dominant taxon at all sampled locations.
- Macroflora was sparse within Melvin bay (ranging from 2 to 5% coverage). Rockweeds (*Fucus* spp.) were the dominant species and occupied a small band in the low intertidal zone. Kelp (*Laminaria* spp.) was observed in the subtidal areas of the southern shore of the bay. Seaweeds are not locally harvested in Melvin Bay.
- Benthic invertebrates were dominated by different families of polychaetes with lesser abundance of nematodes and amphipods. Among other taxonomic groups observed were sponges (Porifera), hydrozoans, flatworms (Platyhelminthes), three gastropod, and three bivalve taxa, several crustacean taxa (copepods, amphipods, decapods), and sea squirts (Urochordata).
- In general, benthic invertebrate abundance and diversity in the area is low; in the intertidal zone, benthic communities occur seasonally when the habitat is not influenced by ice (Stewart and Lockhart 2005). Abundance in the subtidal habitat was also low in late summer (August) with most of the organisms observed less than 1 cm in length, suggesting a low biomass (Nunami Stantec 2012).
- Locally harvested shellfish species include blue mussels and clams.

- Several species, including Arctic char, Arctic cod, Greenland cod, Arctic sculpin, slender eel blenny and Greenland halibut, are considered important to the local commercial, recreational, and subsistence fisheries.
- Only six species of fish were identified during the baseline study in 2011 (Nunami Stantec 2012). Greenland cod (*Gadus ogac*) represented over 50% of fish captured, followed by slender eelblenny (27%) and minor contributions of different species of sculpins. Arctic char was not observed during the baseline field study, but was reported to be in the area at the time of the field study (west of Melvin Bay near the Barrier Islands).
- At least 43 species of seabirds, shorebirds, waterfowl, and marine-associated raptors frequent offshore, inshore, intertidal, or salt marsh habitats of the Hudson Bay marine ecosystem (see Table B-2 of Appendix B in the Shipping Management Plan; Agnico Eagle 2018f). Few of these species are year-round residents.
- The baseline study conducted in 2011 indicated that most marine birds that occur in the vicinity of Rankin Inlet are summer residents and no SARA listed marine bird species occur near Rankin Inlet (Nunami Stantec 2012).
- Marine mammals potentially present in the north and northwest Hudson Bay for variable periods of time include 4 species of cetaceans (3 toothed whales and one baleen whale), 6 species of pinnipeds (seals and walrus), and polar bear. (see Table B-3 of Appendix B in the Shipping Management Plan; Agnico Eagle 2018f). Polar bears (*Ursus maritimus* – Special Concern under SARA) are uncommon to the area. A summary of listed marine mammal species with potential to occur in marine RSA is provided in Table B-5 of Appendix B in the Shipping Management Plan (Agnico Eagle 2018f).
- Narwhal (*Monodon Monoceros*, uncommon at Rankin Inlet), bowhead whales (*Balaena mysticetus*, uncommon at Rankin Inlet) and beluga (*Delphinapterus leucas*) are known to overwinter in Hudson Strait and in polynyas within Hudson Bay. Atlantic walrus (*Odobenus rosmarus rosmarus*), bearded seal (*Erignathus barbatus*), ringed seal (*Phoca hispida*), and harbour seal (*Phoca vitulina concolor*) are year-round residents to at least portions of Hudson Bay, but largely uncommon at Rankin Inlet in recent years. Harp seal (*Pagophilus groenlandicus*) have increased in number in recent years near Rankin Inlet. The remainder of marine mammals identified in Hudson Bay / Hudson Strait, namely killer whale (*Ocinus orca*) and hooded seal (*Cysophora cristata*), are migratory and seasonal visitors limited largely by the presence of solid land-fast ice throughout the winter and spring.

3.3 Project Management Plans

Agnico Eagle has developed Management Plans that are applicable to the Meliadine Mine site, the All-Weather Access Road (AWAR), and the Itivia Fuel Storage Facility.

Updates to the plans have been developed, as required, and submitted to the NIRB and NWB throughout development of the Mine. Table 3 lists the management plans for the Meliadine Mine as they apply for the ocean discharge, with indications on any potential changes that may be required in future updates.

Agnico Eagle is committed to adhering to all existing plans that have been developed for the Meliadine Mine as part of NIRB Project Certificate No. 006 and NWB Type A Water Licence 2AM-MEL1631 conditions. This includes reporting requirements required to measure the achievement of objectives as set out by approval conditions or to demonstrate compliance, such as annual reporting on Project monitoring programs.

Table 3: Project Management Plans Applicable to the Proposed Project Activities for Ocean Discharge

Management Plan	Reference	Changes Required due to the Proposed Project Activities
Water Management Plan	FEIS Volume 2, SD 2-6 (Agnico Eagle 2014) Updated and resubmitted (Agnico Eagle 2018b) NWB Doc 1803312AM-MEL-1631	None
Mine Waste Management Plan	FEIS Volume 2, SD 2-6 (Agnico Eagle 2014) Updated and resubmitted (Agnico Eagle 2018c) NWB Doc 1803312AM-MEL-1631	None
Roads Management Plan	FEIS Volume 2, SD 2-9 Nunavut. Doc 235-1314280007 (Agnico Eagle 2014) Updated and resubmitted (Agnico Eagle 2018d) NWB Doc 1803312AM-MEL-1631	None
Hazardous Materials Management Plan	FEIS Volume 2, SD 2-13 (Agnico Eagle 2014) Updated and resubmitted (Agnico Eagle 2018a) NWB Doc 1803312AM-MEL-1631	None
Risk Management and Emergency Response Plan	FEIS Volume 2, SD 2-15 (Agnico Eagle 2014) Updated and resubmitted (Agnico Eagle 2015) NIRB Doc. No. 150623-11MN034	None
Spill Contingency Plan	FEIS Volume 2, SD 2-16 (Agnico Eagle 2014) Updated and resubmitted (Agnico Eagle 2017) NWB Doc 1803312AM-MEL-1631	None
Shipping Management Plan (including the Marine Environmental Management Plan as Appendix D)	FEIS Volume 8, SD 8-1 (Agnico Eagle 2014) Updated and resubmitted (Agnico Eagle 2018f) NIRB Doc. No. 180104-11MN034	None
Groundwater Management Plan	Submitted (Agnico Eagle 2018e, provided in Appendix D of this FEIS Addendum) NWB Doc. No. 180214 2AM-MEL1613	The submission, review, and approval of a Groundwater Management Plan is a requirement of the current Type A Water Licence 2AM-MEL1631 (Part E, Item 14). An updated GWMP will be submitted if appropriate licenses and approvals are obtained prior to ocean discharge.
Ocean Discharge Monitoring Plan	Conceptual plan - provided in Appendix E of this FEIS Addendum.	This document.

Notes:

Updated management plans are resubmitted to the NIRB, and the NWB as appropriate, in compliance with respective NIRB Project Certificate No. 006 or NWB Type A Water Licence (No. 2AM-MEL1631, 2016) conditions, as adaptive management measures or changes are applied as the Project develops.

3.4 Potential Effects

The potential effects from the discharge of treated groundwater effluent to the marine environment were assessed in the FEIS Addendum (Agnico Eagle 2018g). Effect pathways specific to the treated groundwater effluent discharge activity assessed included the following:

- Change in fish habitat quality due to discharge of groundwater effluent
- Change in health and survivorship of fish (including benthic invertebrates) due to the quality of the groundwater effluent discharge
- Change in marine bird and mammal habitat quality due to the quality of the groundwater effluent discharge
- Change in health and survivorship of marine birds and mammals due to the quality of the groundwater effluent discharge
- Accidental release of groundwater effluent from an unknown location along the discharge pipe can have adverse effects on marine water quality and associated indirect effects on marine wildlife (fish, benthic invertebrates, marine birds, marine mammals).

Groundwater will be treated prior to discharge to comply with the effluent discharge criteria (GC 2017; CCME 2003; BC MOE 2017a; BC MOE 2017b). These criteria are set to be protective of the marine aquatic life. For parameters with no regulated guidelines for discharge, the discharged concentration objectives conservatively considered for the assessment are 95% of the Upper Confidence Level of the Mean (UCLM) for groundwater. For most parameters these are below baseline concentrations at Melvin Bay, whereas 11 parameters are expected to exceed baseline concentrations.

The assessment used a numeric simulation to model behaviour of the effluent plume in the marine environment. Modelling has shown that a discharge of 420 m^3/day effluent through the diffuser will reach a dilution factor of 10 or more within 1 m horizontal and 2 m vertical distances from the port at a worst-case scenario. This dilution factor is at least 3 times higher than the requirement for chloride and temperature and the horizontal distance of 1 m is lower than the regulatory mixing zone boundary of 100 m. The plume will have negative buoyancy and the maximum plume height expected is 13.7 m above the seabed.

The assessment concluded that the treated groundwater discharge through the diffuser would result in a minor environmental change, but would have a negligible residual effect on fish and fish habitat and marine birds and marine mammals relative to baseline or guideline values provided that mitigation measures are in place. Mitigation measures include treatment of groundwater to meet regulatory discharge criteria particularly the amended MDMER, once they come into effect (GC 2017), discharge through a diffuser that aids in mixing, and implementation of the EEM program.

SECTION 4 • CONCEPTUAL MONITORING DESIGN

The following are the main components and objectives of the ODMP:

- Effluent monitoring at the FDP (end-of-pipe monitoring) to verify compliance of brine properties with the discharge criteria and to characterize effluent quality under MDMER.
- Environmental effect monitoring studies to assess short- and long-term effects from the discharge of treated groundwater effluent on marine biota that will include:
  - Water quality monitoring
  - Biological monitoring including studies on sediment quality, benthic invertebrate communities and fish

A summary of monitoring components, sampling frequency and design is provided in Table 4.

Table 4: Conceptual Ocean Discharge Monitoring Program Sampling Summary

Monitoring Component	Sampling Frequency	Monitoring Location	Sample Replication and Number of Samples
Deleterious Substances (MDMER Schedule 4)	Every week	FDP (end-of-pipe)	One grab sample
Acute lethality	Every month (sampled concurrently with effluent characterization)	FDP (end-of-pipe)	One grab sample
Effluent characterization	Four times a year, one month apart during discharge	FDP (end-of-pipe)	One grab sample
Sublethal toxicity	Twice a year, at the start and finish of the discharge	FDP (end-of-pipe)	One grab sample
In situ Water Column Measurements	Four times a year, once a month during discharge	Exposure and reference areas	7 stations in the Exposure Area, 3 stations in each reference area. One vertical profile per station
Water Quality	Four times a year, once a month during discharge	Exposure and reference areas	7 stations in the Exposure Area, 3 stations in each reference area. One sample @1m below the surface and one sample @5 m above the bottom at each station.
Benthic Invertebrate Communities, and sediment quality	Every 3 years in August if triggered by MDMER	Exposure and reference areas	6 stations in the Exposure area and 5 stations in each reference area. Three subsamples per station
Fish population	Every 3 years in August if triggered by MDMER	Exposure and reference areas	20 sexually mature males and 20 sexually mature females of two fish species in each sampling area
Fish tissue	Every 3 years in August if triggered by MDMER	Exposure and reference areas	8 samples of a single species from each sampling area

Notes:

Amended Metal and Diamond Mining Effluent Regulations (MDMER; GC 2017) will be adhered to. Metal Mining Effluent Regulations (MMER) will be adhered to as a minimum while MDMER come into effect.

FDP = Final Discharge Point

4.1 Effluent Monitoring

4.1.1 Deleterious Substances

Effluent water at the FDP (end-of-pipe) will be measured for pH and analysed for concentrations of deleterious substances listed in MDMER Schedule 4 (GC 2017).

4.1.2 Acute Lethality

End-of-pipe brine effluent will be sampled once per month for acute lethality testing per MDMER requirements. Acute lethality testing will be conducted on threespine stickleback in accordance with the procedures set out in sections 5 or 6 of Reference Method EPS 1/RM/10 (ECCC 2017). Effluent characterization samples (Section 4.1.3) will be collected at the same time to aid in interpretation of acute lethality test results.

4.1.3 Effluent Characterization

Effluent characterization will be conducted one month apart, four times a year. Effluent will be sampled and analysed for the following parameters:

- General parameters, including pH, TDS, total suspended solids, hardness, alkalinity, electrical conductivity, salinity and temperature
- Anions including sulphate and chloride
- Nutrients, including ammonia and nitrate
- Total metals and dissolved metals including those listed in MDMER Schedule 4 and Schedule 5 paragraph s. 4

4.1.4 Sublethal Toxicity Testing

Sublethal toxicity testing of brine effluent will be conducted twice a year, at the beginning and at the end of discharge, for three years and once a year after the third year. The following tests will be conducted:

- Fish early life stage development test on inland silverside (*Menidia beryllina*) or topsmelt (*Atherinops affinis*) (US EPA 2002)
- Invertebrate reproduction test on echinoids (sea urchins or sand dollars) (Environment Canada 1992)
- Algae toxicity test on barrel weed (*Champia parvula*) (US EPA 2002)

These tests will be conducted on aliquots of the same sample collected for effluent characterization (Section 4.1.3 Effluent Characterization).

4.1.5 Environmental Effects Monitoring

Agnico Eagle will adhere to MDMER EEM requirements for fish population surveys, water and sediment quality and benthic invertebrate community assessments conceptually outlined in Table 4. Fish tissue monitoring will be conducted if triggered by MDMER conditions. A study design will be provided to ECCC according to the MDMER requirements (GC 2017) that includes all proposed monitoring locations.

4.2 Quality Assurance/Quality Control (QA/QC)

Quality Assurance (QA) refers to plans or programs that encompass a wide range of internal and external management and technical practices designed to ensure the collection of data of known quality that matches the intended use of the data. Quality Control (QC) is a specific aspect of QA that refers to the internal techniques used to measure and assess data quality.

Quality assurance protocols will be followed so data are of known, acceptable, and defensible quality. To make certain that field data collected are of known, acceptable, and defensible quality, field staff will be trained to be proficient in standardized sampling procedures, data recording using standardized forms, and equipment operations applicable to the monitoring program. All field work will be completed according to specified instructions and established technical procedures for standard sample collection, preservation, handling, storage, and shipping protocols. Accredited laboratories will be selected for sample analysis. Accreditation programs are utilised by the laboratories so that performance evaluation assessments are conducted routinely for laboratory procedures, methods, and internal quality control. A data management system will be utilized so that an organized consistent system of data control, data analysis, and filing will be applied to the Marine Monitoring Program.

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

SECTION 5 • BENCHMARKS AND EFFECT THRESHOLDS

This section sets quality benchmarks and effect thresholds against which conditions of marine environment are monitored and whose exceedance indicate treated effluent discharge-related effects. The following criteria are discussed here:

- A benchmark is a set concentration of a chemical in a medium (water or sediments) that is expected to be protective of aquatic life, e.g., CCME Guidelines for the protection of aquatic life.
- Effect is a statistical difference in effect endpoint values between the exposure and reference areas.
- The effect threshold is a magnitude of environmental change, which, if reached, indicates a higher risk to the environment. A concept of Critical Effect Size (CES) exists for certain effect indicators, e.g., benthic invertebrate communities and fish population, which is used as an effect threshold.

Benchmarks and effect thresholds for each environmental variable are typically below the significance threshold, which is a magnitude of environmental change which, if reached, would indicate a significant effect (WLWB 2010). Exceedance of a benchmarks or effect thresholds will trigger adaptive management actions.

5.1 Water Quality

The benchmarks used for water quality variable are the CCME WQGs for the Protection of Marine Aquatic Life, British Columbia Ministry of Environment (BC MOE 2017a) Approved WQG for Marine Aquatic Life (Short-Term) and BC MOE Working WQG for Marine Aquatic Life (BC MOE 2017b) at the edge of the mixing zone of 100 m from the diffuser. For parameters for which no WQG exist, concentrations from the exposure area will be compared with the baseline concentrations and concentrations in the reference areas.

For each parameter, whether its concentration is elevated in the exposure area in comparison to the baseline or reference data will be determined based on a statistical test (ANOVA) on a 95% confidence interval or whether the mean or median is greater than 2 standard deviations.

Baseline data will be collected from the exposure and reference areas before the start of effluent discharge.

Table 5: Summary of Water Quality Guidelines

Parameter	Unit	CCME(1)		BC MOE(2)	
		Short-term	Long-term	Short-term	Long-term
Ammonia (total)	mg/L as N	-	-	0.71 – 312(3)	0.11 – 47(3)
Arsenic (total)	µg/L	-	12.5	12.5	-
Boron (total)	mg/L	-	1.2	1.5	-
Beryllium (total)	µg/L	-	-	-	100
Cadmium (total)	µg/L	-	-	0.12	-
Chloride	-	-	-	Narrative(4)	-
Chlorine-produced oxidants	µg/L	-	0.5	40	3
Chromium (III)	µg/L	-	-	-	56
Chromium (VI)	µg/L	-	-	-	1.5
Colour (apparent)	Pt-Co	-	-	Narrative(5)	-
Colour (real)	Pt-Co	-	-	Narrative(6)	-
Copper (total)	µg/L	-	-	3	<2
Cyanide	µg/L	-	-	1	
Dissolved Oxygen	mg/L	-	>8 and Narrative(7)	-	-
Fluoride	µg/L	-	-	1.5	-
Lead (total)	µg/L	-	-	140	<2
Manganese (total)	µg/L	-	-	-	100
Mercury (total)	µg/L	-	0.016	-	0.0001 / (MeHg/total Hg)
Nickel	µg/L	-	-	-	8.3
Nitrate	mg/L as N	1500	200	-	3.7
pH	-	-	7.0 - 8.7(8)	7.0 - 8.7	-
Salinity	-	-	Narrative(9)	-	-
Selenium (total)	µg/L	-	-	-	-
Silver (total)	µg/L	7.5	-	3	1
Temperature	degC	-	± 1 change from ambient background	-	± 1 change from ambient background
Turbidity	UNT	-	Narrative(10)	Narrative(11)	-
Total Suspended Solids	mg/L	-	Narrative (12)	Narrative (13)	-
Vanadium (total)	µg/L	-	-	-	50
Zinc	µg/L	-	-	55	10

Notes:

(1) Canadian Council of Ministers of the Environment (CCME 2003) Water Quality Guidelines (WQG) for the Protection of Aquatic Life - Marine.

(2) British Columbia Ministry of Environment (BC MOE 2017a) Approved Water Quality Guidelines for Marine Aquatic Life. BC MOE Working Water Quality Guidelines for Marine Aquatic Life (BC MOE 2017b).

(3) Guideline is salinity, pH and temperature dependent, minimum and maximum values are presented for a salinity of 30.

(4) Human activities should not cause the Cl^- of marine and estuarine waters to fluctuate by more than 10% of the natural Cl^- expected at that time and depth

(5) 30-day average transmission of white light ≥ 80% of background

(6) 30-day average true colour of filtered water samples shall not exceed background levels by more than 5 mg/L Pt in clear water systems or 20% in coloured systems

(7) The CCME guidelines for DO are as follows:
- Depression of DO below the recommended value should only occur as a result of natural processes. When the natural DO level is less than the recommended interim guideline, the natural concentration should become the interim guideline at that site.
- When ambient DO concentrations are >8.0 mg/L, human activities should not cause DO levels to decrease by more than 10% of the natural concentration expected in the receiving environment at that time.

(8) The pH of marine and estuarine waters should fall within the range of 7.0 – 8.7 units unless it can be demonstrated that such a pH is a result of natural processes. Within this range, pH should not vary by more than 0.2 pH units from the natural pH expected at that time. Where pH is naturally outside this range, human activities should not cause pH to change by more than 0.2 pH units from the natural pH expected at that time, and any change should tend towards the recommended range.

(9) Human activities should not cause the salinity (expressed as parts per thousand [‰]) of marine and estuarine waters to fluctuate by more than 10% of the natural level expected at that time and depth.

(10) The CCME WQG for Turbidity are as follows:
- clear flow: Maximum increase of 8 Nephelometric Turbidity Units (NTU) from background levels for a short-term exposure (e.g., 24-h period). Maximum average increase of 2 NTUs from background levels for a longer term exposure (e.g., 30-d period).

- high flow or turbid waters: Maximum increase of 8 NTUs from background levels at any one time when background levels are between 8 and 80 NTUs. Should not increase more than 10% of background levels when background is > 80 NTUs.

(11) The BC MOE WQG for Turbidity are as follows:
- Change from background of 8 NTU at any one time for a duration of 24 h in all waters during clear flows or in clear waters
- Change from background of 2 NTU at any one time for a duration of 30 d in all waters during clear flows or in clear waters
- Change from background of 5 NTU at any time when background is 8 - 50 NTU during high flows or in turbid waters
- Change from background of 10% when background is > 50 NTU at any time during high flows or in turbid waters

(12) The CCME WQG for total suspended solids are as follows:
- clear flow: Maximum increase of 25 mg/L from background levels for any short-term exposure (e.g., 24-h period). Maximum average increase of 5 mg/L from background levels for longer term exposures (e.g., inputs lasting between 24 h and 30 d).
- high flow: Maximum increase of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L. Should not increase more than 10% of background levels when background is ≥ 250 mg/L.

(13) The BC MOE WQG for total suspended solids are as follows:
- Change from background of 25 mg/L at any one time for a duration of 24 h in all waters during clear flows or in clear waters
- Change from background of 5 mg/L at any one time for a duration of 30 d in all waters during clear flows or in clear waters
- Change from background of 10 mg/L at any time when background is 25 - 100 mg/L during high flows or in turbid waters
- Change from background of 10% when background is > 100 mg/L at any time during high flows or in turbid waters

5.2 Sediment Quality

The benchmarks used for sediment quality variables are the CCME sediment quality guidelines (SQGs) for the Protection of Marine Aquatic Life (CCME 2003b) (Table 6). For parameters for which no sediment quality guidelines exist, concentrations from the exposure area will be compared with the baseline concentrations and concentrations in the reference areas.

For each parameter, whether its concentration is elevated in the exposure area in comparison to the baseline and reference data will be determined based on a statistical test (ANOVA) on a 95% confidence interval or whether the mean or median is greater than 2 standard deviations.

Baseline data will be collected from the exposure and reference areas before the start of effluent discharge.

Table 6: Summary Sediment Quality Guidelines

Parameter	Unit	CCME[1]	
		ISQG	PEL
Arsenic	mg/kg	7.24	41.6
Cadmium	mg/kg	0.7	4.2
Chromium	mg/kg	52.3	160
Copper	mg/kg	18.7	108
Lead	mg/kg	30.2	112
Mercury	mg/kg	0.13	0.7
Nickel[2]	mg/kg	30	50
Zinc	mg/kg	124	271

Notes:

(1) Canadian Council of Ministers of the Environment (CCME 2001) Sediment Quality Guidelines (SQG) for the Protection of Aquatic Life - Marine.

(2) British Columbia Ministry of Environment (BC MOE 2017b) Working Sediment Quality Guidelines for Marine Aquatic Life.

SECTION 6 • DECISION FRAMEWORK

A decision framework (Figure 2) will used by the Mine to identify an appropriate path through the EEM program, based on the respective situation. The structure of the decision tree is mainly based on the MDMER regulatory requirements and best scientific knowledge and is aimed to prevent or minimize adverse effects on the receiving environment. If any unforeseen adverse effects are identified during the monitoring and their cause is determined, additional mitigation measures will be applied through adaptive management. Mitigation measures developed and implemented with adaptive management will be dependent on the nature and magnitude of the changes observed.

The requirement to conduct the EEM program biological component studies (benthic communities, fish population and fish tissue) can be lifted if no effect has been found during two previous studies. The Mine will continue effluent and water quality monitoring and reporting the results, as required in the MDMER, independently of the biological monitoring studies and reports.

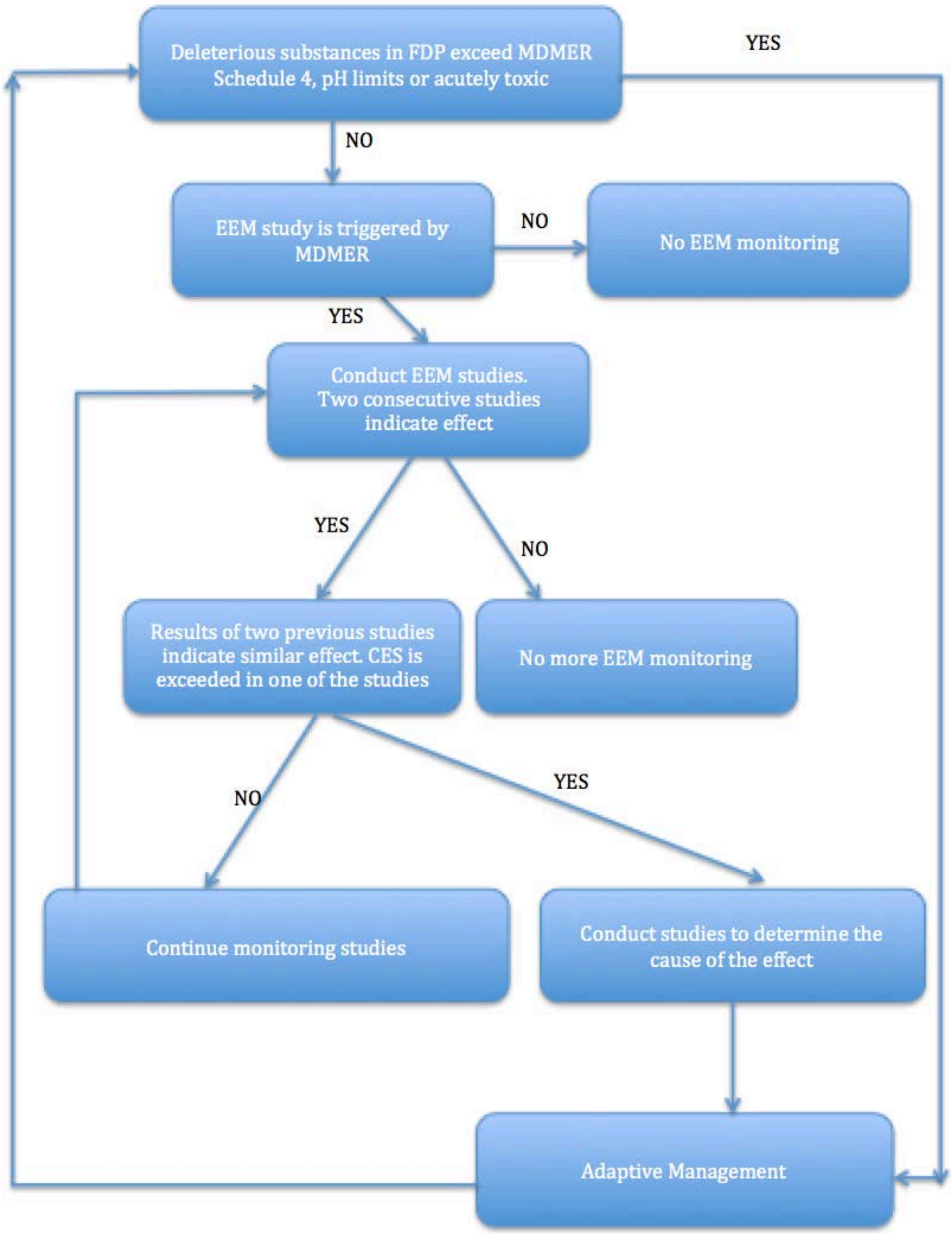


Figure 2: Ocean Discharge Monitoring Plan Decision Tree

SECTION 7 • REPORTING

Reporting will include all the raw data obtained during sampling campaigns, followed by data interpretation, graphical presentation and comparison to applicable guidelines, baseline data and literature data. Results for each component will be synthesized in an integrated manner to evaluate the overall direction of change to the marine ecosystem. The report will have a scientific approach similar to the other documents such as the Aquatic Effects Monitoring Program or EEM reporting and other environmental studies conducted for the Mine.

Comprehensive reports will be prepared and delivered to Environment and Climate Change Canada (as per the MDMER requirements) on the EEM reporting schedule and to NIRB and NWB annually following the discharge of treated groundwater effluent to the marine environment. Reports will be available on the public registry for regulator and stakeholder review and input. Reports filed with ECCC will be reviewed by a Technical Advisory Panel to satisfy the biological components of the MMER EEM program. Data on fish and lower trophic level monitoring will be entered to a federal government website for integration into a national dataset on biological monitoring at metal mines (EC 2012).

SECTION 8 • REFERENCES

Agnico Eagle (Agnico Eagle Mines Limited). 2013. Phase 1 – Meliadine All-weather Access Road Environmental Assessment. Submitted to the Nunavut Impact Review Board in September 2011 by Agnico Eagle Mines Limited (Agnico Eagle).

Agnico Eagle. 2014. Final Environmental Impact Statement (FEIS) - Meliadine Gold Project, Nunavut from: ftp://ftp.nirb.ca/02-REVIEWS/ACTIVE%20REVIEWS/11MN034-Agnico Eagle%20MELIADINE/2-REVIEW/09-FINAL%20EIS/FEIS Accessed on November, 2014.

Agnico Eagle. 2015. Meliadine Gold Project Risk Management and Emergency Response Plan. Version 4. April 2015.

Agnico Eagle. 2017. Meliadine Gold Project Spill Contingency Plan. Version 6. 6513-MPS-05. March 2017.

Agnico Eagle. 2018a. Meliadine Gold Project Hazardous Materials Management Plan.

Agnico Eagle. 2018b. Meliadine Gold Project Water Management Plan. Version 3. 6513-MPS-11. March 2018.

Agnico Eagle. 2018c. Meliadine Gold Project Mine Waste Management Plan. Version 3. 6513-MPS-09. March 2018.

Agnico Eagle. 2018d. Meliadine Gold Project Roads Management Plan. Version 5. 6513-MPS-05. March 2018.

Agnico Eagle. 2018e. Meliadine Gold Project Groundwater Management Plan. Version 1. February 2018.

Agnico Eagle. 2018f. Meliadine Gold Project Shipping Management Plan. Version 7. March 2018.

Agnico Eagle. 2018g. Meliadine Gold Mine – Final Environmental Impact Statement Addendum. Environmental Assessment of Treated Groundwater Effluent Discharge into Marine Environment, Rankin Inlet – Meliadine Gold Project, Nunavut. Submitted to Agnico. Eagle June 2018.

BC MOE (British Columbia Ministry of the Environment). 2017a. Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture.

BC MOE. 2017b. Working Water Quality Guidelines for Marine Aquatic Life.

Canadian Circumpolar Institute. 1992. Nunavut Atlas. R. Riewe (editor). Edmonton, Alberta: Canadian Circumpola Institute and the Tungavik Federation on Nunavut.

CCME. 2001. Canadian Sediment Quality Guidelines for the Protection of Aquatic Life: Introduction. Updated. Canadian Environmental Quality Guidelines, 1999. Winnipeg, MB, Canada.

CCME. 2003. Canadian Environmental Quality Guidelines – Water Quality Guidelines for the Protection of Aquatic Life.

Cohen, S.J., T.A. Agnew, A. Headley, P.Y.T. Louie, J. Reycraft, and W. Skinner. 1994. Climate variability, climatic change, and implications for the future of the Hudson Bay bioregion. An unpublished report prepared for the Hudson Bay Programme. Canadian Arctic Resources Council (CARC), Ottawa, ON. viii + 113 p.

Environment Canada. 1992. Biological test method: fertilization assay with echinoids (sea urchins and sand dollars). Ottawa (ON): Environmental Technology Centre. Report EPS 1/RM/27, December 1992, Amended in November 1997.

ECCC (Environment and Climate Change Canada). 2017. Biological Test Method: Reference Method for Determining Acute Lethality Using Threespine Stickleback. EPS 1/RM/10. Second Edition

Golder (Golder Associates Ltd.). 2016. Updated Predictions of Groundwater Inflow to Tiriginiaq Underground Mine – V5 Mine Plan, Technical Memorandum. November, 2016.

GC (Government of Canada). 2017. Regulations Amending the Metal Mining Effluent Regulations. Canada Gazette Part I, Vol 151, No. 19. May 2017.

GN (Government of Nunavut). 1988. *Environmental Protection Act*. RSNWT (NU) 1988, c E-7.

Nunami Stantec Ltd. 2012. Meliadine Gold Project: Marine Baseline Report, Itivia Harbour, Rankin Inlet, Nunavut. Prepared for Agnico Eagle Mines Limited. Yellowknife, NT. 75 p.

NIRB (Nunavut Impact Review Board). 2008. Nunavut Impact Review Board Guide 8 Project Monitoring document. Nunavut Impact Review Board.

NIRB. 2018. Guidance for Final Environmental Impact Statement Addendum for the “Saline Effluent Discharge to Marine Environment, Rankin Inlet, Meliadine Gold Mine” Project Proposal. April 16, 2018.

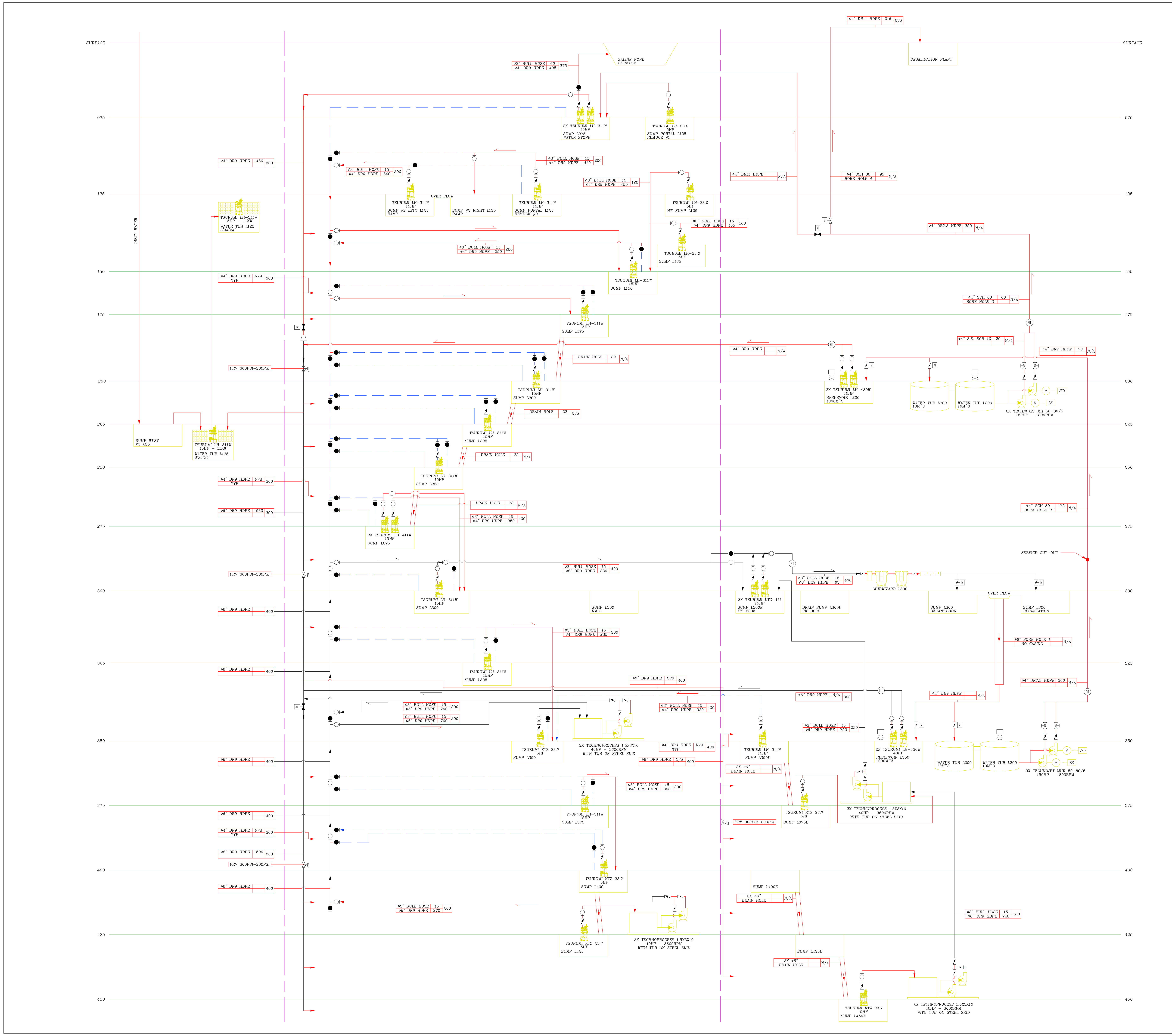
NWB (Nunavut Water Board). 2016. Water Licence No. 2AM-MEL1631 for Agnico-Eagle Mines Ltd.’s Meliadine Gold Project.

SARA (*Species at Risk Act*). 2017. Species at Risk Public Registry website. Available at http://www.sararegistry.gc.ca. Accessed November 2017.

Stewart, D.B., and W.L. Lockhart. 2005. An overview of the Hudson Bay marine ecosystem. Canadian Technical Report of Fisheries and Aquatic Sciences 2586: 487 p.

US EPA (United States Environmental Protection Agency). 2002. Short-term methods for estimating chronic toxicity of effluent and receiving waters to marine and estuarine organisms. Third edition. Cincinnati (OH): Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency. EPA/821/R-02/014, October 2002.

APPENDIX E • UNDERGROUND SUMP FLOW SHEET DIAGRAM



NOTE:

- ESTIMATED LENGTH OF PIPING, TO BE CONFIRMED BY COSTUMER.

PIPE UNDER PRESSURE	
PIPE UNDER PRESSURE 6"	
PIPE WITHOUT PRESSURE	
EQUIPMENT	
LEVEL	
SECTOR	
FIRST PIPE | LENGHT (M) / SECOND PIPE | LENGHT (M)	ø3" BULL HOSE 15 / ø4" DR9 HDPE 410 — 200 FLOW (USGPM)
BALL VALVE NC	
BALL VALVE NO	
GATE VALVE NC	
GATE VALVE NO	
CHECK VALVE	
PRESSURE REDUCING VALVE	
BUTTERFLY VALVE	
MOTORISED BUTTERFLY VALVE	
LEVEL SENSOR	
FLOW METER	FIT
CONCENTRIC REDUCER	

TOTAL HP INSTALLED: 1045 HP

NE PAS UTILISER POUR CONSTRUCTION (NOT FOR CONSTRUCTION)

POUR APPROBATION (FOR APPROVAL)
DATE : 2018-08-02

REV	DATE	DESCRIPTION	INIT.	INIT.
D	2018-11-15	ISSUED FOR COMMENTS	A.L.	A.L.
C	2018-09-26	ISSUED FOR COMMENTS	P.B.	M.B.
B	2018-09-18	ISSUED FOR COMMENTS	P.B.	M.B.
A	2018-08-08	ISSUED FOR COMMENTS	P.B.	A.L.

ÉMISSION/ISSUED FOR

Technosub

CLIENT:
AGNICO EAGLE
MELIADINE

PROJET/PROJECT:
WATER MANAGEMENT AUDIT
P1806201

TITRE/TITLE:
FLOWSHEET DIAGRAM
MID TERME
NOVEMBER 2018

CONÇU PAR/DESIGNED BY: A. Labbe, P. Eng. — INIT.
DESSIN PAR/DRAWN BY: P. Bellerose — INIT.
VERIFIÉ PAR/CHECKED BY: A. Labbe, P. Eng. — INIT.
APPROUVÉ PAR/APPROVED BY: A. Labbe, P. Eng. — INIT.
ÉCHELLE/SCALE: N/A
DATE DE CRÉATION/CREATION DATE: 2018-08-08
DE PROJET/PROJECT #: P1806201
DE DESSIN/DRAWING #: P1806201-0002
REVISION: D