AGNICO EAGLE

MELIADINE GOLD MINE – FINAL ENVIRONMENTAL IMPACT STATEMENT ADDENDUM

Environmental Assessment of Treated Groundwater Effluent Discharge into Marine Environment, Rankin Inlet

JUNE 2018

PLAIN LANGUAGE SUMMARY

Introduction

Agnico Eagle Mines Limited (Agnico Eagle) would like to truck and release treated groundwater from Meliadine Mine into the ocean through a pipe and an engineered structure that disperses water (known as a diffuser) near Rankin Inlet. Agnico Eagle is asking Nunavut Impact Review Board (NIRB) to amend the Meliadine Mine Project Certificate (No. 006) to include the discharge of treated groundwater into Melvin Bay.

Amendment Description

Ownership: Agnico Eagle Mines Limited owns of the Meliadine Project.

Location: Itivia Fuel Storage Facility at Rankin Inlet, and treated groundwater effluent discharged through the discharge pipe and engineered diffuser into Melvin Bay.

Access: The All-weather Access Road (AWAR) is used between Rankin Inlet and the Meliadine site. This is a controlled access, two-lane road, 23.8 km long. The AWAR is open to public use and will be used to truck treated groundwater to Itivia.in the summer.

Source of Groundwater Effluent: groundwater inflows to the underground mine at the Tiriganiaq deposit.

Schedule: construction of the discharge facility at the Itivia Fuel Storage Facility and installation of the discharge pipe and diffuser will start when Agnico Eagle gets all its permits. Discharge of groundwater treated at the Mine to Melvin Bay will occur every year when there is no ice on Melvin Bay (summer months from May to October) while there is mining at the Meliadine Mine until the mine closes in 2032

Discharge process: groundwater will be collected in surface ponds at the Mine site, separate from other water. The groundwater will be treated at the Mine site so that it is safe to discharge into the ocean. Treated groundwater will be trucked from the Mine along the AWAR to a storage tank at the Itivia Fuel Storage Facility at Rankin Inlet, and discharged at a constant rate through the discharge pipe and diffuser into Melvin Bay, 20 m below the water surface. Discharge will only be undertaken when there is no ice on Melvin Bay (May to October, no under ice discharge). Groundwater will be will be stored underground and in ponds during the winter at the Meliadine Mine.

Personnel: a small workforce of about 10 people will be needed to construct the pipe, and two to four drivers will be needed during the summer to haul the water between the mine and Itivia.

Impact Assessment Methods

Valued ecosystem components (VECs) and valued socio-economic components (VSECs) are the most important parts of the environment and to people. Agnico Eagle looked at the impacts of the discharge to air quality, noise, vegetation, marine water and sediment quality, marine wildlife and wildlife habitat, terrestrial wildlife (caribou), archaeology, traditional land use, employment, and infrastructure and social services.

The assessment of potential effects due to the proposed amendment activities looked at the potential effects over time and space. It looked at the potential effects near to the Project and Rankin Inlet, in a larger area around the Project and Rankin Inlet and even larger area within the region including potentially all of Nunavut.

The effects assessment was based on data and experts opinion. Available Inuit Qaujimajatuqangit and community information was also used. The following were used to assess environmental significance of a potential effect due to the proposed amendment activities:

- how big, how far, and how long an effect will last
- activity design or mitigations to limit or avoid potential effects
- historical, cultural, and archaeological significance of the geographic area likely to be affected by the proposed amendment activities

Key Elements and Findings of the Final Environmental Impact Statement Addendum

For the most part discharge to the ocean does not have much impact on the environment. There will be a few more trucks on the road that will create some impacts to air quality, vegetation, and wildlife. More trucks means there may be more dust but Agnico Eagle's handling of dust will keep dust loads similar to what they are now with the Meliadine Mine under construction. Extra trucks could mean more impacts to caribou on the road but similar to now Agnico Eagle will stop work if caribou are on or near the road. The discharge of treated groundwater to the ocean could also affect marine water quality, marine mammals, marine fish and other small organisms in the water. Agnico Eagle plans to treat the water so it is safe and to monitor the water and the animals to confirm that it is safe to discharge.

There is a possibility that the pipe could spill however, because the discharge is treated groundwater that is similar to ocean water, even if the pipe or diffuser had a leak it would still be safe and Agnico Eagle would fix any leaks in the pipe and stop the spill.

People are not expected to be impacted much from the ocean discharge. While there are a few jobs available, there are not very many during construction and most of the employees will come from the region. There are a few trucking jobs that will be available every summer. People will still be able to snowmobile on Melvin Bay as they do now.

ᑕᑯᐅᐅᓪᓚᕆᔨᑐᖅ ᓇᐃᓕᓕᑭᐊᖅᓯᒪᔨᖅᑯᓕ ᑎᑎᕆᖅᓯᒪᔨᖅ

ᐱᒋᐊᕕᑎᓐᓄ

ᐊᓚᓂᒍ ᐃᒍ ᐅᓴᕆᖅᓂᐊᖅᑐᑕᓇᓗᖅᑯᓕ ᐊᓴᖅᑐᑐᒍᐃᔨᒪᔨᓕ ᑯᐃᓵᓱᖅᑕᕈᒪᔨᓕᒃᓗ ᐃᒪᓕᖅ ᖃᒪᑎᓴᐅᓵᓯᒪᔨᖅ ᑕᓵᕆᔨᓕᖅᑎᑦ ᐅᓴᕆᖅᓂᐊᖅᓇᖅᓯᖅᑐᒍᑎᓪᓗᖅᑐᑦ ᑕᓇᐅᕆᓪᓕ ᓵᔨᑐᑐᖅᓯᒪᔨᖅ ᐊᑐᕆᑐᖅ ᐊᑐᕆᑐᖅ ᓴᓇᓴᐅᓵᓯᒪᔨᖅᑐᖅ ᑯᐃᓵᓱᖅᑎᓂᐊᕐᓂᕆᓕᓕᑭᐅᖅ ᐃᒪᕆᖅ (ᑯᐃᓵᓱᖅᑎᓂᐊᕐᓂᕆᓕᓕᑭᐅᖅᑐᖅ) ᑲᖏᖅᑯᓂᓂᐅᓂᔨᐸ ᖃᓄᐅᕆᔪᖏᓂᖅ. ᐊᓚᓂᒍ ᐃᒍ ᐅᓴᕆᖅᓂᐊᖅᓇᖅᑐᑐᓇᓗᖅᑯᓕ ᐊᐱᓚᔨᓕ ᓄᓇᕐᔪᒃ ᐊᕐᖓᑐᑕᓇᓗᖅᑯᓪᓚᓂ ᐅᓴᕆᖅᓂᐊᖅᓇᖅᑐᑐᓇᓗᖅᑯᓕ ᐱᓴᖅᑭᕆᐊᖅᑐᖅᓯᒪᓂ ᑕᓵᕆᔨᓕᖅᑎᑦ ᐱᓕᕆᔨᓕᖅᑐᖅ ᐃᓕᖅᑐᑦ ᑯᐃᓵᓱᖅᑎᓂᐊᕐᓂᕆᓕᓕᑭᐅᖅᑐᖅ (ᐅᓴᐃᐅᑎᓚᖅ 006-ᒥ) ᐃᓚᐅᓴᖅᑕᐅᓴᖅᑯᔨᓪᓚᒍ ᑯᐃᓵᓱᓂᖅ ᐃᒪᓕᖅᑐᖅ ᖃᒪᑎᓴᐅᓵᓯᒪᔨᖅᑐᖅ Melvin Bay-ᒧᑦ.

ᐊᖅᑭᑭᐊᖅᓯᒪᔨᓵᑦ ᖃᓄᐃᓕᑦᑐᓂᖅᓴᖅ

<u>ᓇᖅᑐᓂᓕᖅᓴ:</u> ᐊᓚᓂᒍ ᐃᒍ ᐅᓴᕆᖅᓂᐊᖅᑐᑐᓇᓗᖅᑯᓕ ᓇᖅᑐᓂᖅᑲᖅᑐᑦ ᑕᓵᕆᔨᓕᖅᑎᑦ ᐱᓕᕆᓇᖅᑐᑦ ᐃᒪᓕᖅᑐᑦ ᖃᒪᑎᓴᐅᓵᓯᒪᔨᓕ ᐃᓕᐃᑦ ᑯᐃᓵᓱᖅᑎᓂᐊᕐᓂᕆᓕᓕᑭᐅᖅᑐᖅ ᓴᓇᓴᐅᓵᓯᒪᓂ ᑯᐃᓵᓱᖅᑎᓂᐊᕐᓂᕆᓕᓕᑭᐅᖅᑐᖅ Melvin Bay-ᒥᑦ.

<u>ᖃᓄᐃᓕᑦᑐᓂᖅᓴᖅᓇᓇᕐᓂᖅᓴᖅ:</u> ᐅᑭᐅᓗᓴᐸᑦᑐᑯᓂ ᐊᐠᖅᑯᓂ ᐊᑐᖅᑕᐅᔪᓇᖅᓇᖅᑐᖅ ᐊᑐᖅᑕᐅᐸᖅᑐᖅ ᑲᖏᖅᑯᓂᓂᐅᓂᒥ ᑕᓵᕆᔨᓕᖅᑎᑦ ᐅᓴᕆᖅᓂᐊᖅᓇᖅᑐᖅᓯᒪᓂ. ᑕᒪᓐᓇ ᐊᐅᓪᓚᑕᐅᔪᓗᓂ ᐊᑐᖅᑕᐅᔪᓂᖅ, ᓄᓇᓴᐃᕈᑎᓄᑦ ᓂᓪᓕᓐᖓᓚᒃ ᐃᖅᑭᑦᑕᐅᔪᓂᕆᓕᓕᖅᖢᓂ ᓄᓇᓴᐃᕈᑏᓴᒃ ᒪᔨᕐᒃ ᐸᕈᑎᔪᓐᓇᖅᑲᓂᖅᓴᖅᑎᓪᓗᒃ, 23.8 ᑭᓪᓕᒋᑕᒥᒃ ᑕᑭᓂᒃ. ᐅᑭᐅᓗᓴᐸᑦᑐᑯᓂ ᐊᐠᖅᑯᓂ ᐊᑐᖅᑕᐅᔪᓇᖅᓇᖅᑐᖅ ᒪᑐᐃᓐᓇᔨᖅ ᐃᓄᓐᓄᑦ ᐊᓚᓂᒍ ᐊᑐᖅᑕᐅᔪᓐᓇᖅᑐᖅᓯᒪᓂ ᐃᒪᓕᖅᑐᑦ ᐅᓴᕆᖅᓂᐊᖅᓇᖅᑐᖅ ᐃᑎᓂᓄᑦ ᐊᐠᖅᑯᓂ ᐊᐅᓚᑦ.

<u>ᓇᑭᓐᓇᕆᓂᖅᓴᖅ ᐃᒪᓕᖅ:</u> ᓄᓇᒥ ᐃᒪᓕᖅ ᑲᐅᑎᓪᓗᒍ ᓄᓇᓕᐸ ᐊᒡᓄᑦ ᐅᓴᕆᖅᓂᐊᖅᓇᖅᑐᖅ ᑎᓚᒃᓂᐊᖅᑎᑦ ᓇᓂᔪᓂᐊᖅᑎᑦ.

<u>ᓚᓪᒃᑕᕐᓴᖅᓱᖅ:</u> ᓴᓇᓪᓕᓪᓚᐊᓂᖅ ᑯᐃᓴᕐᓚᖅᑎᑦ ᐃᑎᑎᕆᐊᓂ ᐅᖅᑯᓪᓚᐊᖅᑕᐅᔪᓂᖅᓴᖅᑎᑦ ᐊᓚᓂᒍ ᐃᓪᓕᐅᖅᑲᐃᓂᖅᓴᖅᑎᑦ ᑯᐃᓴᕐᓚᖅᑕᐅᔪᖅᑐᖅ ᓴᓇᓴᐅᓵᓯᒪᓂ ᐃᓚᖅᑭᑐᖅᓯᒪᓂ ᐃᒪᓕᖅᑐᑦ ᐅᓴᕆᖅᓂᐊᖅᓇᖅᑐᖅᓯᒪᓂ ᐃᑎᑎᕆᐊᓂ ᐱᓕᕆᓇᖅᑐᑦ ᐅᓴᕆᖅᓂᐊᖅᓇᖅᑐᖅ Melvin Bay-ᒥ ᑲᒪᒋᔭᐅᓴᖅᑐᖅ ᐊᖅᑭᒐᓚᐅᖅᑐᖅ ᓴᓇᖅᑐᓂᖅᓴᖅᑎᓪᓗᒃ Melvin Bay (ᐊᐅᓚᑦᑐᖅ ᒪᐃᒥ ᐅᑐᐱᓪᓚᒧᑦ) ᐅᓴᕆᖅᓂᐊᖅᑎᓪᓚᓂᑦ ᑕᓵᕆᔨᓕᖅᑎᑦ ᑕᐃᓇᓐᓄᑦ ᒪᑐᐃᓐᓇᕆᓂᖅᓴᖅᑎᓪᓗᒃ 2032-ᒥ.

<u>ᑯᐃᓴᕐᓚᖅᑎᑦ ᖃᓄᐃᓕᑦᑐᓂᖅᓴᖅᑕᐅᔪᓚᖅᑐᖅ:</u> ᓄᓇᒥ ᐃᒪᓕᖅ ᑲᑎᑕᐅᑐᓂᓄ ᑕᓵᓄ ᖃᓄᖅᑲᖅᑐᑦ ᐅᓴᕆᖅᓂᐊᖅᓇᖅᑐᖅ, ᐃᒡᓗᖅᑯᓂ ᐊᓵᖅᓯᓐᓄᑦ ᐃᒪᓕᖅᑎᑎᑎᑎᕐᓂᖅᑐᖅ. ᓄᓇᒥ ᐃᒪᓕᖅᑐᑦ ᑲᑎᑕᐅᑐᓂᓄ ᐅᓴᕆᖅᓂᐊᖅᓇᖅᑐᖅ Melvin Bay-ᒥ ᑲᒪᒋᔭᐅᓚᖅᑐᖅ ᐊᖅᑭᒐᓚᐅᖅᑐᖅ ᓴᓇᖅᑐᓂᖅᓴᖅᑎᓪᓗᒃ ᐃᒪᓕᖅᑐᑦ ᐅᓴᕆᖅᓂᐊᖅᓇᖅᑐᖅᓯᒪᓂ ᐃᑎᑎᕆᐊᓂ ᐱᓕᕆᓇᖅᑐᑦ ᐅᓴᕆᖅᓂᐊᖅᓇᖅᑐᖅ Melvin Bay-ᒥᑦ, 20 ᑎᑦᑕᑦ ᐃᓚᐅᐸᑦ ᐊᒡᓄᑦ. ᑯᐃᓴᕐᓚᖅᑕᐅᔪᓚᖅᑐᖅ ᑭᓇᐅ ᓴᓇᖅᑐᑎᑦᑕᐅᔪᓚᖅᑐᖅ Melvin Bay (ᒪᐃᒥ ᐅᑐᐱᓪᓚᒧᑦ, ᓴᓇᐸ ᐊᒡᓄᑦ ᑯᐃᓴᕐᓚᖅᑕᐅᔪᖅᑎᑦᑕᐅᔪᓚᖅᑐᖅ). ᓄᓇᒥ ᐃᒪᓕᖅ ᓄᓇᕐᔪᐸ ᐊᒡᒐᓗᑕᐅᔪᖅᑎᑦᑕᐅᔪᓚᖅᑐᖅ ᐊᖅᑭᑐᖅ ᑕᓵᕆᔨᓕᖅᑎᑦ ᐅᓴᕆᖅᓂᐊᖅᓇᖅᑐᖅ ᐃᑎᑎᕆᐊᓂ.

<u>ᐱᓇᓱᑦ:</u> ᐱᓇᓱᓂ ᖃᐅᔨᓴᓇᕐᓂᕆᔨᒃ ᐃᓗᒪᑦᑲᒃ ᖃᓄᐃᓕᑦᑐᓂ ᐱᓇᓱᑎᕐᐅᕆᓚᐊᖅᑎᓂᐊᕐᓂᖅᑐᑦ ᓴᓇᓴᐅᓵᓯᒪᓂ, ᐊᓚᓂᒍ ᒪᑐᐃᓐᓇᔨᖅ ᐊᑐᖅᑕᐅᔪᓐᓇᖅᑐᖅᓯᒪᓂ ᐃᑎᑎᕆᐊᓂ ᐅᓴᕆᖅᓂᐊᖅᓇᖅᑐᖅ ᐃᓚᖅᑭᑐᖅᓯᒪᓂ ᐃᒪᓕᖅᑐᑦ ᐅᓴᕆᖅᓂᐊᖅᓇᖅᑐᖅ ᐃᑎᑎᕆᐊᓂ ᐊᐠᖅᑯᓂ ᐊᐅᓚᑦ ᐊᑐᖅᑕᐅᔪᓐᓇᖅᑐᖅᓯᒪᓂ ᐃᒪᓕᖅᑐᑦ ᐅᓴᕆᖅᓂᐊᖅᓇᖅᑐᖅ ᐃᑎᑎᕆᐊᓂ.

ᐊᐢᑐᖅᓯᓂᐅᓇᖅᑐᓂᓗ ᖃᐅᔨᓴᐃᓂᖏᑦ ᖃᓄᐃᑦᑕᐅᑉᐳᖅᑎᖅᑦ

ᐱᓕᓇᐅᑎᑕᐅᔪᑦ ᓄᓇᒥᓂᓂᒃᑯᑦ ᐊᓕᒪᓂ ᐱᓕᓇᐅᑎᑕᐅᔪᑦ ᐃᓅᓴᖅᑎᑎᑦᑐᖅᓂᒃᑯᑦ ᐱᖓᒡᒥᐊᑎᕐᑎᓂᒃᑯᑦᓗ ᐱᓕᓇᐅᑎᑕᐅᓂᖅᓯᖓᔪᑦ ᐊᖓᑎᒥᓂᒃᑯᑦ ᐃᓅᖏᓄᓗ. ᐊᖏᓂᒍ ᐃᒍ ᐅᓴᖃᖏᓂᐊᖅᑐᑕᐅᓂᓚᖅᑯᑦ ᑕᑯᐸᐊᒥᐅᖅᑐᑦ ᐊᐅᑐᖃᖅᑐᓂᒃ ᑯᓇᓂᓗᑎᑦ ᐊᐅᑐᖃᖅᑐᓂᖏᑦᑐᖅᓂᒃ ᓱᒥᑕᐃᖏᓐᓂᑦ, ᖃᓄᖅ ᓂᐱᖃᖅᑎᑎᐅᓴᖅᓯᓚᖅᑕᓂ, ᖃᓄᖅ ᐊᐅᑐᖃᖅᑐᓂᖏᑦᑐᖅᓂᒃ ᐱᑕᖅᑐᓄᑦ, ᐃᓕᖃᑦ ᐊᓚᒪᓗ ᐃᓗᑦᓂᓗᑎᒃᓴᖅᑐᑦ, ᐅᐃᓴᓄᑦᓗ ᐊᓚᒪᓗ ᐅᓕᓴᐅᑎᓂᐅᑦ ᐃᓂᒋᔭᐅᓂᖅᑐᑦ, ᓄᓇᒥᓗ ᐅᒥᐊᖅᑐᑦ (ᐅᖅᑐᓄᑦ), ᐃᑦᓴᓂᓂᐅᓄᑦ, ᐃᓂᖅᑯᓯᓱᐊᖅᑎᒍᑦ ᓄᓇᒥ ᐊᑐᖅᑕᑦᓂᖅᓯᒪᑦ, ᓴᓇᖅᓴᖅᓯᖅᑕᖅᑐᓂᖅᓯᒪᑦ, ᐊᓚᒪᓗ ᐱᖁᑎᑦᓴᐃᓄᓄᑦ ᓄᓇᒥᐊᖅᑐᑦ ᐱᓕᓇᐅᑎᑕᐅᓂᖅᓯᖓᔪᑦ ᐱᖁᑎᑦᓴᐃᓄᓄᑦᓗ ᐱᓕᓇᐅᑎᑕᐅᓂᖅᓯᖓᔪᑦ.

ᖃᐅᔨᓴᐃᓂᖏᑦᑐᖅᓂᒃᑯᑦ ᖃᓄᖅ ᐊᐅᑐᖃᖅᑐᓂᖏᑦᑐᖅᓂᒃᑯᑦ ᑕᑯᐸᐊᓂᖏᑦᑐᖅᓂᒃᑯᑦ ᖃᓄᖅ ᐊᐅᑐᖃᖅᑐᓂᖏᑦᑐᖅᓂᒃᑯᑦ ᖃᓄᐃᑦᑕᐅᑉᐳᖅᑎᖅᑦ ᐃᓅᓴᖅᑎᑎᑦᑐᖅᓂᒃᑯᑦ. ᑕᑯᐸᐊᓂᖏᑦᑐᖅᓂᒃᑯᑦ ᖃᓄᖅ ᐊᐅᑐᖃᖅᑐᓂᖏᑦᑐᖅᓂᒃᑯᑦ ᑕᐅᖅᓯᒪᓂᖅ ᐊᓕᒪᓂᖅᓯᒪᓂᖅ, ᐊᖏᓂᓂᖏᑦᑐᖅᓂᒃᑯᑦᓗ ᐃᓅᓴᖅᑎᑎᑦᑐᖅᓂᒃᑯᑦ ᐊᓕᒪᓂ ᐊᖏᓂᓂᖏᑦᑐᖅᓂᒃᑯᑦ ᐊᓕᒪᓂ ᐊᖏᓂᓂᖏᑦᑐᖅᓂᒃᑯᑦ ᐱᓕᓇᐅᑎᑕᐅᓂᖅᓯᖓᔪᑦ ᑭᖑᓂᓗ ᐱᓕᓇᐅᑎᑕᐅᓂᖅᓯᖓᔪᑦ ᐃᓄᐃᑦᑕᐅᑉᐳᖅᑎᖅᑦ ᐊᓕᒪᓂ ᐊᓕᒪᓂ ᐊᖏᓂᓂᖏᑦᑐᖅᓂᒃᑯᑦᓴᓂᖅᓯᒪᓂᖅᑐᑦ ᑭᖑᓂᓗ ᐃᓄᐃᑦᑕᐅᑉᐳᖅᑎᖅᑦ ᐃᓕᖃᑦᑐᖅᓂᒃᑯᑦ ᐃᓗᓕᖅᑐᑦ ᓄᓇᒥᐊᖅᑐᑦ.

ᐊᐅᑐᖃᖅᑐᓂᖏᑦ ᖃᓄᐃᑦᑕᐅᑎᓂ ᐊᐅᑐᐊᑎᑦᑕᐅᓂᖅᓯᖓᔪᑦ ᑎᑎᕆᖃᖅᓯᒪᔪᓄᑦ ᐊᓕᒪᓗ ᖃᓄᐃᑦᑕᐅᓚᐅᖅᑐᓂᖅᓯᖓᔪᑦ ᐃᓱᓚᑎᓱᓚᖅᑭᓐᓄᑦ. ᐊᑐᐃᓐᓇᐅᔪᓐᓗ ᐃᓄᐃᑦ ᖃᓄᐃᑦᑕᐅᓚᐅᖅᑐᓂᖅᓯᖓᔪᑦ ᑎᑎᕆᖃᖅᓯᒪᓂᖅᓯᖓᔪᑦ ᐊᓕᒪᓗ ᓄᓇᒥᐅᓚᐅᖅᑐᓂᖅᓯᖓᔪᑦ ᐃᓱᓚᑎᓱᓚᖅᑭᓐᓄᑦ. ᐅᑯᐊ ᐊᐅᑐᖃᖅᑐᓂᖏᑦᑐᖅᓂᒃᑯᑦ ᖃᓄᐃᑦᑕᐅᓚᐅᖅᑐᓂᖅᓯᖓᔪᑦ ᐃᓱᓚᑎᓱᓚᖅᑭᓐᓄᑦ ᐊᐅᑐᖃᖅᑐᓂᖏᑦᑐᖅᓂᒃᑯᑦ ᐃᓕᓴᐅᓂᖅᓯᒪᓂᖅᑐᑦ ᐊᐅᑐᖃᖅᑐᓂᖏᑦᑐᖅᓂᒃᑯ

ᐃᓄᐃᑦ ᐊᒃᑐᖅᑕᐅᓂᖅᓗᓪᓕᐊᒥᓱᓕᕆᓂᖅᑕᐅᔪᑦ ᑕᓚᐅᒃᑯᑦ ᑯᐃᓱᓂᒃᑯᑦ. ᓴᓇᓴᒃᓴᑦ ᖃᐅᔨᓪᓗᓇᑦ ᑕᐃᒪᐅᓂᐊᕐᓗᓄᖅᑎᑦᓗᓄᑦ, ᐱᑕᖅᑐᓗᓪᓕᒥᓱᓕᕆᓂᑐᖅ ᓇᑦᑕᖅᑎᓚᑎᑦᓗᓄᑦ ᐊᒻᒪᓗ ᐊᒥᔨᓂᖅᓴᑦ ᓴᓇᔨᓴ ᑭᖑᓪᓕᒪᓐᓇᐅᔭᓂᐊᕐᓗᖅᑐᑦ. ᖃᐅᔨᓪᓗᓇᐅᕐᑦ ᐊᕐᑯᑎᐅᓇᓱᖅᑐᓄᑦ ᓴᓇᓴᒃᓴᑦ ᐊᑐᐃᓪᓇᐅᐅᓂᐊᖅᑐᑦ ᐊᐅᓴᒃᑯᑦ. ᐃᓄᐃᑦ ᔨᑭᑐᒃᑯᑦ ᐃᓐᓇᕐᓂᕐᓇᓪᓇᐅᖅᑕᕐᓂᐊᖅᑐᑦ ᔨᓪ Melvin Bay-ᑯᑦ ᑕᐃᒪᐸᓐᒪᒃᑕ ᒧᓇᐅᕐᓂᖅᑎᑐᑦ.

EXECUTIVE SUMMARY

Introduction

Following Nunavut Impact Review Board (NIRB) guidance dated April 16, 2018, Agnico Eagle Mines Limited (Agnico Eagle) has prepared this Final Environmental Impact Statement Addendum (FEIS Addendum) to the Meliadine Mine Project Certificate (No. 006) to include the discharge of treated groundwater into Melvin Bay as per condition 25, which states "the proponent shall provide to NIRB a saline water management plan which includes, but is not limited to, 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". This FEIS Addendum is for a proposed discharge of treated groundwater effluent from the underground mine of the Tiriganiaq deposit at the Meliadine Gold Mine site (Meliadine Mine) into the marine environment near Rankin Inlet in the Kivalliq region of Nunavut (the proposed amendment activities). This FEIS Addendum has been developed to conform to the *Guidelines for the Preparation of an Environmental Impact Statement* (the Guidelines, NIRB 2012), and per the guidance issued by the Nunavut Impact Review Board (NIRB) - *Information Requirements for the Completion of the FEIS Addendum for Agnico Eagle's Saline Effluent Discharge Proposal* (April 2018). Agnico Eagle is a long established, Canadian headquartered, gold producer with operations located in Canada, Finland, and Mexico, with exploration and development activities in Canada, Finland, Mexico, and the United States of America. Agnico Eagle currently has one operating gold mine and one gold mine under construction in Nunavut. The Meadowbank Mine is currently in operations and the Meliadine Mine is under construction.

Regional Context

The Meliadine Mine is a proposed gold mine located north of the Hamlet of Rankin Inlet, in the Kivalliq region of Nunavut. The Meliadine property consists of 52,173 ha: 887 ha as claims, and 51,286 ha as leases. As well, Agnico Eagle has 3,430 ha of sub-surface Nunavut Tunngavik Inc. (NTI) concessions. The Meliadine Mine is largely on Inuit Owned Lands (IOL RI-01, RI-02) with some infrastructure located within the municipal boundaries of Rankin Inlet. Ocean discharge activities are proposed to be undertaken at the Itivia Fuel and Storage Facility at Itivia Harbour, into Melvin Bay, on the southern end of Rankin Inlet.

In the Meliadine Mine area, winters are long and cold, while summers are short and cool. The physical features of the region have largely been determined by glaciation, underlain by continuous permafrost. Heath tundra and sedge vegetation represent the dominant plant community types. Traditional plants are collected for food and medicine. Caribou are an important part of Inuit life, providing food, fuel (from caribou fat) and materials for clothing, tools and traditional crafts. Wolves are infrequently observed and polar bears are uncommon to the area. The region is also a major breeding and nesting ground for a variety of migratory birds.

The marine part of the Kivalliq region lies within the Northern Arctic Archipelago marine ecozone. The marine ecozone is used by migratory birds and is a major breeding ground for Arctic loons, tundra swans, and snow geese. The proposed ocean discharge activities for the Project will make use of Melvin Bay near Rankin Inlet, as will Project-related shipping. Water depths in Melvin Bay are relatively shallow.

Local waters in Melvin Bay (near Itivia Harbour) are commonly used by local community members for small boat operations. Arctic char represent an important food species for the local community and are mainly harvested during August in the Rankin Inlet region.

Marine mammal species harvested in the area for the proposed amendment activities include beluga whales, walruses, polar bears, ringed seals, bearded seals, harp seals, and harbor seals. Several marine bird species are known to forage and/or nest in the area and egg harvesting occurs in spring for goose, eider, tern, guillemot, and gull. Locally harvested shellfish species include blue mussels.

The Kivalliq region is sparsely populated. It is part of the Inuit homeland and Inuit form over 80% of the population. Over the last 10 years, the fastest growing community in the socio-economic local study area (LSA) has been Whale Cove, and the slowest Chesterfield Inlet. More recently, Rankin Inlet and Baker Lake have been experiencing population growth. Rankin Inlet has a lower percentage of Inuit residents, and higher incomes. More people have English as their mother tongue in Baker Lake and Rankin Inlet than in other communities in the Kivalliq region.

Project Components and Activities

Ownership: Agnico Eagle Mines Limited is the sole owner of the Meliadine Project.

Location: Itivia Fuel Storage Facility at Rankin Inlet, and treated groundwater effluent discharged through the discharge pipe and engineered diffuser into Melvin Bay

Access: The AWAR provides access between Rankin Inlet and the Meliadine site. This is a controlled access, two-lane road, 23.8 km long. The AWAR is open to public use and will be used to truck treated groundwater to Itivia.

Source of Groundwater Effluent: groundwater inflows to the underground mine at the Tiriganiaq deposit.

Schedule: for the proposed amendment activities (i.e., ocean discharge), construction of the discharge facility at the Itivia Fuel Storage Facility and installation of the discharge pipe and diffuser will commence upon receipt of all required regulatory approvals and permits. Discharge of groundwater treated at the Mine to Melvin Bay will occur annually during the open water season (summer months from May to October) during operations through to the end of mine life in 2032.

Discharge process: groundwater inflows will be collected in surface ponds at the Mine site, separate from contact water. The groundwater will undergo treatment at the Mine site to meet applicable regulatory limits and guidelines for ocean discharge. Treated groundwater effluent will be trucked from the Mine along the AWAR to a storage tank at the Itivia Fuel Storage Facility at Rankin Inlet, and discharged at a constant rate through the discharge pipe and engineered diffuser into Melvin Bay, at a depth of 20 m below the water surface. Discharge will only be undertaken during the open water season (May to October, no under ice discharge). Groundwater will be will be stored underground and in surface containment ponds during the winter.

Personnel: a small workforce of approximately 10 people will be required for construction of the discharge facility, and two to four drivers during the open water season for transportation of the treated groundwater effluent.

Need and Purpose of the Amendment

The purpose of the proposed amendment activities is to discharge treated groundwater to Melvin Bay from the underground mine at the Meliadine Mine to support management of excess groundwater inflows. The underground mine at the Tiriganiaq deposit of the Meliadine Mine is planned to extend below the ground surface and 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 works have advanced below the base of the permafrost.

Based on the anticipated flows of groundwater reporting to the underground workings, a short-term and long-term groundwater strategy is required. The preferred alternative is to treat the groundwater reporting from the underground workings and discharge to Meliadine Lake in accordance with the Type A Water Licence 2AM-MEL1631. However, based on the potential volumes of groundwater, it is anticipated that a second discharge location will be required. As per the Meliadine Mine Project Certificate (No. 006), condition 25, states "the proponent shall provide to NIRB a saline water management plan which includes, but is not limited to, 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". Agnico Eagle is proposing to treat groundwater and discharge it as treated groundwater 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. Discharge to the ocean of excess water was considered as a potential alternative in the FEIS (Agnico Eagle 2014), but not assessed.

Impact Assessment Methods

Valued Components (VCs), comprised of Valued Ecosystem Components (VECs) and Valued Socio-Economic Components (VSECs) represent physical, biological, cultural, social, and economic properties of the environment that are either legally, politically, publicly, or professionally recognized as important to a particular region, community, or by society as a whole. All VC's considered in the FEIS for the Meliadine Mine were given consideration in the FEIS Addendum; a matrix table was used to identify interactions with the proposed amendment activities to determine those assessed for the FEIS Addendum. The VCs for the FEIS Addendum include air quality, noise, vegetation, marine water and sediment quality, marine wildlife and wildlife habitat, terrestrial wildlife (caribou), archaeology, traditional land use, employment, and infrastructure and social services. A pathway analysis was then used to identify and assess the linkages between Project components or activities and the corresponding potential effects to VECs or VSECs

The assessment of potential effects due to the proposed amendment activities considered the following general spatial boundaries:

- Local Study Areas (LSA): The spatial boundaries of the LSAs were designed to measure baseline environmental and socio-economic conditions and predict direct effects from the Project footprint and activities on the VECs or VSECs. LSAs were also defined to assess small-scale indirect effects from proposed amendment activities on VECs and VSECs.

- Regional Study Area (RSA): The boundaries for RSAs were designed to quantify baseline conditions at a scale that was large enough to assess the maximum predicted geographic extent (i.e., maximum zone of influence) of direct and indirect effects from the proposed amendment activities on VECs or VSECs. Cumulative effects are typically assessed at a regional spatial scale and, where relevant, may consider influences that extend beyond the RSA and that are transboundary.

The effects analysis was based on residual (incremental) effects for the proposed ocean discharge activities. Where possible and appropriate, the effects analysis was quantitative, although due to the amount and type of data available, some analyses were qualitative. Results from the effects analyses were used to describe the direction, magnitude (intensity), duration, and geographic (spatial) extent of the predicted residual effects to VECs or VSECs.

Cumulative effects were also considered. Potential interactions were identified, analyzed, and assessed for those VECs and VSECs with residual impacts from the proposed amendment activities.

Key sources of uncertainty in the impact classification were identified and how uncertainty was addressed to increase the level of confidence that effects will not be worse than predicted were discussed. Finally, proposed monitoring and follow-up plans were developed to test (verify) impact predictions and determine the effectiveness of environmental design features (mitigation).

Summary of Effects Assessment

A pathway analysis was complete to confirm if the amendment had any residual effects after environmental design features and the implementation of mitigation measures were factored into the assessment.

No linkage pathways or those where mitigation and environmental design features break the connection between a VEC or VSEC and the proposed amendment activities, resulting in no effect to the VEC or VSEC. A number of potential pathways were assessed as having no linkage due to truck traffic on the AWAR, construction of the diffuser pipe and diffuser, ocean discharge of treated effluent, and from a potential spill from the discharge pipe.

There were no links between alteration of marine bird and mammal habitat from installation of the discharge pipe, reduction in sea ice thickness and or timing of seasonal freeze-up that could impact marine bird and mammal habitat quality. Spills or accidental release of treated groundwater effluent from trucks along the trucking route was also found to have no effect on vegetation and wildlife.

Through environmental design features and the implementation of mitigation, other potential pathways were assessed as having a minor (i.e., negligible) effect on a number of VECs and VSECs. The atmospheric assessment determined that changes in air quality as a result of increased truck traffic on the AWAR during construction would be negligible, as monitoring along the AWAR suggests dust mitigations are providing adequate dust control to minimize impacts on vegetation. Acoustically, the proposed amendment activities are expected to generate a negligible level of noise on nearshore activities due to the short construction period for the storage tank (which will be within the Itivia Fuel Storage Facility), discharge pipe and diffuser.

Changes or disturbance to the marine environment due to the proposed amendment activities will be mitigated in a number of ways, including water treatment that will adhere to appropriate guidelines and regulations, placement of the pipe to avoid sensitive natural areas, short in-water construction period, adherence to Type A Water Licence mitigation measures for on-land works and adhering to Management and Monitoring Plans. Adaptive management, including speed limit reductions, road surveillance monitoring, increased awareness for traffic management during post-calving caribou movements in late June through mid-July, and implementation of the Terrestrial Ecosystem Mitigation and Monitoring Plan are expected to minimize the potential for wildlife mortality associated with operation of the proposed amendment activities to a negligible level.

Minor pathways identified for the human environment predominately pertain to Traditional Land Use activities. Engagement with traditional land users regarding the location of the discharge pipe and its diffuser to avoid impacts to snowmobile use for traditional pursuits, as well as engagement regarding the safety of water and fish, will be implemented per the Community Engagement Plan.

Only one primary pathway was determined linking the proposed amendment activities to effects on the marine environment:

- Accidental release of groundwater effluent from an unknown location along the discharge pipe can have direct adverse effects on marine water quality and associated indirect effects on marine wildlife

Key mitigations aimed at offsetting the primary pathway include implementation of secondary containment for the storage tank within the Itivia Fuel Storage Facility, regular visual inspections of equipment, operational activities will be engineered to use handling systems to minimize the risk of accidental spills into the marine environment, controlling discharge in the event there is a malfunction of the pipe or diffuser, and adherence to existing environmental and operational management plans in place for the Meliadine Mine (e.g., Spill Contingency Plan, Risk Management and Emergency Response Plan).

Monitoring

Once the necessary permits and licences are issued and construction of the ocean discharge facility begins, inspections and monitoring programs for the Project will be implemented, as applicable.

Compliance inspection will check that components for ocean discharge are built to approved design standards that include the required environmental controls. Compliance inspection and monitoring will be repeated throughout the life of the Project.

Follow-up monitoring activities will occur in Melvin Bay to verify predictions used to assess the effects were accurate and to employ adaptive management, if required.

Environmental monitoring programs will include a Conceptual Ocean Discharge Monitoring Program to monitor effects to Melvin Bay, and will be further refined with additional baseline data prior to discharge commencement. Additional environmental monitoring will include plant and wildlife monitoring and management, as well as air quality monitoring, per the established management and monitoring plans under Project Certificate (No. 006)

Conclusions

In accordance with the Guidelines and NIRB issued guidance, the FEIS Addendum provides an evaluation of the potential biophysical and socio-economic effects of the proposed amendment activities for ocean discharge for the Project. It includes baseline characterization and provides descriptions of design features and mitigations that will be implemented to remove or minimize potential adverse effects to VCs in the area for the proposed amendment activities, particularly at Rankin Inlet, Itivia Harbour and Melvin Bay. Existing management and monitoring plans are also referenced to assess the validity of the impact predictions made. A Conceptual Ocean Discharge Monitoring Plan has been developed to monitor effects to Melvin Bay.

ᐊᖏᓚᖅᑲᓇᑎᓄᑦ ᓇᐃᔨᓕᑎᐊᖅᓯᒪᔨᖅᑎᑦ ᑐᑭᓯᑎᑎᐊᑕᑎ

ᐱᒋᐊᕈᑎᖓ

ᐃᓕᐅᖅᑲᑕᐅᔨᖅ ᓄᓇᕗᒥ ᐊᐋᑎᓕᓚᕆᖅᑎᑦ ᑲᑎᒪᔨᖅᑕᒡ ᒪᓕᒃᑕᓴᓕᐊᖏᓐ ᐅᑦᓗᖅ ᐊᐃᓚᓕ 16, 2018, ᐊᓂᔪᒍ ᐃᒍ ᐅᓴᖅᓂᐅᐊᖅᑐᓚᕆᖅᑎᑦ ᕿᖅᓇᐃᓯᒪᔨᑦ ᑭᙵᓕᕐᓂᖅᓱᖅᑎᑦ ᐊᐋᑎᑎᕐᓴᖅ ᐊᒃᑐᖅᑕᐅᓂᑲᖅᓂᐅᐊᖅᑎᓕᑐᒍ ᐅᖅᑲᐅᓯᓴᒃᑲᒃ ᐃᓕᑎᐊᕈᑎᑎᒃ ᑕᓯᖅᐸᐊᖅᑎᑦ ᐱᓕᓚᐊᖅᑲᖅᑎᑦ ᐱᓕᓚᑎᐊᕈᑲᓇᖅᓯᓂᒧᑦ ᐱᔨᓇᓇᐅᑎᖅᑎᑦ (ᓇᓴᐅᑎᓕᒃ 006-ᒥᒃ) ᐃᓕᐅᖅᑲᑕᐅᓕᑐᒍ ᑯᕐᔪᓯᑲᕐᕕᖏᓂᖅ ᐃᓚᒋᒃ ᑲᒪᒋᓚᕐᓗᒃ Melvin Bay-ᒧᑦ ᒪᓕᒃᓱᒍ ᐱᓕᓚᐊᖅᑲᓴᓚᐊᓕᒃ 25, ᐃᓚᓇ ᐅᖅᑲᖅᓯᒪᔨᖅ “ᐅᓴᖅᓂᐅᐊᖅᑐᓚᕆᖅᑎᑦ ᑐᓂᓯᓂᐅᐊᖅᑐᑦ ᓄᓇᕗᒥ ᐊᐋᑎᓕᓚᕆᖅᑎᑦ ᑲᑎᒪᔨᖅᑕᓇᓂ ᑕᓚᐅᖅᑎ ᐃᓚᖅᑎ ᐊᐅᓪᓚᕐᔪᐊᑎᒧᑦ ᕿᖅᓇᐃᑎᒃ ᐅᑯᓂᖅᑲᖅᑐᒃ, ᑭᓯᐊᓂ ᑦᕿᑯᐊᑐᐊᖅᑕᖅᑐᒃ, ᐋᖅᑭᒃᑲᐊᖅᓯᒪᔨᓂᓂᒃ ᐋᖅᑭᒃᑭᓯᖅᓯᒪᔨᔪᓂᒃ ᓂᓚᐅᑦᓴᐅᑦᓯᐊᓂᖅᓱᑦ ᐅᖓᑖᓕᒫᑦ ᑯᓚᓕᑕᐅᑎᒃ ᐃᓚᖅᑎ ᓄᓇᕗᒥ ᐊᑦᓯᓂ ᐅᓴᖅᓂᐅᐊᖅᓇᖅᑐᑦ, ᑲᒪᒋᐊᕈᑎᓂᒃ ᐊᑐᖅᑭᒃᑲᓂᖅᑐᑦ ᖃᐅᔨᓴᓂᖅᑐᑦ ᐱᓕᓚᐊᖅᑲᖅᑎᑦ ᐅᑭᐅᖅᑕᕐᓂᖅᓯᒪᔨᖅ ᐃᓚᖅᑎ ᐅᓴᖅᓂᐅᐊᖅᑐᑦ ᐊᐋᑎᓕᓚᕆᖅᑎᑦ ᓄᓇᕗᒥ ᐊᐋᑎᓕᓚᕆᖅᑎᑦ ᑲᑎᒪᔨᖅᑕᓇᓂ ᑕᓚᐅᖅᑎ ᐃᓚᖅᑎ ᓄᓇᕗᒥ. ᐅᖃᓕᓕᖅᑐᐊᖅᑎᑦ ᐊᐋᑎᓕᓚᕆᖅᑎᑦ ᐊᒃᑐᖅᑕᐅᓂᑲᖅᓂᐅᐊᖅᑎᓕᑐᒍ ᐅᖅᑲᐅᓯᓴᒃᑲᖅ ᐃᓕᑎᐊᕈᑎᑎᒃ ᓴᖅᐸᑎᑕᐅᓯᒪᔨᖅ ᒪᓕᒡᓗᓇᖅᑐᓕᒃ *ᒪᓕᒃᑕᓴᓕᓇᓴᐅᔨᓂᒃ ᕿᖅᓇᐃᓂᒡᓗ ᐊᐋᑎᓕᓚᕆᖅᑎᑦ ᐊᒃᑐᖅᓯᓂᐅᓇᓴᖅᑐᓂᒃ ᐅᖅᑲᐅᓯᓴᒃᓗᑦ* (ᒪᓕᒃᑕᓴᓕᖅ, ᓄᓇᕗᒥ ᐊᐋᑎᓕᓚᕆᖅᑎᑦ ᑲᑎᒪᔨᖅᑕᓇᓂ 2012), ᐊᓂᒪᓗ ᒪᓕᒃᓱᓕᑦ ᖃᑲᐃᑕᐅᓯᒪᔨᑦ ᓄᓇᕗᒥ ᐊᐋᑎᓕᓚᕆᖅᑎᑦ ᑲᑎᒪᔨᖅᑕᓇᓂ - *ᑐᓂᓯᓕᐊᑐᖅᓴᓕᑦ ᐱᔨᐅᔨᓕᐊᓕᓂ ᐱᐋᓂᓴᓯᓂᐊᓕᓂᑐᓂ ᐅᓴᖅᓂᐅᐊᖅᑐᑦ ᐊᐋᑎᑎᕐᓴᖅ ᐊᒃᑐᖅᑕᐅᓂᑲᖅᓂᐅᐊᖅᑎᓕᑐᒍ ᐅᖅᑲᐅᓯᓴᒃᑲᒃ ᐃᓕᑎᐊᕈᑎᑎᒃ ᐊᐋᑎᓕᓚᕆᖅᑎᑦ ᐃᓚᒋᒃ ᐃᓕᓴᕐᓂᖅᑕᓇᓂ*) (ᐊᐃᓚᓕ 2018). ᐊᓂᒪᓗ ᐃᒍᖅᑎᑦ ᐊᑎᓂ ᑲᓇᑭᓕᓴᒃᑐᖅ, ᑲᓇᑕᒥ ᐊᖅᓯᓚᖅᑲᖅᓯᓚᐅᖅ, ᔪᔨᒥᒃ ᑲᒪᒋᓚᐅᖅ ᑲᓇᑕᒥ, ᓇᖕᓂᖓᒥ, ᐊᓂᒪᓗ ᒥᐱᓂᒥ, ᐅᖅᑲᖅᓱᐅᓂᖅᓴᓕᐊᓯᓂᐊᓕᐅᖅ ᐱᖓᓕᓕᐊᑎᓂᕐᓂᐊᖅᑐᓂᐅᖅ ᑲᓇᑕᒥ, ᓇᖕᓂᖓᒥ, ᒥᐱᓂᒥ, ᐊᓂᒪᓗ ᐊᒥᐊᓕᑲᖅᑎᑦ ᓄᓇᖏᓐᓂ. ᐊᓂᒪᓗ ᐃᒍᖅᑎᑦ ᐃᓐᓇᐅᔨᖅ ᐊᑕᐅᔨᓂᒥᑦ ᔪᔨᒥᒃ ᐱᔨᓇᓇᐅᑎᖅᑎᑦ ᐊᑕᐅᔨᓂᒥᑦ ᔪᔨᒥᒃ ᐅᖅᑲᖅᓯᓚᖅᑲᖅᑐᒃ ᓇᐸᓕᓂᖅᑎᑦ ᓄᓇᕗᒥ. ᐊᐳᖅᑎᓇᖅᑐᖅ ᐃᓐᓇᐅᔨᖅ ᐊᐅᓚᑦᑎᖅ ᐊᑕᐅᔨᓂᖅ ᐊᓂᒪᓗ ᑕᓯᖅᐸᐊᖅ ᓴᓇᐅᔨᖅᑎᑦ ᐃᓚᖅᑎ ᐊᐋᑎᓕᓚᕆᖅᑎᑦ ᐃᓐᓇᐅᔨᖅᑎᑦ.

ᑭᓴᓪᓕᒥ ᖃᓄᐃᓪᑐᒍᓂᖓ

ᑕᑯᔨᐊᕐᓂ ᐅᖅᑲᖅᓯᒪᔨᖏᑦ ᔪᔭᕆᖅᑎᑦ ᐅᖅᑲᖅᓯᒪᔨᖏᐅᔨᓚᔨᖅᑐᑦ ᖃᖓᓕᓂᒃᑯᓂᐅᔨᑦ ᐅᐊᖏᓇᖓᓕᒃᑯᑦᑐᖅ, ᑭᓴᓪᓕᒥ ᓄᓇᕗᒥ. ᑕᑯᔨᐊᕐᓂᖅ ᐃᓂᖓᓂ ᐊᖓᑎᓂᓕᒃ 52,173 ha-ᓂᒃ: 887 ha ᐱᑕᖅᑲᓂᖖᓂᓄᑦ, ᐊᓂᒪᓗ 51,286 ha ᐊᑐᖅᑐᐊᖅᑕᐅᔨᓕᒃᑯᑦ. ᐊᓂᒪᑐᑕᐅᖅᑲᖅ, ᐊᓂᒪᓗ ᐃᒍᖅᑎᑦ 3,430 ha-ᓂᒃ ᓄᓇᕗᑦ ᐊᒋᔪᑦ ᓄᓇᕗᒥ ᑐᖓᔪᖅᑲᖅᑎᑦ ᑎᑎᖏᓪᓕ ᐱᓕᓚᐊᖏᓐ. ᑕᑯᔨᐊᕐᓂᖅ ᐊᖏᓂᓂᖅᑲᖅᑎᑦ ᐃᓄᐃᑦ ᓄᓇᖅᑎᑎᖏᓪᓕᐅᑐᒍ (ᐃᓄᐃᑦ ᓄᓇᖅᑎᑎᖏᓐ RI-01, RI-02) ᐃᓕᖏᓐ ᐱᓕᓚᐊᖅᑲᓴᓚᐊᖅᑎᑦ ᐱᖅᑎᑎᐊᕐᓴᖅᓂᖅ ᑲᓇᑕᒥ ᕿᖅᓇᐃᓂᒡᓗ ᐃᓕᓴᕐᓂᖅᑕᓇᓂ ᕼᐊᓪᓚᖏᓐᓚ ᓄᓇᖅᑎᑎᖏᓐ ᐱᖅᑎᑎᐊᕐᓴᖅᓂᖅ ᐃᓚᒋᒃ ᐱᖅᑎᑎᐊᕐᓴᖅᓂᖅ ᐃᓚᖅᑎ ᐊᐋᑎᓕᓚᕆᖅᑎᑦ ᐃᓚᒋᒃ ᐅᖅᑲᖅᓯᒪᔨᖏᐅᔨᓚᔨᖅᑐᑦ ᓄᓇᕗᒥ. ᐊᐱᖅᓯᓂᐊᖅᑐᑦ ᐃᓚᖅᑎ ᐊᐋᑎᓕᓚᕆᖅᑎᑦ ᐃᓐᓇᐅᔨᖅᑎᑦ ᐊᐋᑎᓕᓚᕆᖅᑎᑦ ᐃᓚᒋᒃ ᐅᖅᑲᖅᓯᒪᔨᖏᐅᔨᓚᔨᖅᑐᑦ ᓄᓇᕗᒥ, ᐃᓚᖅᑎ ᐊᐋᑎᓕᓚᕆᖅᑎᑦ ᐃᓐᓇᐅᔨᖅᑎᑦ.

ᐃᓕᖅᑎᑎᕐᓴᐅᔨᓪᓚᖅᑐᑦ ᑭᓴᓪᓕᒥ ᐅᑭᐅᖅᑕᖅᑐᒃᓴᑦ ᖃᑭᖅᑕᖅᑎᖅᑎᓕᖅᑐᖅᓯᒪᔨᖅᑎᑦ ᐃᓕᖅᑎᑎᕐᓴᐅᔨᖅᑎᑦ ᓄᓇᕗᒧᑦ ᐊᐅᑐᖅᑕᖅᑎᖅᑎᓕᖅᑐᓂᑦ. ᐃᓕᐅᖅᑎ ᓄᓇᕗᑦ ᕿᑐᕐᑐᑦ ᑎᖅᑎᐊᓄᑦ ᐊᑐᖅᑕᐅᔨᓗᑦ ᒪᓕᒡᓗᓄᐊᖅᑐᓂᒃᑯᑦᑐᖅᑎᑦ ᐊᑐᖅᑕᐅᔨᓂᒃᑯᑦ ᐃᓕᖅᑎᑎᕐᓴᐅᔨᖅᑎᑦ ᓄᓇᕗᒥ ᐃᓕᖅᑎᑎᕐᓴᐅᔨᖅᑎᑦ ᓄᓇᕗᒥ, ᑲᖅᓯᒪᔨᖏᐅᔨᓚᔨᖅᑐᑦ ᐃᓕᖅᑎᑎᕐᓴᐅᔨᖅᑎᑦ ᓄᓇᕗᒥ. ᐃᓕᐅᖅᑎ ᓄᓇᕗᑦ ᐃᓚᖅᑎ ᐊᐋᑎᓕᓚᕆᖅᑎᑦ ᐃᓐᓇᐅᔨᖅᑎᑦ ᐊᐋᑎᓕᓚᕆᖅᑎᑦ ᐃᓚᒋᒃ ᐅᖅᑲᖅᓯᒪᔨᖏᐅᔨᓚᔨᖅᑐᑦ ᓄᓇᕗᒥ, ᐃᓚᖅᑎ ᐊᐋᑎᓕᓚᕆᖅᑎᑦ ᐃᓐᓇᐅᔨᖅᑎᑦ.

>ΔÀ>ᶜ ᐊᖏᓇᓗᑕᐅᓯᑦᑕ ᐱᓕᕆᖏᐃᐅᒋᒥᑦ ᐅძᐊᖏᓴᑦ ᖃᓇᓗᓴᒪᐃᑦ, ᐊᐃᓱᐃᑦ, ᓇᓄᐃᑦ, ᓇᑦᑐᑦ, ᐅᑲᓴᐃᑦ, ᖁᑲᐃᑭᓪᓕᑦ, ᐊᒻᒪᓗ harbour seals. ᖁᑦᓯᑲᑦᓪᓕᑦ ᑎᖏᒋᐊᑦ ᓂᕈᑲᖁᓂᐅᑦᑐᓯᑦ ᐊᒻᒪᓗ/ᐅᕐᓀᔪᓐᓂᑦ ᐅᑦᓗᖁᓯᑦ ᑕᐅᖏᓂ ᐱᓕᕆᖏᐃᐅᒋᒥᑦ ᐊᒻᒪᓗ ᒪᓐᓂᑐᓯᑦ ᐅᐱᖁᓱᒃᑐᓂᑦ ᑲᑎᕆᐊᖃᓂᑦ ᑲᑎᒪᓗᒃᑐᑦ ᐱᐅᓗᓂᑦ, ᐱᖏᓪᓕᓯᑦ, ᐃᒥᖁᐅᑕᐃᓕᐃᑦ, ᐱᕎᑎᐅᓀᑦ, ᐊᒻᒪᓗ ᓇᐅᕐᐃᑦ. ᑕᐅᖏᓂ ᐅᓚᓗᖁᓯᐅᖁᑕᕐᒥᔪᑦ.

ᑭᖏᑦᓕᖁᑎᐊᖁᑐᖁᓄ, ᐃᓄᐃᑦ ᓄᓇᖁᐅᑎᓪᓚ ᐊᒻᒪᓗ ᐃᓄᑦᓕᑦᓀᑦ 80% ᐅᓪᓚᒋᓂᓐᓇᓴᖁᑐᑦ ᐃᓄᖁᐅᑎᑭᕕᐅᓴᒃᐅᐸᒃᐅᑦ. ᖁᐅᓕᑦ ᐅᑭᐅᑦ ᐱᐊᓂᓴᓯᒪᓕᖁᑐᑦ, ᐃᓐᓄᒃᐸᑦᓕᑦᐊᖏᑐᖁᓄ ᐃᓄᖁᑲᓚᑎᑭᓂᓴᐅᓂᒃᐅᐸᒃᐅᑦᓗ ᖁᐅᐅᔨᐃᓂᐅᖁᑲᓚᑎᑭᓂᓴᐅᓂᒃᐅᐸᒃᐅᑦᓗ ᐃᓐᓄᒃᐸᑦᓕᑦᐊᖏᑐᖁᓄ ᑎᑭᕆᖁᐊᐊᖁᓄ, ᐃᓐᓄᒃᐸᑦᓕᑦᐊᖏᓴᓂᓴᐅᓂᒃᐅᐸᒃᐅᑦᓗ ᐃᓗᓕᓕᔨᖁᓄ. ᐃᓐᓇᓴᔨᖏᓴᒪᓕᖁᓄ, ᑲᖏᕆᖁᓕᓂᖁᓄ ᐊᒻᒪᓗ ᖁᑲᒪᓂᒋᐊᖁᓄ ᐃᓐᓄᒃᐸᑦᓕᑦᐊᖏᓴᒪᓕᖁᓄ. ᑲᖏᕆᖁᓕᓂᖁᓄ ᐃᓄᑦᓕᑦᓀᖏᑦ ᖁᑲᓴᓐᓇᐅᓂᖁᑲᓚᐅᓂᖁᓄ, ᐊᒻᒪᓗ ᑭᓇᐅᓴᑦᓕᑦᐊᖏᑦ ᖁᓴᒥᑎᖁᑲᓚᐅᓂᖁᓄ. ᐊᒥᓴᓂᓂᖁᑦ ᖁᑲᑦᓗᓇᐅᑐᖁᑦ ᐅᖁᑲᑦᓗᓇᐅᓂᖁᑲᓚᐅᓂᖁᓄ ᐊᒻᒪᓗ ᑲᖏᕆᖁᓕᓂᖁᓄ ᐊᒥᓴᓂᓂᖁᑦ ᖁᑲᒪᓂᒋᐊᖁᓄ ᐊᒻᒪᓗ ᑲᖏᕆᖁᓕᓂᖁᓄ ᐊᒥᓴᓂᓂᖁᑦ ᖁᑲᑦᓗᓇᐅᑐᖁᑦ

ᐊᐢᑐᖅᓯᓂᐅᓇᔨᖅᑐᓂᒃ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᖃᓄᐃᑦᑐᐅᑎᖅᓴᑦ

ᐱᓚᓇᐅᑎᑕᐅᔪᑦ ᓄᓇᒋᓗᓂᒃᑯᑦ ᐊᓚᒐᓄᓕᒫᑦ ᐱᓚᓇᐅᑎᑕᐅᔪᑦ ᐃᓅᖅᑲᑎᑕᐅᓕᒃᖁᓂᒃᑯᑦ ᐱᖓᒋᑦᑕᐊᑎᕐᓂᐊᓂᒃᑯᓗᒍ ᐱᓚᓇᐅᑎᑕᐅᓂᖅᓱᖓᔪᑦ ᐃᓅᓱᓄᑦ. ᐊᖏᓂᒍ ᐃᒍ ᐅᓴᖏᓐᓂᐊᖅᑐᑕᐅᔪᑦ ᑕᑯᓕᒋᐅᖅᑐᑦ ᐊᐅᑐᖅᓯᓂᐊᓂᖅᑐᓂᒃ ᑯᓘᓐᓃᑦᑐᓂᒃ ᖃᓄᖅ ᐊᐅᑐᖅᓯᓂᐊᓂᖅᑐᓂᒃᑯᓪᓚᖏᓐᓂᑦ, ᖃᓄᖅ ᓂᐱᖅᑲᑎᑕᐅᓴᖏᓐᓂᑦ, ᖃᓄᖅ ᐊᐅᑐᖅᓯᓂᐊᓂᖅᑐᓂᒃᑯᓪᓚᖏᓐᓂᑦ ᐱᑕᖅᑐᓄᑦ, ᐃᓚᖓᑦ ᐊᓚᒐᓂᒃ ᐃᓗᓕᓂᒃᑯᓗᒍ, ᐃᓕᖓᑦ ᐊᓚᒐᓂᒃ ᐃᓗᓕᓂᒃᑯᓗᒍ (ᑐᐅᑐᓄᑦ), ᐃᑦᓴᖓᓂᑕᓄᑦ, ᐃᓕᓴᒃᑯᓯᑐᖅᑎᒍᑦ ᓄᓇᒥ ᐊᑐᖅᑕᖅᓂᖓᔪᑦ, ᓴᓇᔨᖅᓴᖅᑕᖅᓯᓚᖓᓂᖅᓴᑦ, ᐊᓚᒐᓂᒃ ᐱᖓᔪᑎᖅᓂᐊᖅᑐᓄᑦ, ᐃᓅᖅᑲᑎᑕᐅᓴᖏᓐᓂᑦ ᐊᐅᑐᖅᓯᓂᐊᓂᖅᑐᓂᒃᑯᓗᒍ.

ᐱᔨᐅᔨᓴᐊᓕᓂᒃ ᐊᓚᒐᓂᒃ ᐱᓵᓯᑕᐅᔪᖅ ᐊᖅᑭᑦᑕᐊᖅᓯᓚᓂᔪᑦ

ᑕᒪᐅᓇ ᐱᓕᓚᐊᖅᓱᓇᓴᑐᖅ ᑯᐃᓴᓯᒪᓂᔪᑦ ᑲᒪᑎᔨᐅᓴᓚᒥᒃ ᐃᒪᖅᑎᒃ Melvin Bay-ᒧᑦ ᓄᓇᐅᑦ ᐊᒋᐊᓂ ᐅᔨᕿᓂᐊᖅᑐᓂᖏᓐᔪᖅᑐᓂᒃ ᑕᓴᖅᔪᐊᖅᑎᒥ ᐃᑲᔪᖅᑲᑕᐅᖅᑯᓯᔪᑐᒍ ᓄᓇᒧᑦ ᑯᐃᑕᐅᑐᐃᓇᖅᑐᓄᑦ. ᓄᓇᐅᑦ ᐊᒋᐊᓂ ᐅᔨᕿᓂᐊᖅᓴᐃᒃ ᑎᓇᑐᓂᐊᖅᑎᒥ ᓇᓂᓴᓴᓴᐃᐅᓚᐅᖅᑎᒥ ᑕᓴᖅᔪᐊᖅᑐᓂᒃᑯᓪᓚᖏᓐᓂᑦ <ᖅᓇᑲᑕᐅᓴᖅᑯᓯᔪᑐᒍ ᐊᖏᑦᑕᓕᒫᓂᖅᑐᓄᑦ ᐱᓕᕆᔨᖅᑐᓄᑦ ᐊᐅᑕᖅᓯᓂᐊᓂᖅᑐᓂᒃᑯᓪᓚᖏᓐᓂᑦ ᐊᐅᑕᖅᓯᓂᐊᓂᖅᑐᓂᒃᑯᓗᒍ ᐊᒋᐊᓂ ᐅᔨᕿᓂᐊᖅᓴᐃᒃ ᐊᐅᑕᑕᐅᓂᐊᖅᑐᓂᒃᑯᓗᒍ ᐊᒋᐊᓂ ᐅᔨᕿᓂᐊᖅᑐᓂᒃᑯᓗᒍ ᐊᒋᐊᓂ ᐅᔨᕿᓂᐊᖅᓴᐃᒃ ᐊᐅᑕᑕᐅᓂᐊᖅᑐᓂᒃᑯᓗᒍ ᐊᒋᐊᓂ ᐅᔨᕿ

ᖃᓄᐃᓕᓐᓂᕆᔨᓄᑦᓯᓐᓂᒃ ᐊᒻᒪᓗ ᖃᐅᔨᓴᖅᓯᓗᓂᑦ ᒪᓕᔪᐊᕐᓇᒪᔭᐃᓚᐅᑦ ᐊᑐᐊᕆᓂᓕᕆᔨᖅᑐᑦ ᓄᓇᕗᓂᕐᓂᖅᑐᑦ ᐅᖃᓗᓐᓄᐅᑦ ᐱᒻᒪᓕᓂᐅᑎᓕᕆᔨᖅᑐᑦ ᐃᓚᖓᑎᑎᐅᓂᖅᑐᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ.

ᖃᐅᔨᓴᐃᓂᖃᖅᑎᓯᓯᓂᑦ ᖃᓄᖅ ᐊᑐᖃᓕᕐᓂᖃᕐᓴᖅᓚᐅᑦ ᐋᖅᑭᒋᐊᕈᑕᕆᔨᓴᓪᓚᑦ ᖃᓄᐃᓕᓐᓂᕆᔨᖅᑐᑦ ᐃᓕᓴᕐᓂᐊᕐᓂᖅᑐᑦ ᐅᔾᔨᓴᓂᐅᓕᖅᑐᑦ ᐅᑭᓯᖃᖅᑐᓂᒃ ᐅᑭᐅᓂᒃᑯᑦ ᐱᓕᕆᔨᖅᑐᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦ ᓄᓇᕗᓂᕐᓂᖅᑐᑦ ᐅᖃᓗᓐᓄᐅᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦ ᐃᓚᖓᑎᑎᐅᓂᖅᑐᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ.

- ᓄᓇᕗᓐᓂᒃ ᖃᐅᔨᓴᐃᖅᑎᖓᔪᓂᖅ: ᐃᓕᓴᕐᓂᒃ ᑭᓯᓚᖃᖅᖢᓂᒃ ᓄᓇᕗᑦᓯ ᖃᐅᔨᓴᐃᖅᑎᖓᔪᓂᑦᓯ ᑎᑎᕋᐅᓴᖅᑕᐅᓕᕆᓂᖅᑐᑦ ᐅᓴᑐᕋᐅᒪᔪᓕᐊᑎᓪᓚᖅ ᑐᙵᓚᐅᒃᖢᓴᓂᖅ ᐊᖏᕐᕕᑎᓴᓂᑦᓯ ᐊᒻᒪᓗ ᐃᓄᐃᑦᑐᕐᓂᖅᑐᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ ᖃᐅᔨᓴᖅᑐᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦ ᐃᓄᐃᑦᑐᕐᓂᖅᑐᑦ ᐅᖃᓗᓐᓄᐅᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ. ᓄᓇᕗᓐᓂᒃ ᖃᐅᔨᓴᓂᐅᑎᓪᓚᖅ ᐊᓗᐃᓇᕐᓂᐊᕈᑕᕆᔨᓴᓪᓚᖅ ᖃᐅᔨᓴᐃᓂᖅᓯᑦ ᒥᑭᔪᓂᖅᑐᒥᓯᓐᓂᒃ ᑐᑭᓯᓚᑦᑕᒫᓂᐅᑎᓪᓚᖅ ᐊᑐᖃᓗᓐᓄᐅᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦ ᐃᓄᐃᑦᑐᕐᓂᖅᑐᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ ᓄᓇᕗᑦ ᒪᓕᓴᕐᓂᒃ ᐊᒻᒪᓗ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ ᒪᓕᓴᕐᓂᒃ.
- ᐅᖅᑭᓕᓂᒥ ᖃᐅᔨᓴᐅᑎ: ᐅᓪᓕᓂᖅᓱᐃᓕ ᐅᖅᑭᓕᓂᒥ ᑎᑎᕋᐅᓴᖅᑕᐅᓕᕆᓂᖅᑐᑦ ᓇᓗᓇᐃᔾᔨᐃᓂᒪᓕᒃ ᑐᙵᓚᐅᒃᖢᓴᓂᖅᑐᑦ ᖃᐅᔨᓴᐃᓕᓐᓄᐅᑦᓯᓐᓂᒃ ᖃᐅᔨᓴᖅᑕᐅᔪᓕᐊᑎᓪᓚᖅᑐᑦ ᖃᐅᔨᓴᐃᓂᖅᑐᑦ ᖃᐅᔨᓴᐃᓂᖅᑐᑦᓯᓐᓂᒃ ᐊᓂᒪᓂᖅᓴᖅᑐᑦ ᓄᓇᕗᑦ ᐊᖏᕐᓂᖅᓴᓄᑦ (ᐅᖅᑐᑎᑎᓕᐊᒍ ᖃᐅᔨᓂᖅᓴᖅᑐᑦ ᓄᓇᕗᑦ ᐊᖏᕐᓂᖅᓴ) ᑐᑭᓯᓕᕆᔨᖅᑐᑦ ᐊᒻᒪᓗ ᑐᑭᓯᓕᕆᔨᖅᑎᓯᖅᑐᑦ ᐊᑎᖓᔪᓂᖅᑐᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦ ᓄᓇᕗᓂᕐᓂᖅᑐᑦ ᐅᖃᓗᓐᓄᐅᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ. ᑲᑎᕐᕕᓕᕆᔨᖅᑐᑦ ᐊᑎᖓᔪᓂᖅᑐᑦ ᖃᐅᔨᓴᐃᓂᖅᑕᐅᓗᑦ ᐅᖅᑭᓕᓂᒥ ᑐᙵᓚᐅᒃᖢᓴᓂᖅᑐᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦ ᓄᓇᕗᓂᕐᓂᖅᑐᑦ ᐅᖃᓗᓐᓄᐅᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ ᐊᒻᒪᓗ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ ᓄᓇᕗᑦ ᒪᓕᓴᕐᓂᒃ ᐊᒻᒪᓗ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ ᒪᓕᓴᕐᓂᒃ. ᑲᑎᕐᕕᓕᕆᔨᖅᑐᑦ ᐊᒻᒪᓗ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ ᐅᓪᓕᓂᖅᓴᖅᑐᑦ ᐅᖅᑭᓕᓂᒥ ᐅᖃᓗᓐᓄᐅᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ ᐊᒻᒪᓗ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ ᒪᓕᓴᕐᓂᒃ.

ᐊᒻᒪᓗᓯᓂᖅᑐᑦ ᖃᐅᔨᓴᐃᖅᑐᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ (ᐃᓕᓐᓂᐊᕐᓂᖅᑐᒃ) ᐊᒻᒪᓗᓯᓂᖅᑐᑦ ᑕᕆᐅᕐᓗᑦ ᑯᐃᓴᖅᑎᑕᕐᓂᕐᓗᑦ. ᐱᓯᓂᐅᕐᓱᖓᓚᐅᖅ ᐊᒻᒪᓗ ᐅᓪᓚᒃᓯᑦ, ᐊᒻᒪᓗᓯᓂᖅᑐᑦ ᖃᐅᔨᓴᐃᖅᑎᖓᔪᓂᖅᑐᑦ ᐅᖅᑭᓕᓂᒥ ᐅᖃᓗᓐᓄᐅᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ ᓄᓇᕗᑦ ᒪᓕᓴᕐᓂᒃ ᐊᒻᒪᓗ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ ᒪᓕᓴᕐᓂᒃ. ᑲᑎᕐᕕᓕᕆᔨᖅᑐᑦ ᐊᒻᒪᓗᓯᓂᖅᑐᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ ᒪᓕᓴᕐᓂᒃ ᐊᒻᒪᓗ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ ᒪᓕᓴᕐᓂᒃ.

ᑲᑎᕐᕕᓕᕆᔨᖅᑐᑦ ᐊᒻᒪᓗᓯᓂᖅᑐᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ ᐊᒻᒪᓗ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ ᒪᓕᓴᕐᓂᒃ. ᐊᒻᒪᓗᓯᓂᖅᑐᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ ᒪᓕᓴᕐᓂᒃ ᐊᒻᒪᓗ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦ ᐃᓕᓴᕐᓂᒃᑯᑦ ᐱᓕᕆᓂᐊᕐᓂᖅᑐᑦᓯᓐᓂᒃ ᒪᓕᓴᕐᓂᒃ.

ᑲᑎᕐᕕᓕᕆᔨᖅᑐᑦ

ᐅᖅᑭᒋᓐᓂᒃ ᐱᓕᕆᐅᑎᑕᐅᔪᓐᓇᖅᑐᒃ ᐃᓄᖃᖅᑎᑭᓐᓂᖅᑐᒃ ᐱᖅᓯᓕᐊᑎᕐᑎᓂᖅᑐᓗ ᐊᓕᓗ ᐱᓕᕆᐅᑎᑕᐅᔪᓐᓇᖅᑐᒃ ᖃᓄᐃᓕᓕᐅᕈᑕᐅᔪᓂ, ᓴᖅᑭᑎᕐᓂᓪᓕᓚᐅᖅᑐᓂ ᐱᓕᕆᐅᑎᑕᐅᔪᓂᖅ ᐱᓕᕆᐅᑎᑕᐅᔪᓐᓇᖅᑐᒃ ᐱᖅᓯᓕᐊᑎᕐᑎᓂᖅᑐᒃ ᐃᓄᖃᖅᑎᑭᓐᓂᖅᑐᒃ ᐱᖅᓯᓕᐊᑎᕐᑎᓂᖅᑐᒃ ᐃᓄᖃᖅᑎᑭᓐᓂᖅᑐᒃ ᐱᖅᓯᓕᐊᑎᕐᑎᓂᖅᑐᒃ.

ᖃᐅᔨᒪᓕᒃ ᓇᐅᒃᑯᔪᓕᐊᓴᖅ ᑕᑯᑎᐊᖅᑕᐅᓕᐅᔭᖅᑐᑦ ᐃᓕᓐᓂᐊᕐᑕᐅᑐᖃᖅᑐᑦ ᓄᓇᒃᑯᑐᑦ ᐃᓐᓇᕐᓂᐊᖅᑐᓴᖅᑭᑦᓯᓂᖅᓄᓪᓗᒃ ᐊᐅᓚᑦᑯᑎᒋᔭᐅᓚᕆᒃᑯᑦ, ᓴᓇᔨᐅᑎᓪᓗᒍ ᔨᐊᓚᒃᑎᓇᐅᑎ ᔨᐅᓪᓕᐅᖅ ᐊᓚᓗ ᔨᐊᓚᒃᑎᓇᐅᑎ, ᑕᓇᐅᔪᒪᑦ ᑯᕕᔨᓂᖅ ᖃᒪᓕᕆᐅᔪᓐᓇᖅᑐᒃ ᐃᒪᓂᖅᑐᒃ, ᐊᓚᓗ ᑯᕕᔪᖅᑭᖅᑭᓪᓕᑦ ᑯᖏᕕᑦᓯᓕᕆᐅᑎᒃ ᐃᒪᓂᖅᑐᒃ ᐃᓕᓐᓂᖅᑐᒃ.

ᐊᐅᑐᓂᖅᑭᖅᔨᓕᕆᐅᑎᑕᐅᔪᓐᓇᖅᑐᒃ ᐋᖅᑭᐅᑎᐊᖅᑕᐅᔨᓚᕆᒃᑯᑦ ᐃᓚᒋᐅᑕᐅᓀᐅᑐᒃ ᑎᖓᒥᐊᓂ ᐊᓚᓗ ᐃᓚᒋᐅᑕᓂ ᐃᓂᒋᓀᑕᖓᓂ ᐃᓕᐅᖅᑲᐃᓂᒪᑦ ᑯᖏᕕᑦᓯᓕᕆᐅᑎᑕᐅᔪᓐᓇᖅᑐᒃ, ᐃᓐᓇᐅᖅᓯᐊᐅᓕᖅᓴᓪᓗᒍ ᔨᑯᑦ ᐃᐸᕐᐅᓂᖅ ᐊᓚᓗ ᐃᓕᓐᓂᖅᑐᒃ ᐃᓂᒋᓀᑕᖓᓂ ᐊᐅᓚᑦᑯᑎᒋᔭᐅᓚᕆᒃᑯᑦ ᖃᐅᔨᒪᓕᒃ ᐃᓕᓐᓂᖅᑐᒃ ᐃᓂᒋᓀᑕᖓᓂ. ᑯᓚᐸᖅᑲᐅᑦ ᐅᖅᑭᒋᓐᓂᖅ ᑯᓚᐸᖅᑎᓂᖅᑲᐅᑦ ᐱᕐᔪᐊᖏᓂᖅᑐᒃᑯᑦ ᐊᖏᓂᖅᑎᒥᐅᑐᒃᑯᑦ ᑲᑎᒪᔨᓕᕆᐅᑎᑕᐅᔪᓐᓇᖅᑐᒃ ᐊᖏᓂᖅᑎᒥᐅᑐᒃᑯᑦ ᐃᓕᓐᓂᖅᑐᒃᑯᑦ ᐃᓐᓇᐅᖅᓯᐊᐅᓕᖅᓴᓪᓗᒍ ᐊᐅᓚᑦᑯᑎᒋᔭᐅᓚᕆ

ᐊᖏᑕᐊᖏᑕᑐᑦ ᓇᐅᒃᑯᓐᓇᕆᑦ ᐅᓗᓇᐃᖅᑕᐅᓂᒪᔪᑦ ᐃᓇᖏᓐᓄᑦ ᐱᔪᑎᖅᓴᐅᖅᑐᑦ ᐃᑕᖅᑯᓂᖅᑎᒍᑦ ᐊᑐᖅᑕᐅᐳᖅᑐᒃᑯᑦ. ᐱᑕᓚᑎᓪᓗᑕᑦ ᐃᑕᖅᑯᓂᖅᑎᒍᑦ ᓄᓇᒥ ᐃᓕᑕᐅᔪᖅ ᓂᔪᓕᖏᓪᓗᑦ ᐱᔪᑎᑎᑦᓴᑐᒍ ᐊᐅᑐᖅᓯᓂᖅᑎᑯᓂᖅᑐᒃ ᓯᑭᔅᑐᑐᓄᑦ ᐃᑕᖅᑯᓂᖅᑎᒍᑦ ᓄᓇᒪᖏᓐᓄᐊᔪᓄᑦ, ᐊᒻᒪᓗ ᐊᑦᑕᓇᖅᑐᒋᑦᑐᖅᑯᓂᖅᑐᑯᓗᒍ ᐃᒪᐅᑯᑦ ᐃᓴᖅᓗᓂᓪᓗ, ᐊᑐᓕᖅᑎᖅᑕᐅᓕᐊᖅᑐᑦ ᓄᓇᕐᓂᒃ ᐱᓕᕆᖅᑎᑎᒍᑦ <ᖅᓇᐅᑕᐅᔪᑯᑦ.

ᐊᑕᐅᓯᑐᐊᖅ ᓇᐅᒃᑯᓐᓇᕆᐊᖅ ᓇᓗᓇᐃᖅᑕᐅᓕᐅᕐᖅᑐᖅ ᐊᐅᑐᐊᓂᓕᒃ ᐱᓕᕆᖏᓐᓇᐅᔪᑯᑦ ᐊᐅᑐᖅᓯᓂᖅᑎᕆᔭᖅᑐᖅ ᐃᒪᖃᑎᒌᑦ

- ᐱᖅᑕᓗᐊᖅᑭᓂᑯᑦ ᑯᐊᓯᓂᖅ ᐃᒪᖃᒃ ᓄᓇᒥᖏᓐᖁᕐᑐᑦ ᖃᐅᐅᓪᓚᕐᖓᑕᐅᑦ ᓄᓇᒥ ᑕᐃᑯᓇ ᓯᑦᓗᓕᖃᖅᓴᐅᑯᑦ ᐃᒪᖃᑎᒌᑦ ᓴᓇᕐᓂᖅᓴᐃᑯᑦ ᐊᐅᑐᖅᓯᓂᖅᑎᕆᔭᖅᑐᖅᑐᑦ ᐃᒪᖃᑎᒌᑦ. ᐊᒻᒪᓗ ᐊᐅᑐᓂᓕᒃ ᑐᖅᑭᓯᓂᑯᑦ ᐃᒪᖃᑎᒌᑦ ᐊᐅᑐᖅᓯᓂᖅᑎᕆᔭᖅᑐᖅᑐᑦ ᐅᒪᖃᑎᒌᑦ.

ᐊᒻᒪᓗᑦ ᐊᐅᑐᖅᓯᓂᖅᑎᕆᔭᖅᑐᖅᑐᑦ ᐊᐅᑐᖅᓯᓂᖅᑎᕆᔭᖅᑐᖅᑐᑦ ᐃᒪᖃᑎᒌ

ᐃᓗᓕᕆᔨᕕᓂᖅ ᐊᒻᒪᓗ ᐃᓄᖅᑎᑎᑦᓴᓂᖅᓯᑦ ᐱᓱᑦᓕᐊᑎᕋᑎᓂᖅᓯᒪᓕᒃᑐᓂᖅ ᐊᖏᑐᖅᓯᓂᐅᓚᖅᑐᓂᖅ ᐱᓕᕆᐊᖓᔪᒪᓕᕐᒥ ᑕᕆᐅᕐᓗᑦ ᓯᕗᓪᓕᐊᕐᓂᖅᓯᑦ. ᐃᓗᓕᖅᑲᖅᑐᓂ ᑐᙳᓚᕐᒪᐅᔨᕕᖅᓯᑦ ᖃᓄᐃᔅᑐᓂᙵᕐᓂᖅ ᐊᒻᒪᓗ ᓇᓗᓇᐃᔨᐃᓯᒪᔪᑦ ᑎᑎᕋᐅᔪᖅᑕᐅᓯᒪᔪᓂᖅ ᐊᒻᒪᓗ ᐋᖅᑭᐅᐊᖅᓯᔪᑎᓂᖅ ᐊᑐᓕᖅᑎᖅᑕᐅᓂᐊᖅᑐᓂᖅ ᐱᑕᖅᑭᓐᓂᖅᓯᑦᔨᓗᑦᑕᑦ ᖃᖅᔨᓐᓇᑭᓗᖅᔨᓗᑦᑕᓗᓐᓂᑦ ᓇᒃᒪᕐᑕᖅᑑᓂᖅᓯᑦ ᐱᒻᒪᓕᐅᑎᑕᐅᔪᖅᑐᓂ ᓇᓇᐅᖅᓯᑦ ᐱᓕᕆᐦᐃᓕᖅ, ᐱᓗᐊᖅᑐᒥ ᑲᖏᖅᑕᓂᖓᒥ, ᐃᑎᕕᐊᓂ ᐊᒻᒪᓗ Melvin Bay-ᒥ. ᓴᖅᑭᑲᓕᖅᑐᑦ ᐊᐅᓪᓚᑎᓂᖓᓕᑦ ᖃᐅᔨᓴᐃᓂᖓᓕᑦᓗᓐ ᕿᖓᐅᑦ ᑕᑯᑎᐊᖅᑕᐅᔨᐸᖓᓪᓕᒥᔪᑦ ᖃᐅᔨᓴᐃᓂᖓᓕᑦ ᐊᖏᑐᖅᓯᐅᔨᓕᔨᓂᖅ ᓂᓚᐅᑎᓴᐅᔨᓂᖅ. ᐃᓕᓕᑎᓴᐅᔨᔪᑦ ᑕᕆᐅᕐᓗᑦ ᑯᐅᔨᓴᐃᓂᖓᓕᑦ ᖃᐅᔨᓴᐃᓂᖓᓕᑦ ᐊᖏᑐᖅᓯᐅᔨᓕᔨᓂᖅ ᐊᖏᑐᖅᓯᐅᔨᓕᖅᑐᓂᖅ Melvin Bay-ᒧᑦ.

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ACRONYMS

Agnico Eagle	Agnico Eagle Minerals Limited
AWAR	All Weather Access Road
CCME	Canadian Council of Ministers of the Environment
CORMIX	Cornell Mixing Zone Expert System
CRA	commercial, recreational, and Aboriginal Fisheries
DFO	Fisheries and Oceans Canada
EA	Environmental Assessment
FEIS	Final Environmental Impact Statement (FEIS) - Meliadine Gold Project, Nunavut
Golder	Golder Associates Ltd.
HDPE	high-density polyethylene
Heritage Resource	Heritage resources are defined as, but not limited to, archaeological and historical sites, burial grounds, palaeontological sites, historic buildings and cairns.
Heritage Record	Collection of physical heritage resources that can be used as an analytical to make inferences about the past
IQ	Inuit Quajimajatugangit
LSA	Local Study Area
Meliadine Mine	Meliadine Gold Mine
MDMER	Metal and Diamond Mining Effluent Regulations
MMER	Metal Mining Effluent Regulations
NIRB	Nunavut Impact Review Board
NPC	Nunavut Planning Commission
NWB	Nunavut Water Board
ODMP	Ocean Discharge Monitoring Plan
ppm TDS	Parts Per Million of Total Dissolved Solids
PC No. 006	NIRB Project Certificate No.: 006
RO	Reverse Osmosis
RSA	Regional Study Area
SARA	*Species at Risk Act*
SWTP	Saline Water Treatment Plant
TEMMP	Terrestrial Environment Management and Monitoring Plan
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
VC	Valued Component
VEC	Valued Ecosystem Component
VSEC	Valued Socio-Economic Component
Y	Year in which operation of the mine commences

SECTION 1 • INTRODUCTION

Golder Associates Ltd. (Golder) was retained by Agnico Eagle Mines Limited (Agnico Eagle) to undertake an environmental and socio-economic assessment (EA) for the proposed discharge of treated groundwater effluent from the underground mine of the Tiriganiaq deposit at the Meliadine Gold Mine site (Meliadine Mine) into the marine environment near Rankin Inlet in the Kivalliq region of Nunavut. Agnico Eagle has previously completed environmental impact statements (EIS) for the construction and operation of an All-Weather Access Road (AWAR) (Agnico Eagle 2013) and for the Meliadine Mine located north of Rankin Inlet, which included nearshore barge operations in Itivia Harbour and seasonal shipping activities in Hudson Bay and Hudson Strait (Agnico Eagle 2014). 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.

This EA has been drafted for the purposes of describing the existing environmental and socio-economic conditions in the area at Itivia Harbour and Melvin Bay where the proposed amendment activities would be undertaken, as well as predicting and evaluating the potential effects (direct and indirect) on the receiving environment due to the proposed amendment activities, in fulfilment of the Nunavut Impact Review Board (NIRB) Final Environmental Impact Statement (FEIS) Addendum Guidelines (NIRB 2018).

1.1 Proponent Information

Agnico Eagle is a long established, Canadian headquartered, gold producer with operations located in Canada, Finland, and Mexico, and exploration and development activities in Canada, Finland, Mexico, and the United States. Agnico Eagle is the sole owner of the Meliadine Mine. In Canada, Agnico Eagle also owns and operates the LaRonde, Lapa, and Meadowbank mines.

1.1.1 Land Tenure

As described in the FEIS (Agnico Eagle 2014), the Meliadine property consists of 52,173 hectares (ha; 887 ha as claims, and 51,286 ha as leases). Those 51,286 ha are administered by Indigenous Services Canada (ISC, formerly Aboriginal Affairs and Northern Development Canada), and referred to as Crown Land. As well, Agnico Eagle has 3,430 ha of sub-surface Nunavut Tunngavik Inc. (NTI) concessions where the sub-surface mineral rights are administered directly by NTI. The Meliadine Mine's gold deposits are situated on Inuit Owned Lands (IOL) and administered by NTI (sub-surface and mineral rights) and the Kivalliq Inuit Association (KIA; surface rights) on behalf of the Inuit Beneficiaries as designated under the Agreement between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in right of Canada (Nunavut Agreement; GC 1993b).

No new land leases are required for the proposed amendment activities. These activities will be on lands in use for the Meliadine Mine and the AWAR, and at the Itivia Fuel Storage Facility which is located on leased land within the Nunavut Airports property.

1.2 Sustainability and Precautionary Principle

Agnico Eagle is committed to creating value for their shareholders by operating in a safe, socially, and environmentally responsible manner, while contributing to the prosperity of our employees, their families, and the communities in which we operate.

This is imbedded into the 4 fundamental values that make up the keystones of Agnico Eagle's Sustainable Development Policy: Operate Safely, Protect the Environment, and treat Employees and Communities with Respect (FEIS Volume 2, Section 1.2.2; Agnico Eagle 2014).

In developing the Meliadine Mine, Agnico Eagle integrated the development engineering teams with the environmental and social specialists early in the process. Parameters of Meliadine Mine and assessment were chosen to be as conservative as possible to make sure that all potential adverse impacts were captured. This approach has been extended to this FEIS Addendum.

1.2.1 Application of the Precautionary Principle

As understood by Agnico Eagle, the "precautionary principle" or precautionary approach is as follows: if an action has a suspected risk of causing harm to the public or to the environment, in the absence of scientific consensus, then that action should be considered harmful (FEIS Volume 2, Section 2.1; Agnico Eagle 2014). The principle implies that there is a social responsibility to protect the public from exposure to harm when scientific investigation has found a plausible risk. These protections can be relaxed only if further scientific findings emerge that provide sound evidence that no harm will result. Agnico Eagle's approach can be summarized as follows:

- Priority 1 – Collect the scientific data required to allow scientific consensus to be achieved.
- Priority 2 – Consult with local stakeholders to incorporate local and traditional knowledge into our data to help reach consensus.
- Priority 3 – Design all facilities and activities with adaptive management in mind. In cases where uncertainty remains, Agnico Eagle has looked for applicable data from similar settings elsewhere so that others experience can be brought into consideration. Agnico Eagle has also built in appropriate safety factors in the design of the facility or in the proposed action. In each case, Agnico Eagle has incorporated flexibility so that the activity or design can be actively adapted to accommodate possible future change.
- Priority 4 – Design and implement monitoring programs to address all areas of uncertainty so that data are being generated to a) allow for scientific consensus to be achieved, and b) to allow activities where some uncertainty exists to be adaptively managed in a timely manner.

SECTION 2 • REGULATORY REGIME

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.

The proposed amendment activity of discharging saline (treated groundwater) effluent from the underground mine to the marine environment is being proposed to help manage groundwater at the Meliadine Mine. In consultation with the NIRB, Agnico Eagle has prepared this FEIS Addendum for the authorization to carry out the proposed activity, 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 amendment activities" in this report; NIRB 2018). The concordance table is found in Appendix A.

On January 5, 2018, the NIRB received a referral from the Nunavut Planning Commission (NPC) to screen Agnico Eagle's project proposal, accompanied by a positive conformity determination under the Keewatin Regional Land Use Plan by the NPC. The NIRB undertook a cursory review of the project proposal and requested additional information to determine whether a formal reconsideration of the terms and conditions of Project Certificate No. 006 was necessary, and to support NIRB's assessment of the potential ecosystemic and socio-economic effects of the proposed amendment activities. Agnico Eagle provided all the additionally requested information on February 15, 2018.

Following receipt of responses from intervenors, the NIRB concluded that the project proposal to discharge saline (treated groundwater) effluent to the marine environment constitutes a significant modification to the previously assessed Meliadine Mine. NIRB further noted that the discharge proposal is "within the scope of, and integrally linked to the original project". This FEIS Addendum has been completed to support the necessary technical review of the "Saline Effluent Discharge to Marine Environment, Rankin Inlet, Meliadine Gold Mine" as proposed by Agnico Eagle and as part of the NIRB's reconsideration of Project Certificate No. 006 pursuant in accordance with Article 12, Section 12.8.2 of the Nunavut Agreement (GC 1993b) and with s. 112 of the *Nunavut Planning and Project Assessment Act*, S.C. 2013, c. 14 (NuPPAA). NIRB issued Guidance for Final Environmental Impact Statement Addendum for the "Saline Effluent Discharge to Marine Environment, Rankin Inlet, Meliadine Gold Mine" (NIRB 2018). NIRB will assess conformity against the guidance provided.

As a requirement of the Meliadine Mine Project Certificate (No. 006), condition 25, states "the proponent shall provide to NIRB a saline water management plan which includes, but is not limited to, 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". In addition, other conditions and/or mitigations outlined by regulatory agencies under the following Acts (or applicable licence requirements) should be adhered to:

- *Environmental Protection Act* (GC 1988) - The discharge of the treated groundwater effluent into the marine environment is also subject to authorization under the Section 5 (3)(a) of the EPA.
- *Federal Fisheries Act* (GC 1985a) - Environment and Climate Change Canada administers the Metal Mining Effluent Regulations (MMER) under the *Fisheries Act* for Meliadine Mine. The Metal and Diamond Mining Effluent Regulations (MDMER) are anticipated to come into effect for ocean disposal of the treated groundwater effluent.

- *Navigation Protection Act* (GC 1985b) - The need for a permit will be determined through the review process for this FEIS Addendum by Transport Canada, which administers this act.
- *Migratory Birds Convention Act* (GC 1994) - Agnico Eagle will be in adherence with this act.
- *Species at Risk Act (GC 2007)* - Agnico Eagle will be in adherence with this act.
- Heritage Permitting under applicable Nunavut legislation - Agnico Eagle will continue to adhere to the legal requirements related to archaeological and palaeontological work in Nunavut, which include Section 33 of the *Nunavut Agreement,* and the *Nunavut Archaeological and Paleontological Site Regulations* developed pursuant to Section 51(1) of the *Nunavut Act* (GC 1993a, b; GN 2003).

2.1 Nunavut Planning Commission

All project proposals in the Keewatin Planning Region that require amendment to a licence or authorization from a land use authorizing agency must be re-assessed by the NPC for conformity with the Keewatin Regional Land Use Plan (NPC 2000). The Meliadine Mine and associated activities are entirely within the Kivalliq (Keewatin) Region of Nunavut and therefore is subject to confirmation of conformity determination to the Keewatin Regional Land Use Plan.

Agnico Eagle submitted an NPC Application for the "Saline Effluent Discharge to Marine Environment, Rankin Inlet, Meliadine Gold Mine" on December 13, 2017. The NPC determined that the proposed amendment conforms with the Keewatin Regional Land Use Plan. The NPC also determined that the proposed amendment activities would be a significant modification because of the addition of a location for the discharge of the saline (treated groundwater) effluent and the revised method of treatment.

2.2 Nunavut Impact Review Board

The Meliadine Mine was subject to the environmental and socio-economic impact assessment and permitting processes established under the Nunavut Agreement. Article 12, Part 5 of the Nunavut Agreement sets out the environmental and socio-economic review and assessment requirements managed by the NIRB, one of five Institutions of Public Government established under the Nunavut Agreement.

The Meliadine Mine's original application was screened by the NIRB in accordance with Article 12, Part 4 of the Nunavut Agreement. On July 8, 2011 the NIRB recommended to the then-Minister of Indian Affairs and Northern Development that the proposed project should be the subject of a review pursuant to s. 12.4.4(b). On September 14, 2011 the Minister referred the Meliadine Mine Project to the NIRB for review pursuant to Article 12, Part 5 or 6 of the Nunavut Agreement. Following a Part 5 review the NIRB recommended that the Meliadine Mine proceed subject to terms and conditions, and in January 2015, the Minister of Indigenous Services Canada (formerly Indigenous and Northern Affairs Canada) approved the NIRB recommendation. On February 26, 2015 the NIRB issued a Project Certificate for the development of Meliadine Mine (NIRB Project Certificate No. 006). The Project Certificate states Agnico Eagle will maintain sole responsibility for the construction, operations (including dewatering and mining), on-going inspection, and maintenance of all the components of the Meliadine Mine.

SECTION 3 • AMENDMENT DESCRIPTION

3.1 Background

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).

The Meliadine Mine plan proposes mining methods for the development of the Tiriganiaq gold deposit which includes one underground mine. There are four phases to the development of the Meliadine 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). Mining facilities in Project Certificate No. 006 and as permitted in the Nunavut Water Board (NWB) Type A Water Licence (No. 2AM-MEL1631, 2016) include a water management system that includes containment ponds, water diversion channels, retention dikes/berms, and a Water Treatment Plant. The general location and site layout of the Meliadine Mine are shown in Figure 1.

3.2 Rationale for the Amendment

This FEIS Addendum describes a proposed discharge of treated groundwater effluent from the underground mine at the Meliadine Mine to the marine environment at Melvin Bay in the Kivalliq region of Nunavut.

The underground mine at the Tiriganiaq deposit of the Meliadine Mine is planned to extend to approximately 625 m below the ground surface (mbgs) and 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 works have advanced below the base of the permafrost. Tiriganiaq Pit 1 and Tiriganiaq Pit 2 will be mined within the permafrost; therefore, groundwater inflows to both open pits is expected to be negligible and were not considered as sources of groundwater requiring treatment and discharge.

Based on the anticipated flows of groundwater reporting to the underground workings, a short-term and long-term groundwater strategy is required. Groundwater inflow to the underground mine will range between 300 cubic metres (m^3)/day in 2018 up to 420 m^3/day in 2023 and 2024 (see Section 3.4.1). Currently there is also additional groundwater stored on surface in saline water storage ponds that has been influenced by rock from the underground workings in the short-term (expected to be up to 800 m^3/day in combination with groundwater inflows). During the Type A Water Licensing process in 2015, Agnico Eagle considered several options presented in Appendix F of the Water Management Plan (Agnico Eagle 2015a) and since that time has continued to investigate alternative options.

The preferred alternative is to treat the groundwater reporting from the underground workings and discharge to Meliadine Lake in accordance with the Type A Water Licence 2AM-MEL1631 through Collection Pond 1 (CP1). However, based on the potential volumes of groundwater, it is anticipated that a second discharge location will be required. Agnico Eagle is proposing to treat groundwater and

discharge it as treated groundwater 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.

For the ocean discharge option, the treated groundwater effluent would be trucked from the Mine and discharged in Melvin Bay at Itivia Harbour – the Itivia Fuel Storage Facility and AWAR are presented in Figure 2. The discharge facility will include a storage tank at the Itivia Fuel Storage Facility and an engineered marine outfall, comprised of a discharge pipeline extending to an engineered diffuser located in Melvin Bay, discharging during the open water season from 2019 to 2032. The treated groundwater effluent will be discharged in a controlled manner through the diffuser in compliance with the required discharge criteria, to allow for maximum dilution and minimum environmental impact to the marine environment.

EMULSIONS PLANT
TEMPORARY OVERBURDEN STOCKPILE
CHANNEL 2
FRESHWATER INTAKE CAUSEWAY
SEWAGE TREATMENT PLANT
INDUSTRIAL SITE PAD
LANDFARM
MELIADINE ESKER
WATER TREATMENT PLANT
WTP INTAKE CAUSEWAY
TREATED SEWAGE DISCHARGE
ORE STOCKPILE 3
ORE STOCKPILE 1
ORE STOCKPILE 2
CHANNEL 1
CULVERT 3
CULVERT 4
WATER TREATMENT PLANT
CULVERT 5
CHANNEL 6
CP6 JETTY
CP6
H19
MELIADINE LAKE
BERM2
TAILINGS
TAILINGS STORAGE FACILITY (TSF)
CULVERT1
WASTE ROCK COVER
CULVERT2
CHANNEL 3
CRUSHER
LANDFILL BERM1
CHANNEL8
CHANNEL7
CHANNEL4
WASTE ROCK & OVERBURDEN STORAGE FACILITY 2 (WRSF2)
WASTE ROCK & OVERBURDEN STORAGE FACILITY 1 (WRSF1)
P1
P-AREA
P2
P3
SALINE POND
CP5 JETTY
CP5
WASTE ROCK & OVERBURDEN STORAGE FACILITY 3 (WRSF3)
CULVERT 6
CHANNEL 5
BERM3
TIRIGANIAQ PIT 1 (TIRI_1000_01)
TIRIGANIAQ PIT 2 (TIRI_1000_02)
CP1
CP2
CP3
CP4
D-CP1
D-CP3
D-CP4
D-CP5
D-CP6
G2
B7
B33
B33A
B34
A8
A9
A35
A37
A38
A40
A54
H1
H2
H3
H4
H5
H7A
H7B
H7C
H8
H9
H10
H11
H12
H13
H14
H15
H15D
H15E
H15G
H16
H17
J2
J3
J4
J5
J6
J7
Permanent Camp
Exploration Camp
Mine Infrastructure Area
All-weather Access Road
Hudson Bay
Rankin Inlet
FO PLANT
STUDY AREA
0
250
500
METRES

LEGEND

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

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

CLIENT
AGNICO EAGLE MINES LIMITED
AGNICO EAGLE

PROJECT
MELIADINE GOLD PROJECT
NUNAVUT

TITLE
SITE LAYOUT
MELIADINE MINE SITE

CONSULTANT
GOLDER

YYYY-MM-DD	2018-06-14
DESIGNED	JR
PREPARED	CDB
REVIEWED	
APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
1773384	1100	A	1

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3.3 Groundwater Management Alternatives

Project alternatives for the Meliadine Mine were considered based on the potential range of groundwater flows and quality that could be generated (refer to Appendix F of the Water Management Plan; Agnico Eagle 2015a). The option selection has been driven by the expected quality and quantity of the water.

Dependent on the groundwater inflow volume, the following options were considered for the long-term management of groundwater inflows to the underground mine:

- treat saline groundwater and store/use the groundwater from the treatment process on-site (Section 3.3.1)
- mix treated groundwater with surface contact water in CP1 prior to release to the receiving environment in Meliadine Lake (Section 3.3.2)
- ocean disposal of treated groundwater (see Section 3.4, Ocean Disposal Project Description)

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 Project alternatives for the Meliadine Mine to apply to the Groundwater Management Plan (Agnico Eagle 2018a). 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."*

The alternatives are discussed below. The Groundwater Management Plan (Agnico Eagle 2018a; provided in Appendix D) was submitted to the NWB and NIRB in February 2018, in compliance with Condition 14 of the Type A Water Licence.

3.3.1 Treat and Store/Use Groundwater On-site

This option was considered as part of the FEIS Project alternatives (Agnico Eagle 2014, Volume 2, SD 2-1 Section 5.10) and for the Type A Water Licence Application. It involves storing all excess groundwater in surface water ponds at Meliadine Mine. As outlined in the Water Management Plan (Agnico Eagle 2018c), a total of nine water containment ponds are planned on-site at the Mine surface (CP1, CP3, CP4, CP5 and CP6, the P-Area ponds [P1, P2, and P3], and the Saline Pond), and associated water retention dykes, water diversion berms, channels, and culverts, to manage surface water and underground water (Figure 1).

Groundwater inputs to surface storage alone for management are expected to range approximately from a minimum of 0.11 Mm^3/year to a maximum of 0.18 Mm^3/year, dependent on year of Mine life (Agnico Eagle 2018c). Evaporators have been in use on-site since mid-2017 at P1 to reduce groundwater volumes stored in surface water ponds. A single evaporator is estimated to remove approximately 500 m^3/day when operated for 24 hours with ideal wind and relative humidity conditions.

While evaporators have been used with some success, the combined volumes of groundwater with anticipated surface water volumes influenced by underground rock to be managed is greater than the available long-term storage at the Mine, and therefore, discharge to environment is required.

Short-term storage and treatment options are being implemented at the Mine pending regulatory approvals for the long-term groundwater management option.

3.3.2 Treated Groundwater Discharge to Meliadine Lake

Discharge to Meliadine Lake was assessed as part of the FEIS (Agnico Eagle 2014) and discharge criteria have been defined in the Type A Water Licence 2AM-MEL1631. Mine surface and groundwater storage facilities are presented in Figure 1.

Hatch (2013) investigated groundwater treatment options for the site and concluded that a combination chemical reverse osmosis and mechanical vapour compression evaporator plant would be the most efficient method of treating excess groundwater for discharge. Agnico Eagle has also undertaken a pilot test of a SaltMaker combined with a Chemical-Reverse Osmosis (RO) post-treatment system.

The groundwater will flow through a Salt Water Treatment Plant (SWTP), comprised of a set of SaltMakers, and will be treated to remove excessive total suspended solids (TSS), calcium chloride ($CaCl_2$), sodium chloride (NaCl), metals, phosphorous (P), and nitrogen compounds. The salt generated by the water treatment unit will be stored on-site at the Mine, where it will be re-used for underground operations and/or disposed of at an appropriate disposal location. Given the predicted groundwater volumes, a maximum of three SaltMakers are proposed to be built at the Mine, forming the SWTP, to treat the groundwater for discharge. Each SaltMaker has the capacity to treat water at a flow rate of 120 m^3/day, and a set of three SaltMakers for the SWTP will meet the discharge volumes predicted (totalling 400 m^3/day capacity), though temporary storage on site is required during peak underground operations where the predicted flow may be up to 420 m^3/day.

The first SaltMaker is planned to be commissioned in Q3-2018 and the second and third SaltMakers will be built in Q1-2019 to meet increasing groundwater inflow needs. The need for a third SWTP will be determined based on the capacity of the Mine for surface and underground storage.

The expected treated groundwater effluent temperature from the SWTP is expected to be approximately 35°C, with an approximate pH of 7.5 (Saltworks 2017). The SWTP treated groundwater effluent largely meets the required Water Quality Output requirements defined in Agnico Eagle's Desalination Water Treatment Plan Design Criteria and passes toxicity tests (Saltworks 2017). Saline groundwater effluent quality after treatment through the SWTP indicates that total dissolved solids (TDS) would be approximately 158 mg/L (condensed water after treatment; Saltworks 2017).

Post-treatment options, such as the RO post-treatment system, are being considered if required, to meet applicable effluent quality criteria for Meliadine Lake. The permeate resultant from Chemical-RO post-treatment system meets all the required site-specific Water Quality Objectives and passes all toxicity tests. Saline effluent quality after treatment through the SWTP indicates that TDS concentration would be considerably reduced, at approximately 55 mg/L after RO post-treatment (Saltworks 2017). Pilot testing of the SaltMaker condensed water and RO permeate quality results are presented in the SaltMaker Pilot Final Report document (Saltworks 2017). The results indicate that values will meet site-specific water quality objectives for water management, which also comply with MMER.

Mine effluent discharge is permitted under the Type A Water Licence 2AM-MEL1631. It is the preferred option if the conditions of the Type A Water Licence 2AM-MEL1631 can be met. The option to discharge treated groundwater effluent from the SaltMaker to Meliadine Lake will be described and submitted to the NWB in the Groundwater Management Plan and approval will be required, prior to discharge, as per the Term and Condition Part E, No. 14 of the Type A Water Licence No. 2AM-MEL1631.

3.4 Ocean Discharge Description

Pending necessary permits and/or authorizations, Agnico Eagle proposes to directly discharge treated groundwater effluent into Melvin Bay at Itivia Harbour, treating the saline underground inflows to meet discharge water quality criteria for Melvin Bay. Agnico Eagle anticipates that treatment for metals and potentially TDS may be required. However, it is expected that groundwater stored at surface at the Mine will be influenced by surface water inputs (e.g., by precipitation). Temporary storage of groundwater (treated through the underground TSS removal plant) may occur, dependent on volumes.

Agnico Eagle is considering treatment options to meet applicable discharge criteria. Agnico Eagle is committed to responsibly managing water resources to minimize or eliminate potential effects on the local aquatic ecosystem in accordance with Project Certificate No. 006, the Type A Water Licence No. 2AM-MEL1631, and the objectives as outlined in the Water Management Plan (Agnico Eagle 2018c). Groundwater will be treated on-site using a combination of on-site water management ponds and a treatment system such as a SaltMaker to meet the required discharge criteria.

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 an engineered marine outflow, comprised of a discharge pipe extending to an engineered diffuser located in Melvin Bay. The treated groundwater effluent will be discharged seasonally in a controlled manner through the diffuser to allow for maximum dilution and minimum impact on the marine environment.

At closure, any treated groundwater stored on surface at the Mine would be returned underground. The discharge conveyance system is described further in Section 3.4.6. Treated groundwater effluent quality will be required to meet the Canadian federal end-of-pipe discharge criteria (MMER), including the amended MDMER (GC 2017; anticipated to come into effect in 2018-2019), and the Canadian Surface Water Quality Guidelines (Canadian Council of Ministers of the Environment [CCME] Guidelines for the Protection of Aquatic Life [CCME 2003]), at the edge of the mixing zone for the discharge into Melvin Bay via an engineered diffuser. It is recognized that further discussions are required with relevant stakeholders to confirm that this approach meets the amended MDMER (GC 2017).

The Groundwater Management Plan (Agnico Eagle 2018a; provided in Appendix D) will be updated to take into account the change in operation and technologies associated with ocean disposal and submitted to regulators prior to any discharge. 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).

A conceptual Ocean Discharge Monitoring Plan has also been developed to monitor marine water quality, including monitoring methodology, locations, frequency and considerations for adaptive management (provided in Appendix E) in concordance with NIRB's guidance (NIRB 2018).

3.4.1 Groundwater Volumes

The proposed underground mine at Meliadine Mine will be mined below the permafrost from 2018 until to the end of mine life in 2032. Groundwater inflow predictions to the underground mine were modelled in 2016 (Golder 2016a) and a summary of predicted groundwater inflows between 2017 and 2032 are provided in Table 1.

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 2016a).

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, or potential losses through the ventilation system. Both mechanisms will potentially reduce actual groundwater inflows to the Mine relative to what was predicted. As such, these predicted inflows to the underground mine development represent unmitigated estimates and can be considered as conservative. 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 2018c).

Excess groundwater will not be managed underground and will be pumped for direct discharge and/or storage on the surface at the Mine in the Saline Pond, the P-area ponds, and/or CP5. The pond capacities and maximum water elevation are presented in Table 2. As indicated in Section 3.3.2, groundwater inputs to surface storage for management are expected to range approximately from a minimum of 0.11 Mm^3/year to a maximum of 0.18 Mm^3/year, dependent on year of Mine life (Agnico Eagle 2018c).

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)
CP5	46,674	66.0
Saline Pond	32,686	62.9
P1	20,781	68.5
P2	6,828	66.5
P3	18,432	67.0

Source: Agnico Eagle (2018c).

3.4.2 Source Material Characteristics

3.4.2.1 Description of the Source Water Chemistry and Treatment

2015 groundwater investigations and previous groundwater investigations indicate that TDS concentrations are relatively consistent with depth below the permafrost at approximately 64,000 mg/L (Golder 2016a, Golder 2016b). The salinity of deep groundwater samples collected to date from Meliadine are at the high end of what has been observed at other sites in the Canadian Shield at corresponding depths (Frape and Fritz 1987; Stotler et al. 2012; Dominion 2014). The concentration of major ions, principally sodium, chloride and calcium, and corresponding electrical conductivity and TDS concentration is substantially higher in Meliadine sub permafrost groundwater than in surface waters and Hudson Bay water, though the chemical composition of groundwater is similar to that of Hudson Bay sea water, albeit more concentrated in the major ions because of the development of permafrost which concentrated the salts in the free water underneath. It is sodium-chloride based with low trace metal content. The high solution TDS of the groundwater and together with the predominance of sodium over calcium infers the presence of a deep Canadian Shield brine overprinted with the signature of relict ocean-derived brine (Golder 2016b).

Recent groundwater quality data from the underground mine collected by Agnico Eagle in 2016 and 2017 from a diamond drillhole (DDH) location at the Mine, indicates mostly stable concentrations for several parameters (Table 3), and suggest that TDS concentrations may be less at approximately 50,000 to 55,000 mg/L, on average. The assumption of TDS at 64,000 mg/L may thus represent a more conservative estimate. It should also be noted, 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 ammonium nitrate, fuel oil [ANFO] and emulsion explosives).

Where water, influenced by the underground workings, and groundwater is stored at the Mine, it will be influenced by non-contact surface water, such as precipitation. Non-contact groundwater (treated via the underground TSS removal plant) pumped from underground for direct discharge with the groundwater stored on site will combine in the storage tank at the the Itivia Fuel Storage Facility prior to disposal via the diffuser to the ocean – as such, TDS values as well as other parameters are anticipated to be reduced sufficiently to meet applicable discharge criteria at the edge of the mixing zone and MDMER requirements.

Table 3: Average Underground Mine Groundwater Quality

Representative Months (average per month)		Aug 2016	Sep 2016	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017
Parameters (total metal)	**Units**														
pH	pH	7.09	7.09	7.34	7.99	7.17	7.08	6.87	7.11	7.32	7.38	7.27	8.27	7.45	7.33
Alkalinity	mg/L	65	69	56	72.6	64	57	61.7	51	64.5	68	68	75	68.2	64
Conductivity	µmhos/cm	53320	70323	77750	79800	56000	77000	76500	77000	79000	79000	76308	74385	72200	72667
Total Hardness (as $CaCO_3$)	mg/L	14923	14644	13125	13260	13700	13200	18267	12700	18400	12433	12623	12500	12583	11700
Turbidity	NTU	82.85	93.00	56.25	27.56	74.00	123.75	69.00	88.00	90.00	51.00	75.00	61.00	47.02	104.33
Total Dissolved Solids (TDS)	mg/L	39663	50765	58600	60600	55000	54350	66433	54900	57500	57300	55123	57815	57520	54567
Total Suspended Solids (TSS)	mg/L	41	68.5	61	108.6	29	45	75.7	63	248.5	102.7	102.2	156	86	102
Aluminum (Al)	mg/L	0.56	8.72	0.075	0.32	0.06	0.21	0.10	6.02	1.29	0.51	1.45	0.73	0.97	1.75
Ammonia Nitrogen (NH_3-NH_4)	mg/L	4.66	4.20	5.93	5.98	3.50	4.13	105.3	4.50	4.95	5.20	5.51	11.1	4.87	4.43
Antimony (Sb)	mg/L	0.005	0.008	0.009	0.005	0.01	0.013	0.009	0.05	0.01	0.008	0.023	0.038	0.05	0.033
Arsenic (As)	mg/L	0.0012	0.32	0.005	0.005	0.002	0.003	0.005	0.01	0.008	0.004	0.016	0.016	0.102	0.013
Barium (Ba)	mg/L	0.05	0.19	0.09	0.10	0.05	0.06	0.61	0.10	0.27	0.07	0.09	0.25	0.10	0.07
Beryllium (Be)	mg/L	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.01	0.002	0.002	0.005	0.008	0.01	0.01
Boron (B)	mg/L	1.4	1.7	1.5	1.5	1.8	1.6	4.98	5.0	4.9	1.5	2.7	3.97	5.0	2.5
Total Organic Carbon (TOC)	mg/L	4.95	2.65	3.68	4.28	2.00	2.23	11.67	2.10	2.95	2.63	3.20	5.30	2.57	2.50
Dissolved Organic Carbon	mg/L	2.60	2.35	3.45	3.74	1.90	1.90	10.17	1.70	2.30	2.37	2.70	4.90	2.32	2.10
Calcium (Ca)	mg/L	1899	1955	1965	1816	1800	1710	3777	1650	3737	1593	1608	1771	1610	1565
Cadmium (Cd)	mg/L	0.00002	0.0002	0.0002	0.0013	0.0002	0.0003	0.0002	0.001	0.0003	0.0002	0.0005	0.001	0.001	0.002
Chloride (Cl - dissolved)	mg/L	—	33500	31000	32800	34000	31250	38000	31000	31500	32000	31385	31538	32800	29333
Chromium (Cr)	mg/L	0.01	0.015	0.018	0.014	0.02	0.025	0.017	0.01	0.02	0.017	0.05	0.075	0.1	0.88
Copper (Cu)	mg/L	0.26	0.44	0.009	0.009	0.01	0.01	0.008	0.05	0.01	0.01	0.02	0.04	0.05	0.03
Cyanide (CN)	mg/L	0.005	0.006	0.008	0.017	0.005	0.005	0.19	0.005	0.028	0.005	0.006	0.01	0.005	0.008
Iron (Fe)	mg/L	9.68	40.28	6.48	5.23	4.31	4.76	8.96	3.60	8.78	6.19	9.81	6.33	8.24	4.10
Lead (Pb)	mg/L	0.002	0.002	0.004	0.005	0.004	0.005	0.005	0.02	0.004	0.003	0.009	0.015	0.02	0.018
Magnesium (Mg)	mg/L	2475	2170	2053	2118	2230	2168	2150	2080	2200	2050	2092	1962	2105	1975
Manganese (Mn)	mg/L	1.06	1.13	0.79	0.78	1.06	0.83	1.41	0.82	0.99	0.87	0.98	0.76	0.972	0.532
Mercury (Hg)	mg/L	0.0002	0.01	0.00001	0.00002	0.00001	0.00001	0.00001	0.00001	0.000001	0.00001	0.00001	0.00001	0.00001	0.00001
Molybdenum (Mo)	mg/L	0.01	0.015	0.04	0.013	0.02	0.025	0.055	0.01	0.25	0.026	0.047	0.075	0.1	0.17
Nickel (Ni)	mg/L	0.05	0.04	0.02	0.01	0.02	0.025	0.04	0.1	0.07	0.017	0.05	0.08	0.1	0.35
Nitrate (NO_3) as N	mg/L	0.15	0.168	0.88	0.57	0.1	0.5	116.39	0.1	2.58	0.23	0.89	4.35	0.17	0.34
Nitrite (NO_2) as N	mg/L	0.02	0.04	0.089	0.072	0.05	0.05	8.01	0.1	0.125	0.086	0.14	0.391	0.042	0.027
Total Kjeldahl Nitrogen (TKN)	mg/L	4.49	3.65	6.95	7.58	5.90	3.78	112.47	4.60	5.20	7.83	7.40	12.0	72.02	4.50
Phosphorous (P)	mg/L	0.05	0.14	0.05	0.05	0.04	0.07	0.14	0.04	0.13	0.12	0.08	0.09	0.1	—
Potassium (K)	mg/L	512	504.5	460.5	493.6	454	496	595	407	609	433	463	518	488	763
Radium-226 (Ra 226)	mg/L	—	—	—	1.9	1.7	0.49	0.33	0.3	1.2	1.95	1.8	1.9	2.2	0.29
Selenium (Se)	mg/L	0.23	0.006	0.0018	0.0033	0.002	0.003	0.002	0.01	0.002	0.002	0.005	0.0075	0.01	0.007
Silver (Ag)	mg/L	0.002	0.003	0.0004	0.0005	0.0004	0.001	0.0003	0.002	0.0009	0.0004	0.0012	0.0018	0.0002	0.018
Sodium (Na)	mg/L	16379	16000	14100	14600	15100	14625	14700	13400	15400	13900	14369	14654	14417	9433
Strontium (Sr)	mg/L	39.8	39.4	44.7	40.9	40.1	43.1	171	38.4	136	40	39	43.5	36.5	23.6
Sulphate (SO_4 – dissolved)	mg/L	—	3350	3125	3260	3200	3125	2700	3100	3100	3233	3169	2969	3120	3067

Table 3: Average Underground Mine Groundwater Quality

Representative Months (average per month)		Aug 2016	Sep 2016	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017
Parameters (total metal)	**Units**														
Thallium (Tl)	mg/L	0.0009	0.0008	0.0009	0.0006	0.001	0.001	0.001	0.001	0.0002	0.0002	0.0005	0.001	0.001	0.002
Tin (Sn)	mg/L	0.051	0.075	0.088	0.058	0.01	0.125	0.233	0.5	0.1	0.083	0.231	0.38	0.5	12.6
Titanium (Ti)	mg/L	0.595	0.21	0.088	0.07	0.01	0.125	0.233	0.5	0.1	0.083	0.231	0.38	0.5	0.25
Uranium (U)	mg/L	0.002	0.003	0.002	0.002	0.002	0.003	0.002	0.01	0.006	0.002	0.005	0.008	0.01	0.09
Vanadium (V)	mg/L	0.05	0.08	0.09	0.06	0.1	0.13	0.08	0.5	0.1	0.08	0.23	0.38	0.5	0.33
Zinc (Zn)	mg/L	0.06	0.08	0.36	0.1	0.1	0.125	0.1	0.5	0.12	0.08	0.23	0.38	0.5	0.34

Source: Groundwater quality data from DDH sample location (Agnico Eagle, October 2017).

3.4.3 Discharge Volumes

The discharge volumes are anticipated to be up to 420 m^3/day, per the predicted groundwater inflows presented in Table 1. This, in combination with the maximum anticipated volume of groundwater to be stored at the Meliadine Mine (maximum of approximately 0.18 Mm^3/year as described in Section 3.4.1), may result in a total of approximately 800 m^3/day for the option to discharge groundwater from underground and groundwater stored at the Meliadine Mine to Melvin Bay. Agnico Eagle is currently investigating the appropriate volume for marine discharge based on discharge criteria and volume of water on-site at the Meliadine Mine that may require ocean disposal.

It is expected that in the short-term, a greater volume of water will be required to discharge to the ocean due to the current volume (Table 4) of water being stored at the Mine and the seasonality of the discharge. It is also anticipated that in wet years the volume of water requiring discharge may be greater than in dry years.

Table 4: Current Volume of Water Stored at the Meliadine Mine on Surface

Surface Pond	Water Volume (m^3)
CP5	36,335 [a]
Saline Pond	4,419 [b]
P1	9,734 [c]
P2	406 [c]
P3	6,822 [c]

a) Volume of water as of October 14, 2017

b) Volume of water as of September 27, 2017

c) Volume of water as of October 4, 2017

Source: Agnico Eagle (correspondence 2017).

3.4.4 Discharge Schedule

Table 5 outlines the timeline for key activities for the Meliadine Mine and associated activities, including tasks and facilities for the preferred options and the alternate option (i.e., ocean discharge).

Table 5: High Level Project Schedule for the Meliadine Mine and Associated Activities

Activity	Timeline	Notes
On-site water storage	Ongoing	—
Groundwater Management Plan	Six months prior to discharge	Type A Water Licence 2AM-MEL1631 requirement
Construction of Diffuser and Pipe, including Receiving Tank	Q3-2018	Pending permit approvals
Commissioning of Salt Water Treatment Plant (SaltMaker #1)	Q3-2018	—
Commissioning of Salt Water Treatment Plant (SaltMaker #2, and #3 if required)	Q1-2019	—
First Discharge to the Ocean	Q2-2019	—
Active Discharge to the Ocean	Annually May through October to 2032	—

Table 5: High Level Project Schedule for the Meliadine Mine and Associated Activities

Activity	Timeline	Notes
Operation of Salt Water Treatment Plant	24 h a day / 7 days a week, May thru Oct	In-service as required
Inactive Discharge	Annually November through April to 2032	Water will be stored underground and in surface containment ponds during the winter
Truck Transportation	Annually May through October to 2032	—
Final Saline Effluent Discharge to the Ocean	Seasonally, End of Mine life 2032	—

Source: Agnico Eagle (2018c).

3.4.5 Transportation and Discharge Facility

The groundwater will be trucked from the Mine to the Itivia Fuel Storage Facility at a minimum volume 400 m^3/day from May to October. This will require eight trips per day with a 50,000 litre (L) diesel-fueled water truck that will travel via the AWAR (see Figure 1). Each round-trip between the Mine to the discharge location is approximately 3-hours (including loading, travel, and unloading); therefore two water trucks will be required, with two people to operate during open water season (May to October). A third truck will be available in case of mechanical malfunction.

At a volume of 800 m^3/day for treated groundwater effluent discharge, the same transportation details apply, however, additional trucks will be required to meet the additional volume to be discharged. Four water trucks will be required, each with one individual to operate during the open water season (May to October). A fifth truck will be available in case of mechanical malfunction. Agnico Eagle is currently investigating the appropriate volume for marine discharge (Section 3.4.4) but is anticipated to range from 400 to 800m^3/day.

All trucks will be fueled using diesel facilities located on-site (Agnico Eagle 2018e), shown as Figure 2. No additional fuel storage is required above that permitted under the Type A Water Licence 2AM-MEL1631.

For the ocean discharge option, the saline effluent would be trucked from the Mine and discharged in Melvin Bay at Itivia Harbour. The discharge facility will include an unheated water storage tank at the Itivia Fuel Storage Facility with a capacity to hold up to 2,000 m^3 (2 ML tank), and an engineered marine outflow (discharge pipeline extending to an engineered diffuser located in Melvin Bay), operating during the open water season from 2019 to 2032. Refer to Figure 2 which provides a conceptual rendering of the tanks at the Itivia Fuel Storage facility and the proposed engineered marine outfall.

NO. DESSIN
DRAWING NO. 65-100-210-200_R0

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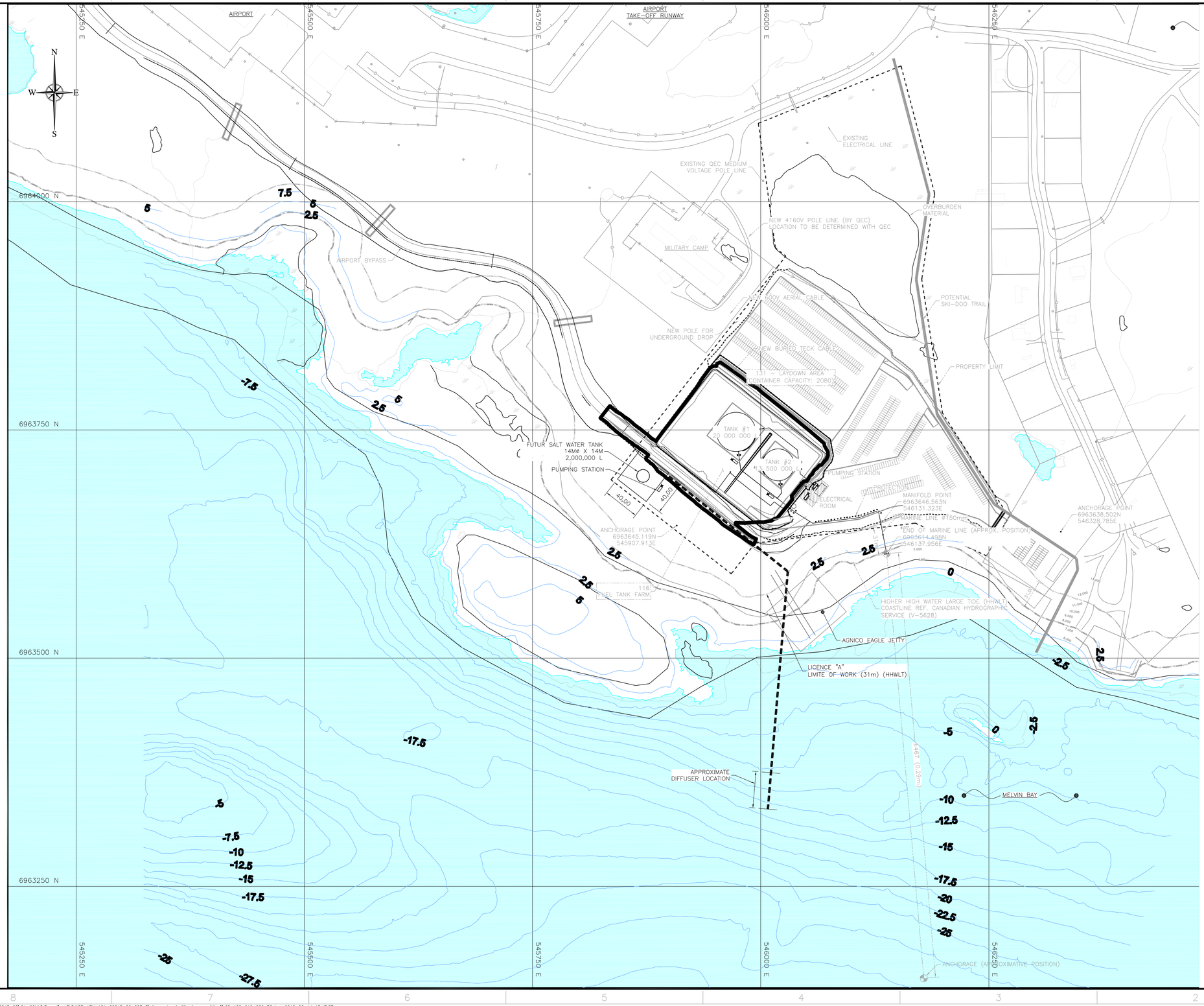

PLAN CLÉ
KEY PLAN

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NOTES GÉNÉRALES / GENERAL NOTES

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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
0	2018-06-14	ISSUED FOR PERMITTING	I.G.	S.D.	
A	2018-06-13	ISSUED FOR COMMENTS	S.P.	S.D.	

REVISIONS

TITRE / TITLE

AGNICO EAGLE – MÉLIADINE DIVISION
000 – GENERAL
210 – GENERAL ARRANGEMENT
SALINE WATER STORAGE FACILITY
RANKIN INLET
PLAN VIEW

DESSINÉ PAR / DRAWN BY	STEVEN PERRON	DATE 2018-06-13
VÉRIFIÉ PAR / CHECKED BY	UGO BANVILLE, Ing.	2018-06-13
APPROUVÉ PAR / APPROVED BY	STEPHAN DUPUIS, P. Eng.	2018-06-13
ÉCHELLE / SCALE	1:2000	DATE 2018-06-12
NO. DESSIN / DRAWING NO.	65-100-210-200	
NO. PROJET / PROJECT NO.	6526	REVISION 0 / FEUILLE / SHT 1 / 1

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\\cavds1dat01\Projet_18X-XXXX-XX\181-00245-00\01-COMM\Envoyé_AEM\WSP-AEM-181-00245-00-003 (Saline water facility for permitting)\65-100-210-200_R0.dwg-2018-06-14 15:17:57

FILE NO. 65-100-210-200_R0.dwg

3.4.6 Discharge Conveyance System

The engineered marine outfall to discharge groundwater to the ocean into Melvin Bay at Itivia Harbour is based on modelling design parameters for the proposed amendment activities to meet the required discharge criteria at the edge of the mixing zone, to minimize potential effects on the marine environment. The preliminary requirements for the diffuser design are described in the following subsections and also in Appendix F.

3.4.6.1 Diffuser Design and Location

Several factors are taken into consideration for the design and location of the diffuser, including regulatory guidelines to meet required discharge criteria, as well as biophysical and socio-economic considerations.

Currently, there are no specific criteria for mixing zone discharges in Canadian coastal and estuarine water for mine effluent. However the Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories (NWT 1992) provide guidance that the limits of initial mixing zone in marine environments is 100 m from all points of discharge. A radius of 100 m from the point of discharge is widely used for marine environmental compliance assessments. There are also no federal guidelines available for chloride or thermal discharges to the marine environment, as the Canadian Water Quality Guidelines do not provide a guideline for the chloride ion in marine environments (CCME 2011), but their interim guideline for marine salinity states that human activity should not cause salinity (expressed in ppt) to fluctuate by more than 10% of the natural level expected at that time and depth (CCME 1999). The British Columbia Ministry of the Environment Guidelines (BC MOE 2017a) state the following:

- “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.” (Modelled after the CCME salinity 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

Based on the bathymetry of Melvin Bay at Itivia Harbour, the diffuser will be placed at greater depth to provide the best possible mixing. A rocky outcrop is located near the Itivia Harbour landing barge location to the south-east of the proposed receiving tank location (see Figure 2). Military facilities are located to the north-west of the Itivia Fuel Storage Facility, including buildings and a by-pass road; vehicles cannot stop within 500 m of these military facilities.

In consideration of the existing facilities and the bathymetry of Melvin Bay, the proposed location for the diffuser pipe is to extend it from the receiving tank directly south-south-west into Melvin Bay (see Figure 2). The diffuser port would be placed on the seabed at a depth of approximately 20 m, to allow for an unconstrained mixing zone and to avoid interference with use of Itivia Harbour by ships and boats at high and low tide.

The discharge pipe is anticipated to be a 3 or 4 inch diameter pipe, placed inside a larger insulating pipe. The pipe is anticipated to be a high-density polyethylene (HDPE) pipe and to have an outfall length of up to 350 m from the storage tank or 230 m from the shoreline, with a single or double port for discharge depending on the required dilution factor to meet the required discharge criteria. The port is proposed

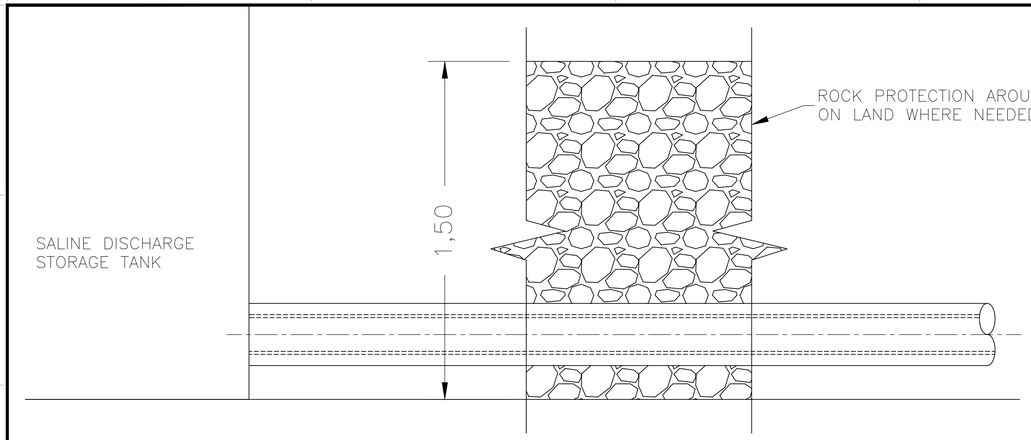
to be an approximately 2 inch diameter HDPE pipe, placed at a vertical angle of 90° from the horizontal plane (upward) at the seabed, at a depth of approximately 20 m below the water surface.

The treated groundwater effluent will be discharged in a controlled manner through the diffuser in compliance with the required discharge criteria to allow for maximum dilution and minimum environmental impact to the marine environment. Saline effluent quality will be required to meet the Canadian federal end-of-pipe discharge criteria (MDMER), including the amended MDMER (GC 2017; anticipated to come into effect in 2018), and Canadian Surface Water Quality Guidelines (CCME Guidelines for the Protection of Aquatic Life [2003]).

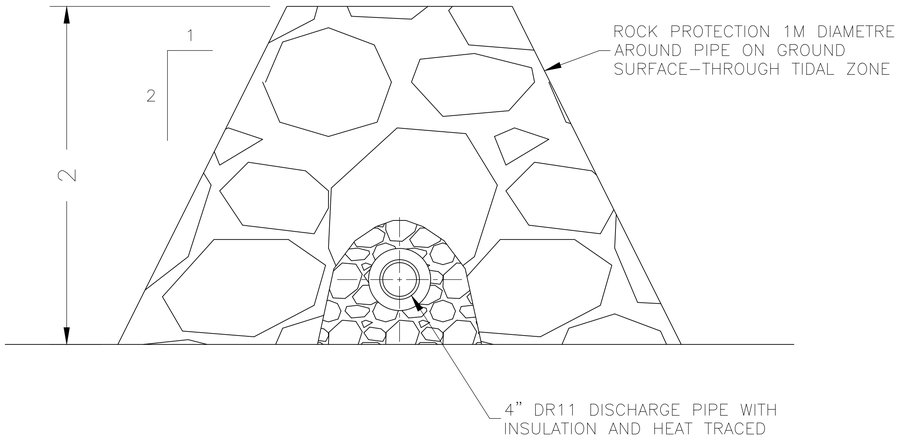
The discharge conveyance system is depicted in Figure 2, and a conceptual sketch is shown in Figure 3. Conceptual renderings of the engineered marine outfall are depicted in Photograph 1 to 4 below. The final diffuser design will be provided, if the FEIS Addendum is approved, 60 to 90 days prior to construction.

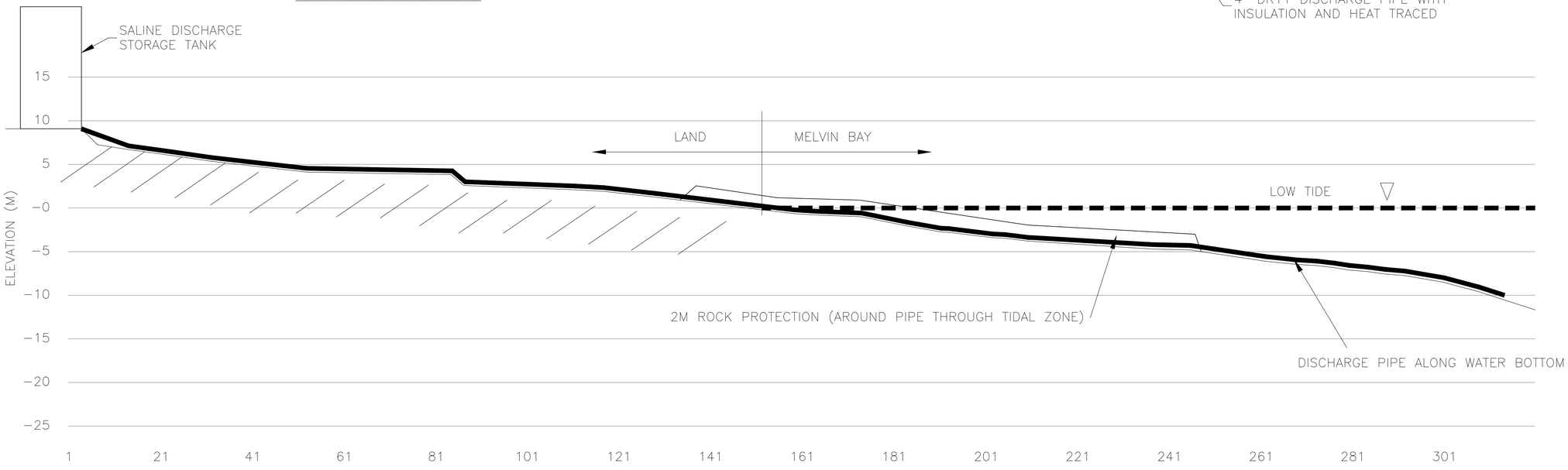
NO. DESSIN
DRAWING NO. 65-100-210-201_R0

FORMAT ARCHD



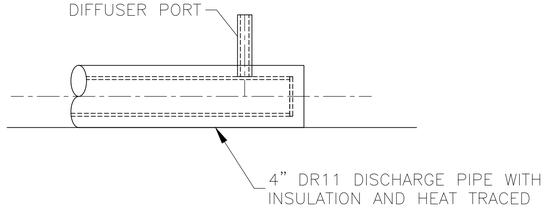
STORAGE TANK CONNECTION POINT





NOTE(S)

- IN CONSIDERATION OF THE EXISTING FACILITIES AND THE BATHYMETRY OF MELVIN BAY, THE PROPOSED LOCATION FOR THE DIFFUSER AND DISCHARGE PIPE IS TO EXTEND IT FROM THE STORAGE TANK AT THE ITIVIA OIL HANDLING FACILITY DIRECTLY SOUTH–SOUTH–WEST INTO MELVIN BAY.
- DISCHARGE PIPE (4" DR11 INSULATED AND HEAT TRACED DISCHARGE PIPE) IS ANTICIPATED TO BE A HIGH–DENSITY POLYETHYLENE (HDPE) PIPE WITH AN OUTFALL LENGTH OF 170M FROM THE LOW TIDE LINE, WITH A SINGLE PORT FOR DISCHARGE TO MEET DISCHARGE CRITERIA.
- THE DISCHARGE PIPE WILL REQUIRE PLACEMENT ON THE SURFACE WITH A ROCK PROTECTION OF 2 M AND 2:1 SIDE SLOPES, THROUGH THE TIDAL ZONE, DUE TO THE PRESENCE OF PERMAFROST ACTIVE LAYER.
- THE DIFFUSER PORT IS PROPOSED TO BE A 1.5 INCH DIAMETER HDPE PIPE, PLACED AT A VERTICAL ANGLE OF 90° FROM THE HORIZONTAL PLANE (UPWARD) FROM THE SEABED AT A DEPTH OF 20 M, TO ENSURE AN UNCONSTRAINED MIXING ZONE AND TO AVOID INTERFERENCE WITH THE USE OF ITIVIA HARBOUR BY SHIPS AND BOATS AT HIGH AND LOW TIDE.
- THE PIPE AND DIFFUSER PORT WILL BE CONSTRUCTED ON SHORE AND THE PIPE FLOATED OUT AND SUNK INTO MELVIN BAY, USING INERT MATERIALS TO MAINTAIN THE PIPE AT THE BOTTOM OF THE BAY (CONCRETE WEIGHTS OR SIMILAR). ALL MATERIALS WILL BE SUCH THAT THEY CAN BE REMOVED UPON END OF MINE LIFE.
- DISCHARGE WOULD BE DURING THE SUMMER MONTHS (MAY – OCTOBER, OPEN WATER SEASON) ONLY.
- 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.



END OF DISCHARGE PIPE

PLAN CLÉ
KEY PLAN

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

Ref. 151-06440-40

NOTES GÉNÉRALES / GENERAL NOTES

DEMANDE DE PROPOSITION
REQUEST FOR PROPOSAL
AGNICO EAGLE DATE : 2018-06-14

NE PAS UTILISER
POUR CONSTRUCTION
NOT FOR CONSTRUCTION
AGNICO EAGLE DATE : 2018-06-14

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DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

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

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT
0	2018-06-14	ISSUED FOR PERMITTING	I.G.	S.D.	
A	2018-06-13	ISSUED FOR COMMENTS	S.P.	S.D.	

REVISIONS

TITRE / TITLE
AGNICO EAGLE – MELIADINE DIVISION
000 – GENERAL
210 – GENERAL ARRANGEMENT
SALINE WATER STORAGE FACILITY
RANKIN INLET
SECTION AND DETAILS

DESSINÉ PAR / DRAWN BY	STEVEN PERRON	DATE 2018-06-13
VÉRIFIÉ PAR / CHECKED BY	UGO BANVILLE, Ing.	2018-06-13
APPROUVÉ PAR / APPROVED BY	STEPHAN DUPUIS, P. Eng.	2018-06-13
ÉCHELLE / SCALE	1:2000	DATE 2018-06-12

NO. DESSIN / DRAWING NO. 65-100-210-201

NO. PROJET / PROJECT NO.	REVISION	FEUILLE / SHT
6526	0	1 / 1

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\\cavdo1dat01\Projet_18X-XXXX-XX\181-00245-00\01-COMM\Envoyé_AEM\WSP-AEM-181-00245-00-003 (Saline water facility for permitting)\65-100-210-201_R0.dwg-2018-06-14 16:12:09

FILE NO. 65-100-210-201_R0.dwg

Photo 1: Conceptual rendering of treated groundwater effluent storage tank at the Itivia Fuel Storage Facility, including the engineered marine outfall connection (discharge pipe and rock protection).

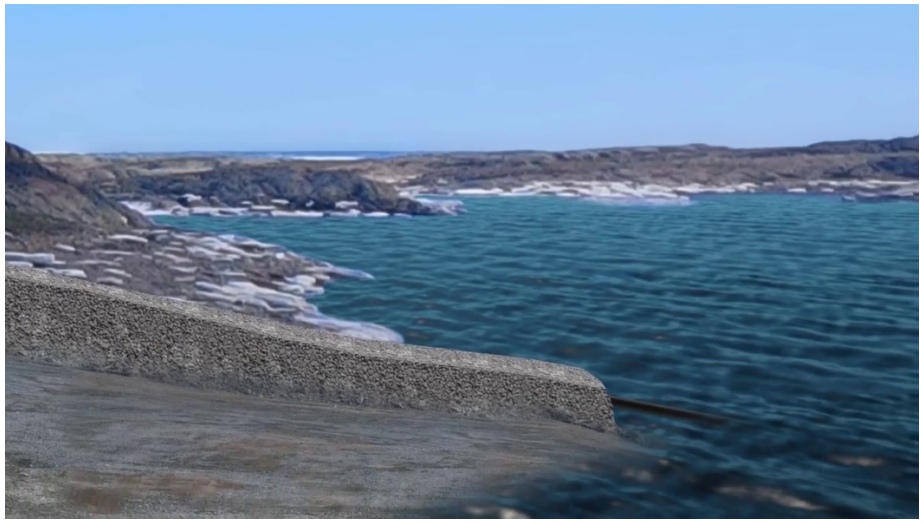


Photo 2: Conceptual rendering of engineered marine outfall – discharge pipe within rock protection over land and into Melvin Bay (the rock protection will continue through the tidal zone).

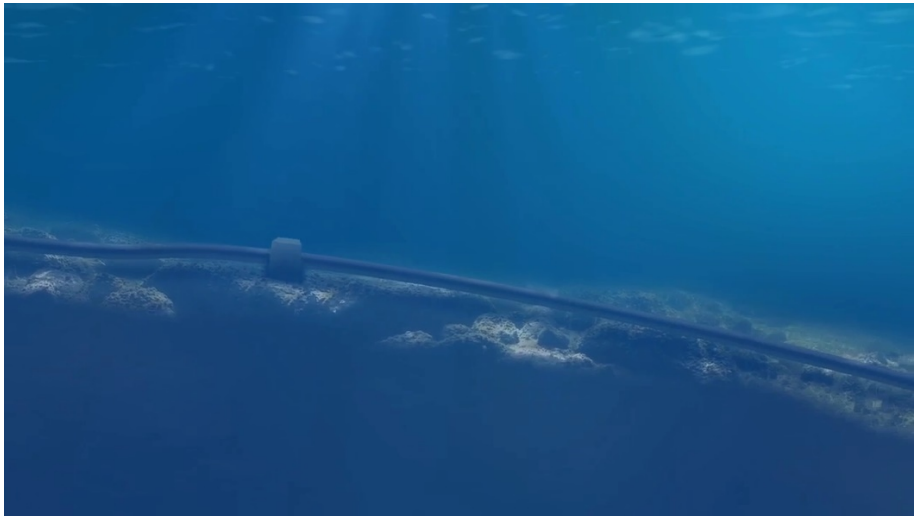


Photo 3: Conceptual rendering of engineered marine outfall – discharge pipe along the seabed at Melvin Bay, with stabilizing weights.

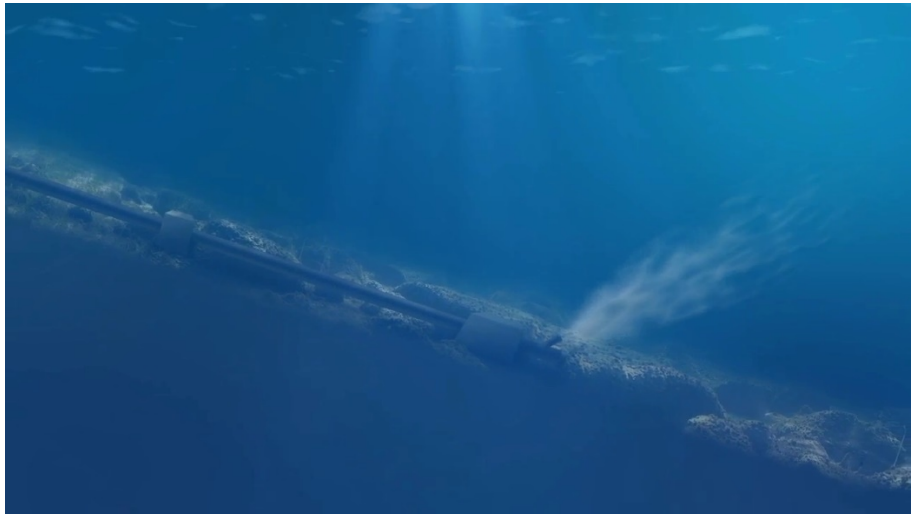


Photo 4:: Conceptual rendering of engineered marine outfall – discharge pipe along the seabed at Melvin Bay, with stabilizing weights and the diffuser port at the end at a depth of approximately 20 m below the water surface.

3.4.6.2 Diffuser Construction

Construction of the diffuser for either a single or double port design will be very similar, with variations in pipe and port size. Due to the presence of permafrost and the active layer, the burial of the discharge pipe is not an option, and instead the pipe will require placement on the surface with a rock protection 1.5 m deep and 2:1 side slopes[1] through the tidal zone, and then lowered to the seabed where it will extend to reach a depth of approximately 20 m below the water surface. Fabrication is anticipated to occur on the shoreline and the pipe and diffuser would be floated out to its location and then sunk during the open water season.

The installation of the pipe and diffuser would require approximately 10 people for four weeks to complete. Staff will be made up of construction engineers, vessel and crane operators, construction labourers (skilled and unskilled) and a crew of up to four staff during concrete casting. The equipment required to install the pipe and diffuser is proposed as follows:

- HDPE pipeline fusers/welders
- concrete collar casting area (rebar and plywood forms etc.)
- land based small crane
- land based large crane for lifting fused pipeline into the water
- vessel with a davit for lifting up to 1000 lb and to aid pulling the pipeline into the water
- 2 or 3 boats for divers and positioning the diffuser and pipeline
- diving safety equipment including a decompression chamber
- small tools

3.4.7 Contaminants of Concern

Modelling of the discharge for an engineered marine outfall has been completed to evaluate ocean discharge of treated groundwater effluent at a constant rate through an outfall installed in a suitable location in Melvin Bay, with an assumed discharge quality after treatment to comply with the effluent discharge criteria described below in Table 6 and Table 7. Additional details regarding the modeling are provided in Appendix F. The following sections provide a discussion on the results of the modeling and identification of contaminants of concern.

3.4.7.1 Water Quality Parameters

This section provides a discussion of toxicity information on select water quality parameters (potential contaminants concern) that have been identified in the proposed treated groundwater effluent, specifically chloride, salinity, temperature, and TDS. These parameters were selected as they have naturally high concentrations in the untreated groundwater from the underground inflows at the Meliadine Mine (as described in Section 3.4.2), particularly compared to applicable standard or guidelines, or background concentrations in Melvin Bay (as described in Section 6.1).

[1] Information provided regarding the engineering of the discharge pipe has been completed for assessment purposes only and should not be considered final design.

Of the three main components of the treated groundwater effluent (i.e., calcium, sodium, and chloride), which are also major constituents of seawater, toxicology testing in comparison to CCME guideline (2011) indicates that the toxic effects of calcium chloride and sodium chloride are likely due to the chloride anion, thus the emphasis in the present document is on the effects of chloride rather than those of calcium or sodium. Chloride ions do not degrade in the environment and tend to remain in solution, once dissolved.

Evans and Frick (2001) reviewed the literature on the biological effects of chloride and drew a number of conclusions regarding chloride salt toxicity and effects on aquatic biota. Tolerance to elevated chloride concentrations decreases with increasing exposure time. Short-term exposures to concentrations of chloride in the hypersaline range (>50,000 mg/L) may kill adult fish and other organisms rapidly (e.g., 15 minutes). As exposure time increases, tolerance to chloride decreases. Tolerance to chloride can be increased through gradual increases in chloride concentrations, allowing the organism to develop mechanisms for dealing with the osmotic shock and other physiological stresses.

A number of studies reviewed by Evans and Frick (2001) measured the effects of physical variables on salinity tolerance. Aquatic biota are more tolerant of chloride in water in which oxygen concentrations are close to saturation. While some studies suggest that organisms are more tolerant to chloride at lower temperatures, other studies have shown that the reverse is true.

Zooplankton and benthic invertebrates appear to be relatively more sensitive to sodium chloride concentrations than fish. As well, within a given taxonomic category (e.g., benthic invertebrates or fish), there is significant inter-species variation in salinity tolerances.

Potassium chloride tends to be the most toxic chloride salt to fish and aquatic invertebrates. Magnesium chloride is next in toxicity, followed by calcium chloride and then sodium chloride. Fish fry may be more tolerant of elevated concentrations of calcium compared to sodium chloride.

As indicated in Section 3.4.6.1, a radius of 100 m from the point of discharge is widely used for marine environmental compliance assessments. Since salt content in the marine water and treated groundwater effluent plume are mainly comprised of chloride ions, and the chloride ion is considered more toxic than sodium or calcium ions, chloride guidelines were used to assess the near field mixing zone. The guideline for marine and estuarine waters are based on natural ambient conditions taking into consideration the natural environmental regimes (e.g., temperature) in which organisms have adapted through evolutionary processes. Background surface water quality data in the receiving environment (i.e., Melvin Bay) for the relevant parameters were compiled from the baseline data collection program (Nunami Stantec Ltd. 2012, provided in Appendix B) and are summarized in Table 6 and Table 7 for temperature and salt related ions, respectively. In addition, the concentrations of potential contaminants of concern from untreated groundwater (as presented in Section 3.4.2, Table 3) are added to Table 6 and Table 7 respectively for comparison to baseline concentrations recorded in Melvin Bay.

Table 6: Summary of Melvin Bay Background Marine Water Temperature and Salinity taken in August 2011 and Average Untreated Groundwater Concentrations

Parameter	Surface	Bottom	Untreated Groundwater
Temperature (°C; n=3)	8.5 to 9.45	7.93 to 9.07	-3.4°C - +3.8°C[a]
Salinity (ppt; n=3)	29.29 to 29.35[b]	29.30 to 29.38[b]	55 to 56[c]

Source: Nunami Stantec 2012.

a) 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.

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

c) Estimated average groundwater salinity based on average TDS groundwater concentrations presented in Section 3.4.2, Table 3 (55,700 mg/L average TDS). 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 7: Summary of Select Melvin Bay Background Marine Ion Concentrations taken in August 2011 and Average Untreated Groundwater Concentrations

Ion	I1	R1	R2	Untreated Groundwater[a]
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: Nunami Stantec 2012.

a) Averages per untreated groundwater concentrations presented in Section 3.4.2, Table 3.

No federal or provincial/territorial guideline was available for chloride discharges to the marine environment; therefore, the guideline published by the BC MOE (2017a), as described in Section 3.4.6.1, was considered. This narrative guideline indicates that the chloride concentration at the mixing zone boundary should not exceed the baseline salinity of 29,300 mg/L by more than 290 mg/L (10%). As shown in Appendix F, the dilution factors resulting from the effluent model indicated that chloride concentrations would meet the narrative guideline within 1 to 3 m of the discharge point.

For the purposes of the modelling, it was assumed that approximately 50% of TDS would be represented by chloride. As a result, it was also considered appropriate to apply the narrative guideline for chloride of ±10% to TDS as well. It was assumed that groundwater will be treated prior to discharge through appropriate means such that the TDS concentration of the treated groundwater effluent is no greater than approximately 37,700 mg/L, based on the baseline TDS concentration of 34,300 mg/L plus 10%. To reach a TDS concentration difference of no more than 10% at the edge of regulatory mixing zone, the required dilution factor via the diffuser is 3 (see Appendix F for derivation).

There are also no federal or provincial/territorial guidelines for thermal changes to the marine environment due to mixing zone discharges. The guideline published by the BC MOE (2017a), as described in Section 3.4.6.1, was considered. As detailed in Appendix F, the required dilution factor via the diffuser for temperature is 3.

3.4.7.2 Contaminants with Federal or Provincial Guidelines

Treatment options are currently being investigated for groundwater prior to discharge to the marine environment. For evaluation and design purposes, it was considered that groundwater will be treated to meet the most stringent of the available acute regulatory guidelines at the discharge point, specifically the following:

- Metal and Diamond Mining Effluent Regulations (proposed MDMER), once they come into effect (GC 2017).
- 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).

The guidelines from each source are shown in Table 8 and were used to select the standard-based effluent discharge criteria for evaluation and design purposes. Given that groundwater will be treated to meet required guidelines at the end-of-pipe, the discharged groundwater effluent plume is not considered to pose an acute risk to aquatic receptors for the contaminants described above.

Table 8: Meliadine Mine – Standard-based Effluent Discharge Criteria

Parameter	Units	MDMER [a]	CCME [b]	BC MOE [c]	Standard-Based Effluent Discharge Criteria [d]
Total Suspended Solids (TSS)	mg/L	15	Narrative [e]	Narrative [f]	15
Ammonia (as N)	mg/L	-	-	5.91	5.91
Arsenic	mg/L	0.3	-	0.0125	0.0125
Copper	mg/L	0.3	-	0.003	0.003
Cyanide (free)	mg/L	0.5	-	0.001	0.001
Lead	mg/L	0.1	-	0.14	0.1
Nickel	mg/L	0.5	-	-	0.5
Nitrate (as N)	mg/L	-	1500	-	1500
Radium-226 (Ra 226)	Bq/L	0.37	-	-	0.37
Silver	mg/L	-	0.0075	0.003	0.003
Zinc	mg/L	0.5	-	0.055	0.055

a) Metal and Diamond Mining Effluent Regulations (MDMER; GC 2017) Schedule 4 Authorized Limits of Deleterious Substances - Maximum Authorized Monthly Mean Concentration (proposed).
b) Canadian Council of Ministers of the Environment (CCME 2003) Short-term Water Quality Guidelines (WQG) for the Protection of Aquatic Life - Marine.
c) 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).
d) End of pipe discharge criteria is based on the minimum of the MDMER, CCME and BC MOE.
e) The CCME WQG for total suspended solids (TSS) based on clear flow is a 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 hours and 30 days). For high flow, the WQG is a maximum increase of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L, and should not increase more than 10% of background levels when background is ≥ 250 mg/L.
f) The BC MOE WQG for TSS 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; and
   • Change from background of 10% when background is > 100 mg/L at any time during high flows or in turbid waters.

3.4.7.3 Contaminants without Guidelines

For contaminants without guidelines, the 95% upper confidence limit of the mean (95% UCLM) of the available DDH untreated groundwater data (August 2016 to September 2017 presented in Table 3) were calculated as the initial discharge concentrations for the purposes of the effluent modeling and are presented in Table 9. A comparison of the effluent concentrations considering a dilution factor of 3 via the diffuser (see Appendix F) with background concentrations is also shown. There are no acute guidelines for the parameters listed; therefore, no conclusions about potential environmental risk for effluent concentrations that are greater than background values can be made.

Table 9: Meliadine Mine – Assumed Treated Groundwater Effluent Discharge Criteria and Concentrations after Diffuser Dilution

Parameter	Units	Concentrations		
		Background (1)	Untreated Groundwater (95% UCLM) (2)	Effluent from Diffuser (3)
pH (pH units)	pH units	7.48 – 7.56	7.634	7.16
Alkalinity (as $CaCO_3$)	mg/L	143	71.35	23.78
Total Hardness (as $CaCO_3$)	mg/L	6400	14101	4700
Turbidity	NTU	0.13	90.54	**30.18**
Total Dissolved Solids (TDS)	mg/L	34,300	58165	**37700**
Aluminum	mg/L	<0.30	1.832	**0.61**
Antimony	mg/L	<0.0010	0.0047	**0.002**
Barium	mg/L	<0.010	0.299	**0.10**
Beryllium	mg/L	<0.00050	0.00165	**0.0006**
Bicarbonate (as $CaCO_3$)	mg/L	175	69.09	23.03
Boron	mg/L	4.79	2.389	0.80
Total Organic Carbon (TOC)	mg/L	3.6	6.448	2.15
Dissolved Organic Carbon (DOC)	mg/L	-	5.69	1.90
Cadmium	mg/L	<0.00050	5.83E-04	0.0002
Calcium	mg/L	404	2164	**721**
Chloride (dissolved)	mg/L	20133	33274	11091
Chromium	mg/L	<0.050	<0.1(3)	0.03
Iron	mg/L	<0.60	13.37	**4.46**
Lithium	mg/L	0.167	3.33	**1.11**
Magnesium	mg/L	1310	2129	709.67
Manganese	mg/L	<0.020	1.076	**0.36**
Mercury	mg/L	<0.000050	4.01E-05	0.00001
Molybdenum	mg/L	0.0112	0.0181	0.01
Nitrite (as N)	mg/L	<2.5	2.156	0.72
Total Kjeldahl Nitrogen (TKN)	mg/L	<2	55.4	**18.47**
Phosphorus	mg/L	<6.0	0.069	0.02
Potassium	mg/L	394	514.2	171.40
Selenium	mg/L	<0.020	0.0457	0.02
Silica (reactive)	mg/L	-	19.77	6.59
Sodium	mg/L	10867	14784	4982
Strontium	mg/L	7.27	65.21	**21.74**
Sulfate	mg/L	2890	3160	1053.33
Thallium	mg/L	<0.00020	3.57E-04	0.0001
Tin	mg/L	<0.020	<0.5(4)	0.17
Titanium	mg/L	<0.020	0.187	**0.06**
Uranium	mg/L	0.00311	0.00168	0.0006
Vanadium	mg/L	<0.0050	<0.5(4)	0.17

"<" Concentration is below the reported detection limit (RDL).
"-" Parameter was not measured/reported.
Underlined – Untreated Groundwater Concentration (95% UCLM) is greater than background.
Bold – Diluted Effluent Concentration (after discharge through the engineered diffuser) is greater than background.

(1) Maximum background concentration in Melvin Bay (Nunami Stantec Ltd. 2012)
(2) Discharge concentration is the 95% Upper Confidence Level of the Mean (UCLM) of the August 2016 to September 2017 DDH groundwater data (untreated groundwater) provided by Agnico Eagle (see Table 3). 95% UCLM calculated using the US EPA ProUCL Version 5.1 software.
(3) Effluent from Diffuser = estimated untreated 95UCLM groundwater concentrations per the modelled dilution factor of 3 for the diffuser (per Appendix F).
(4) A 95% UCLM could not be calculated due to low detection rates within the dataset. The maximum reported value has been used as a conservative approach and for comparative purposes.

3.4.8 Effluent Modelling to Support the Environmental Assessment

To understand the diffusion and dilution of discharging the treated groundwater effluent into Melvin Bay, Golder undertook a preliminary modelling assessment to determine the physical dimensions of the outflow to comply with the applicable regulatory standards and guidelines within the mixing zone. The model results are provided in Appendix F, and summarized here. The scope of the model included:

- Near field modelling of dispersion of treated groundwater effluent plume using Cornell Mixing Zone Expert System (CORMIX; Doneker, and Jirka, 2007)
- Near field modelling of dispersion of negative buoyant plume associated with the treated groundwater effluent using CORMIX
- Assessing the plume dilution behavior

The CORMIX model 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). This model is an internationally recognized model and recognized and supported by the United States Environmental Protection Agency for predicting effluent dilution in an aquatic receiving environment. CORMIX has been applied worldwide for conceptual design and analysis of effluent diffusers.

Nearshore ambient and effluent characteristics required to implement the mixing model are presented in Appendix F. The required dilution factor is 3.

The moderate tide in Melvin Bay is expected to provide good flushing and mixing conditions, in addition to the effluent jet momentum contribution to initial mixing. A conservative approach was used for selecting the ambient flow conditions for the mixing zone analysis for the treated groundwater effluent plume (including thermal requirements). The treated groundwater effluent plume meets the effluent discharge criteria presented in Table 8 and Table 9 through dilution well within the 100 m distance for the ambient and discharge conditions test (within 1 m horizontal and 2-3 m vertical distance from the diffuser port). The thermal plume met the temperature regulatory guideline (BC MOE 2017a, described in Section 3.4.6.1) in less than 1 m from the discharge point.

The modelling of the treated groundwater effluent discharge was limited to nearshore oceanographic characteristics. The modelling study did not include geotechnical, structural or hydraulic engineering assessments of the proposed outfall or water quality analysis of the proposed discharge. This work would be completed as part of detailed final design.

SECTION 4 • AMENDMENT ACTIVITIES INTERACTIONS AND MANAGEMENT

The predicted residual effects presented for the physical, biological, and socio-economic environment in the FEIS (Agnico Eagle 2014; summarized in Volume 11) considered Project activities for the Meliadine Mine site, AWAR, and activities at Rankin Inlet. The geographic area for the proposed amendment activities presented in this FEIS Addendum for discharge to the ocean is within the Project footprint assessed in the FEIS, including wildlife habitats. Baseline data was collected in Melvin Bay as part of the FEIS and Melvin Bay was considered an impacted area from shipping, spills and use by small boats and the local community. Consistent with the original FEIS, the local study area (LSA) at Itivia Harbour and Melvin Bay does not support critical habitat for benthic invertebrates, fish, birds, or marine mammals. Effects at Rankin Inlet and Itivia Harbour assessed in the FEIS were associated with material receipt, storage, and transfer to the Meliadine Mine. Given that the Project remains smaller in scale than what was assessed in the FEIS, many of the FEIS predicted effects will remain unchanged as a result of the proposed amendment activities, which will be primarily focused at Itivia Harbour to capacitate the discharge of saline treated groundwater effluent to the ocean at Melvin Bay. Mitigation measures described in the FEIS will continue to be applied, including for the proposed amendment activities, as appropriate. In accordance with the NIRB Project Certificate No.006 (2015), a saline water management plan has been provided to the NIRB (Groundwater Management Plan; Agnico Eagle 2018a), including mitigation measures designed to address the potential for higher-than-predicted volumes of saline water inflows into the underground mine, treatment and disposal methods (Appendix D).

A matrix table of proposed amendment activities and valued components listed in the FEIS (VCs – representing Valued Ecosystem Components [VECs] and Valued Socio-Economic Components [VSECs]) is provided, and for each of the VCs, all reasonable interactions between the proposed amendment activities from construction through operations were identified (Table 10).

Table 10: Linkage Matrix Between Proposed Amendment Activities and Biophysical and Socio-Economic Components

FEIS Valued Component (VC; Agnico Eagle 2014)	Proposed Amendment Activities – Ocean Discharge			
	Construction of the discharge pipe and diffuser on land	Discharge pipe and diffuser installation	Trucking treated groundwater effluent along the AWAR to Itivia Fuel Storage Facility	Discharge of treated groundwater effluent to Melvin Bay
Air Quality			X	
Climate and Meteorology				
Greenhouse Gases and Climate Change			X	
Noise	X		X	
Vibration				
Geology				
Permafrost				
Soils and Terrain				
Vegetation	X		X	
Terrestrial Wildlife and Wildlife Habitat	X		X	
Birds and Bird Habitat				
Hydrogeology and Groundwater Quality				

Table 10: Linkage Matrix Between Proposed Amendment Activities and Biophysical and Socio-Economic Components

FEIS Valued Component (VC; Agnico Eagle 2014)	Proposed Amendment Activities – Ocean Discharge			
	Construction of the discharge pipe and diffuser on land	Discharge pipe and diffuser installation	Trucking treated groundwater effluent along the AWAR to Itivia Fuel Storage Facility	Discharge of treated groundwater effluent to Melvin Bay
Hydrology				
Freshwater water quality and sediment quality				
Freshwater plankton and benthos				
Freshwater fish and fish habitat				
Marine water and sediment quality		X		X
Marine Plankton and Benthos		X		X
Marine Vegetation		X		
Marine Fish and Fish Habitat		X		X
Marine Birds		X		X
Marine Mammals		X		X
Population Demographics				
Economic Development and Opportunities	X			
Community Infrastructure and Public Service				
Individual and Community Wellness				
Governance and Leadership				
Traditional Activities and Knowledge		X		X
Non-traditional land and resource use		X		X
Cultural, Archaeological and Paleontological Resources	X			
Ecological Health[a]				X
Human Health				

a) Ecological Health is not assessed separately but inherently considered as part of the assessment on marine mammals in fish in relation to the treated effluent discharge and the investigation into contaminants of potential concern.

Valued Components (VCs) per the Meliadine Final Environmental Impact Statement (FEIS; Agnico Eagle 2014).

X = VC interaction with the Proposed Amendment Activities in this FEIS Addendum

Blank = No VC interaction with the Proposed Amendment Activities in this FEIS Addendum

Table 11 presents the potential changes to FEIS VCs in relation to the proposed amendment activities presented in this FEIS Addendum, including new potential effects that require assessment. VCs assessed in the FEIS for the Mine that are not relevant to the proposed amendment activities have not been included. VCs with no interactions with the proposed amendment activities, as identified in Table 11, will have no change per the assessment completed in the FEIS (Agnico Eagle 2014) and are not carried forward.

Table 11: Meliadine Mine FEIS Valued Components (Agnico Eagle 2014) and Proposed Amendment Activities Interactions Matrix and Potential Changes in the Assessment

FEIS Valued Component (VC)	FEIS / FEIS Addendum Predicted Effect Pathways	FEIS Assessed Significance (Agnico Eagle 2014)	Changes due to Proposed Amendment Activities	Change to Significance
Physical Environment				
Air Quality/ Emissions Mine Site	TSP, PM_{10}, $PM_{2.5}$, NO_2, SO_2 and CO at 1-hour, 24-hour and Annual periods	Non-significant	Minimal increase in equipment use (such as pumps and water treatment plants), and minimal seasonal increase in traffic to transport treated groundwater effluent from water management ponds, could result in increased air emissions which may cause localized changes	Given that the Project remains smaller than what was assessed in the FEIS, effects due to the proposed activities are expected to result in non-significant impacts with application of mitigation measures as presented in the FEIS and adherence to the Project Certificate conditions
Air Quality/ Emissions AWAR (Operations)	TSP, PM_{10} at 24-hour periods	Non-significant	Minimal seasonal increase in traffic along the AWAR (for transport of treated groundwater effluent during operations) could result in increased air emissions	Effects due to the proposed activities are expected to result in non-significant impacts with application of mitigation measures as presented in the FEIS and adherence to the Project Certificate conditions
Air Quality/ Emissions - Itivia Harbour	Air emissions were assessed relative to where the greatest impacts would be measured. This assessment was completed at the Meliadine Mine site and AWAR for the construction period. Air emissions due to the proposed amendment activities associated with construction and operation of the discharge facility (access road, storage tank, discharge pipe)	Not assessed	Equipment use during construction, minimal increase in equipment use during operations (e.g., crane for discharge pipe installation, pumps during operation), and minimal seasonal increase in traffic to transport treated groundwater effluent to the storage tank could result in increased air emissions, which may cause localized changes	Effects due to the proposed activities are expected to result in non-significant impacts with application of mitigation measures as presented in the FEIS and adherence to the Project Certificate conditions
Greenhouse Gases and Climate Change	Project and proposed amendment activities will result in greenhouse gas emissions which may influence climate change	Non-significant	The Project is anticipated to have virtually no impact on future global climate change as the predicted Project Greenhouse Gas emissions were determined to be globally insignificant (FEIS Volume 5, Section 5.4.5). The seasonal additional traffic required for the proposed amendment activities will not change this prediction.	Effects due to the proposed activities are expected to result in non-significant impacts with application of mitigation measures as presented in the FEIS and adherence to the Project Certificate conditions
Noise - Mine Site	Project activities will result in noise emissions, which may cause changes in noise levels	Non-significant	Minimal increase in equipment use (such as pumps and water treatment plants), and minimal seasonal increase in traffic to transport treated groundwater effluent from water management ponds, could result in increased noise levels and a higher likelihood of sensory disturbance	Given that the Project remains smaller than what was assessed in the FEIS, effects due to the proposed activities are expected to result in non-significant impacts with application of mitigation measures as presented in the FEIS and adherence to the Project Certificate conditions

Table 11: Meliadine Mine FEIS Valued Components (Agnico Eagle 2014) and Proposed Amendment Activities Interactions Matrix and Potential Changes in the Assessment

FEIS Valued Component (VC)	FEIS / FEIS Addendum Predicted Effect Pathways	FEIS Assessed Significance (Agnico Eagle 2014)	Changes due to Proposed Amendment Activities	Change to Significance
Noise - AWAR (operations)	Project vehicles along the AWAR will result in noise emissions, which may cause changes in noise levels	Non-significant	Minimal seasonal increase in traffic along the AWAR (for transport of treated groundwater effluent) could result in a higher likelihood of sensory disturbance	Effects due to the proposed activities are expected to result in non-significant impacts with application of mitigation measures as presented in the FEIS and adherence to the Project Certificate conditions
Noise – Rankin Inlet [Itivia Harbour]	Activities associated with material receipt, storage and transfer to the Project will result in noise emissions, which may cause localized changes in noise levels	Non-significant	Noise emissions due to the proposed activities associated with construction and operation of the discharge facility will result in increased equipment use (e.g., crane for discharge pipe installation, pumps during operation), and minimal seasonal increase in traffic to transport treated groundwater effluent to the storage tank within the existing Itivia Oil Handling Facility could result in a higher likelihood of sensory disturbance	Effects due to the proposed activities are expected to result in non-significant impacts with application of mitigation measures as presented in the FEIS and adherence to the Project Certificate conditions
Terrestrial and Aquatic Environment				
Vegetation	Residual ground disturbance can cause permanent loss and alteration of vegetation (including listed and traditional use plant species)	Non-significant	No changes will result to the Project footprint as a result of the proposed activities as they will be within the previously assessed Project footprint and study areas. Structures at Itivia Harbour will be developed within the existing Itivia Oil Handling Facility. The pipe will be assembled on the beach, which is likely to have minimum vegetation associated with it	No change - effects due to the proposed activities are expected to result in negligible to minor impacts which are not anticipated to result in a substantial change to the VC with application of mitigation measures as presented in the FEIS and adherence to the Project Certificate conditions
Vegetation	Physical loss or alteration of vegetation from the Project footprint affecting plant populations and communities (including listed and traditional use plant species)	Non-significant	Air emissions and dust deposition from increased equipment use (e.g., pumps) and traffic may cover vegetation and lead to chemical, physical and/or physiological changes to plants, affecting wildlife habitat	No changes are proposed to the Project footprint as a result of the proposed activities, as they will be within the previously assessed Project footprint and study areas Effects due to the proposed activities are expected to result in negligible to minor impacts which are not anticipated to result in a substantial change to the VC with application of mitigation measures as presented in the FEIS, and adherence to the Project Certificate conditions

Table 11: Meliadine Mine FEIS Valued Components (Agnico Eagle 2014) and Proposed Amendment Activities Interactions Matrix and Potential Changes in the Assessment

FEIS Valued Component (VC)	FEIS / FEIS Addendum Predicted Effect Pathways	FEIS Assessed Significance (Agnico Eagle 2014)	Changes due to Proposed Amendment Activities	Change to Significance
Vegetation and Wildlife and Wildlife Habitat	Change in habitat due to altered quality from a major or minor spill	Non-significant	Equipment use during construction (discharge pipe installation) within the existing Itivia Oil Handling Facility, and minimal seasonal increase in traffic to transport treated groundwater effluent to the storage tank could result in a higher likelihood of potential spills or accidental release of treated groundwater effluent from trucks	Effects due to the proposed activities are expected to result in negligible to minor impacts which are not anticipated to result in a substantial change to the VC with application of mitigation measures as presented in the FEIS and adherence to the Project Certificate conditions
Wildlife and Wildlife Habitat	Sensory disturbance can change the amount of different quality habitats, and alter wildlife movement and behaviour (distribution)	Non-significant	Increased equipment use (e.g., pumps) and traffic along the AWAR (transport of treated groundwater effluent) could result in a higher likelihood of sensory disturbance Minimal increments in disturbance from mine activities due to the proposed activities are unlikely to cause sufficient disturbance that would prevent caribou, and other wildlife, from engaging in typical behaviours	Effects due to the proposed activities are expected to result in non-significant impacts with application of mitigation measures as presented in the FEIS and adherence to the Project Certificate conditions
Wildlife and Wildlife Habitat	Disruption or alteration of caribou migration routes from the presence of the mine or from mine-related activities	Non-significant	Increased equipment use (e.g., pumps) and traffic along the AWAR (transport of treated groundwater effluent) could result in higher likelihood of collision with vehicles causing injury or mortality to individual animals, which can affect population sizes	Effects due to the proposed activities are expected to result in negligible to minor impacts which are not anticipated to result in a substantial change to the VC with application of mitigation measures as presented in the FEIS and adherence to the Project Certificate conditions
Bird and Bird Habitat: Upland Birds and Raptors	Sensory disturbance can change the amount of different quality habitats, and alter bird movement and avoidance behaviour (distribution)	Non-significant	Increased equipment use (e.g., pumps) and traffic along the AWAR (transport of treated groundwater effluent) could result in higher likelihood of altering bird movement and avoidance behaviour. Mild increments in disturbance from mine activities due to the proposed activities is unlikely to cause sufficient disturbance that would prevent birds from engaging in typical behaviours	Effects due to the proposed activities are expected to result in non-significant impacts with application of mitigation measures as presented in the FEIS and adherence to the Project Certificate conditions

Table 11: Meliadine Mine FEIS Valued Components (Agnico Eagle 2014) and Proposed Amendment Activities Interactions Matrix and Potential Changes in the Assessment

FEIS Valued Component (VC)	FEIS / FEIS Addendum Predicted Effect Pathways	FEIS Assessed Significance (Agnico Eagle 2014)	Changes due to Proposed Amendment Activities	Change to Significance
Marine Environment				
Benthic Invertebrates Marine Fish and Fish Habitat (including marine vegetation)	Change in health and survivorship of marine benthic invertebrates or fish and effects to fish habitat due to in-water works and presence of pipe	Not assessed	Equipment use and traffic at Itivia Harbour (installation of discharge pipe and port) could result in higher likelihood of potential spills and/or displacement of habitat due to pipe	While there may be some minor changes to habitat quality, they are expected be short-term in duration or restricted to the mixing zone. Therefore effects due to the proposed activities are expected to be negligible with application of following best practices, suitable mitigation measures and adherence to the current Project Certificate conditions and federal regulations[a]
Benthic Invertebrates Marine Fish and Fish Habitat (including marine vegetation)	Change in habitat and water quality due to discharge of treated groundwater effluent from the Meliadine Mine	Not assessed	Discharge of the treated groundwater effluent will meet regulatory requirements for applicable guidelines and standards	Effects due to the proposed activities are expected to result in negligible to minor impacts which are not anticipated to result in a substantial change to the VCs with application of best practices and suitable mitigation measures, and adherence to the current Project Certificate conditions, the Groundwater Management Plan and federal regulations[a]
Marine Fish and Fish Habitat (including marine vegetation) Marine Birds and Mammals	Change in habitat due to altered water quality from a major spill	Non-significant	Increased equipment use and traffic at Itivia Harbour (treated groundwater effluent storage tank location and installation of discharge pipe and port) could result in higher likelihood of potential spills	Effects due to the proposed activities are expected to result in negligible to minor impacts with application of mitigation measures as presented in the FEIS, following best practices for fuelling and maintenance, and adherence to the Project Certificate conditions
Benthic Invertebrates Marine Fish and Fish Habitat (including marine vegetation) Marine Birds and Mammals	Accidental release of treated groundwater effluent from an unknown location along the discharge pipe or from the storage tank at the Itivia Oil Handling Facility	Not assessed	Discharge of the treated groundwater effluent will meet regulatory requirements for applicable guidelines and standards. Accidental release along the discharge pipe or from the storage tank can have direct adverse effects on marine water quality and associated indirect effects on marine wildlife	The magnitude of the effects due to the proposed activities will depend on the time of year that a spill could occur. During the fall, winter and early spring when ice limits the amount of available habitat, most species will not be present in the immediate vicinity. With a spill during the open water summer season, it is expected that the natural marine environment in Melvin Bay would lessen the effects of an accidental release, in addition to spill counter-measures, adherence to the Project Certificate conditions and Groundwater Management Plan

Table 11: Meliadine Mine FEIS Valued Components (Agnico Eagle 2014) and Proposed Amendment Activities Interactions Matrix and Potential Changes in the Assessment

FEIS Valued Component (VC)	FEIS / FEIS Addendum Predicted Effect Pathways	FEIS Assessed Significance (Agnico Eagle 2014)	Changes due to Proposed Amendment Activities	Change to Significance
Benthic Invertebrates Marine Fish and Fish Habitat Marine Birds and Mammals	Reduction in sea ice thickness and or timing of seasonal freeze-up	Not assessed	Treated groundwater effluent discharge will be during the open water summer season only to eliminate potential effects on sea ice thickness and timing of seasonal freeze-up	Effects due to the proposed activities are expected to be non-detectable and therefore non-significant with open water discharge only
Marine Sediment and Water Quality	Potential disturbance of material from near shore and in-water construction for discharge pipe installation could affect sediment and water quality	Not assessed	Construction activities at Itivia Harbour could affect sediment and water quality, particularly in the near-shore environment	While there may be some minor changes to habitat quality, they are expected be short-term in duration or restricted to the mixing zone. Therefore impacts due to the proposed activities are expected to be negligible with application of following best practices, suitable mitigation measures, adherence to the current Project Certificate conditions, and federal regulations[a]
Heritage Resources				
Historical Resources	Construction and other activities that disturbed previously undisturbed areas, as well as accidents and malfunctions	Not assessed	Equipment use and traffic, including installation of the discharge pipe at Itivia Harbour, could result in a higher likelihood of ground alteration that affects physical heritage resources	Effects due to the proposed activities are expected to result in negligible impacts and therefore be non-significant with application of mitigation measures as presented in the FEIS and adherence to the Project Certificate conditions
Socio-Economic Environment				
Economic Development Opportunities: Employment, Business Opportunities and Contracting	Project would increase the demand for labour during construction and operational phases, which should lead to a considerable number of local jobs	Significant (positive impact)	Construction for the proposed amendment activities could result in the use of local contractor; however, the construction period is short, and the number of employment opportunities would be very small and could likely be filled by the contractor's existing workforce	No change - effects of the Meliadine Project on employment opportunities are expected to remain significant (positive); however, incremental change from the proposed amendment activities is highly limited due to its scale and duration
Non-Traditional Land Use: Recreation	Change in recreational land use in the Project footprint during construction due to access restrictions, and operations due to the presence of Project components	Not assessed	Impacts to recreational use (e.g., snow mobile use) of the area around proposed amendment activities' components due to construction and operations	Effects due to the proposed amendment activities are expected to be short-term in duration and result in negligible impacts and therefore any change would be non-significant

Table 11: Meliadine Mine FEIS Valued Components (Agnico Eagle 2014) and Proposed Amendment Activities Interactions Matrix and Potential Changes in the Assessment

FEIS Valued Component (VC)	FEIS / FEIS Addendum Predicted Effect Pathways	FEIS Assessed Significance (Agnico Eagle 2014)	Changes due to Proposed Amendment Activities	Change to Significance
Traditional Activities and Knowledge: Traditional Harvesting	Change in marine mammal and fish behaviour and health due to underwater noise from, or collisions with, Project vessels	Not significant	Potential adverse impacts to traditional marine mammal and fish harvesting if activities for the installation of the discharge pipe impacts marine wildlife behaviour or health	Effects due to the proposed activities are expected to be short-term and continue to be not significant with the application of proper construction practices and mitigation measures, including adherence to Project Certificate condition
Traditional Activities and Knowledge: Traditional Harvesting	Effects on population size and distribution changes the availability of birds and terrestrial animals for traditional harvesting	Not significant	Potential adverse impacts to traditional harvesting if construction and operations of the proposed amendment activities impact the behaviour or health of birds and terrestrial animals	Effects due to the proposed amendment activities are expected to continue to be not significant with the application of mitigation measures reducing or removing impacts to birds and terrestrial animals due to construction and operations, per the FEIS and Project Certificate conditions
Traditional Knowledge and Activities: Land Use and Mobility	Project impacts on access to land use areas	Moderate (positive)	Potential adverse impact on traditional land use during the summer months due to the location of the discharge pipe	The potential adverse impact on access to areas used for traditional activities due to the proposed amendment activities will be limited by design, effective mitigation and engagement. No change to the FEIS prediction of the overall moderately positive impact on access to land use areas is expected. Mitigation will be applied per the FEIS and adherence to Project Certificate conditions

a) Federal regulations refer to the Metal Mining Effluent Regulation (MMER) and the Metal and Diamond Mining Effluent Regulations (MDMER, once the regulations come into effect) and Fisheries and Oceans Canada (DFO) Measures to Avoid Causing Harm to Fish and Fish Habitat.

FEIS = Final Environmental Impact Statement (Agnico Eagle 2014)

The Groundwater Management Plan (Appendix D) was developed per Condition #25 in the NIRB Project Certificate No.006 (2015) and the Type A Water Licence (2AM-MEL1631, Part E, Item 14).

4.1 Project Management Plans

Agnico Eagle has developed Management Plans that are applicable to the Meliadine Mine site, the 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 12 lists the management plans for the Meliadine Mine as they apply to the proposed amendment activities for ocean discharge assessed in this FEIS Addendum, with indications on any potential changes that may be required.

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 or 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. Agnico Eagle reports annually to NIRB on several environmental disciplines including atmospheric environment monitoring, geotechnical, permafrost and geochemical monitoring, surface water and freshwater environment monitoring, terrestrial wildlife and habitat monitoring, marine environment monitoring and socio-economic monitoring, and annual reporting to the NWB per the conditions under the Type A Water Licence.

Table 12: Meliadine Mine Management Plans Applicable to the Proposed Amendment Activities

Management Plan	Reference	Changes Required due to the Proposed Amendment Activities
Terrestrial Environment Management and Monitoring Plan	FEIS Volume 6, SD 6-4 (Agnico Eagle 2014) NIRB Doc. No. 180104-11MN034Updated and resubmitted (Golder 2015) NIRB Doc No. 151120-11MN034	None
Air Quality Management Plan	FEIS Volume 5, SD 5-1 (Agnico Eagle 2014) NIRB Doc. No. 180104-11MN034 Updated and resubmitted (Agnico Eagle 2015c) NIRB Doc. No. 151106-11MN034	None
Noise Abatement and Monitoring Plan	FEIS Volume 5, SD 5-2 (Agnico Eagle 2014) Updated and resubmitted (Agnico Eagle 2017a) NIRB Doc. No. 170412-11MN034	None
Heritage Resources Protection Plan	FEIS Volume 9, SD 9-1 (Agnico Eagle 2014; Golder 2014)	None
Water Management Plan	FEIS Volume 2, SD 2-6 (Agnico Eagle 2014) Updated and resubmitted (Agnico Eagle 2018c) NWB Doc 1803312AM-MEL-1631	None
Mine Waste Management Plan	FEIS Volume 2, SD 2-6 (Agnico Eagle 2014) Updated and resubmitted (Agnico Eagle 2018d) 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 2018e) NWB Doc 1803312AM-MEL-1631	None
Hazardous Materials Management Plan	FEIS Volume 2, SD 2-13 (Agnico Eagle 2014) Updated and resubmitted (Agnico Eagle 2018f) 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 2015d) NIRB Doc. No. 150623-11MN034	None

Table 12: Meliadine Mine Management Plans Applicable to the Proposed Amendment Activities

Management Plan	Reference	Changes Required due to the Proposed Amendment Activities
Spill Contingency Plan	FEIS Volume 2, SD 2-16 (Agnico Eagle 2014) Updated and resubmitted (Agnico Eagle 2017b) 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 2018g) NIRB Doc. No. 180104-11MN034	None
Groundwater Management Plan	Submitted (Agnico Eagle 2018a, provided in Appendix D of this FEIS Addendum) NWB Doc. No. 180615 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.	New plan developed to support the assessment.

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.

SECTION 5 • ENGAGEMENT

Community and public engagement for the proposed amendment activities were planned in accordance with community relations best practices, NIRB's Guide 6b: *A Proponent's Guide to Conducting Public Consultation for the NIRB* Environmental *Assessment Process* (NIRB 2006) and Agnico Eagle's Responsible Mining Management System (RMMS) Standard. Public meetings were held at Hamlet Rankin on February 26, 2018, at the Hamlet Office, and at the Rankin Inlet Community Hall on March 6, 2018.

The consultation meetings provided the community with an understanding of the proposed amendment activities and potential effects. Information gathered during engagement meetings has been considered and incorporated in this EA where relevant, including the effects assessment and mitigation measures. Public concerns revolve around water quality and monitoring, and use of the area where the discharge pipe and diffuser placement is proposed, in relation to the area being used by boats and impacts on marine mammals.

For the biophysical environment, the community asked questions on potential effects to water quality, fish, and marine mammals. Regarding water quality, concerns raised included if the effluent will be contaminated by mining activities, if it was too salty and if the temperature would be higher than the receiving ocean temperature. This is in relation to concerns on potential effects on fish and the development of excess aquatic vegetation due to a warm effluent. These concerns were discussed at the meeting – Agnico Eagle commented on treatment options being considered and the regulation limits and guidelines that will be complied with for the discharge. The discharge pipe and diffuser were also described, which are being engineered to help meet regulatory limits and guidelines. Agnico Eagle also described that monitoring programs are ongoing and would be extended for the proposed amendment activities.

On the socio-economic environment, the community expressed concerns regarding the use of the area for the discharge pipe and diffuser by snowmobilers, ice fishing and fishing in general, as well as access by boats. Agnico Eagle provided additional descriptions of the proposed outflow and planning considerations. In general, the community does not have major concerns with the placement of the discharge pipe and diffuser, as it is out of the way of use by snowmobilers, and boats will be able to access the area.

Agnico Eagle is in on-going engagement with the community and Table 13 provides a summary of community meetings, meetings and open houses which occurred between April 2016 and March 2017 with topics relevant to the proposed amendment activities (i.e., activities on the AWAR and at Itivia Harbour).

Table 13: Community Consultation after April 2016

Date/Time	Title	Location	Type of Communication	Description	Subject Categories
2016-09-20 00:00	Rankin Inlet - HTO Meeting	Rankin Inlet	Meeting	Rankin Inlet - HTO Meeting	Community - Hunters and Trappers' Organization (HTO) Environment
2017-04-19 00:00	2017 Q1: Rankin Inlet - Itivia Open House and Q1 Employment Information Session April 2017	Rankin Inlet	Open House	Rankin Inlet - Itivia Open House and Q1 Employment Information Session April 2017	IIBA - Employment Information Session (EIS) Project - Construction Activities Human Resources - Labour Pool Process
2017-05-15 00:00	Rankin Hamlet Agnico Working group	Rankin Inlet	Meeting	Meeting items; Blasting update (Itivia), Community Funding Agreement, Signage update, Agnico Family Fun Days	Community - Hamlet Working Committee Community - Impacts Community Community Agreements - Community Investment Fund (CIF) Community Agreements - Green Community Agreement Health & Safety
2017-07-17 00:00	Rankin SAO: Dust control	Rankin Inlet	Meeting	Met with Justin Merritt (Rankin SAO) to make arrangements for water use for dust control for Itivia area	Community - Impacts Environment - Dust Environment - Water
2017-07-27 00:00	Rankin Inlet Public Meeting - Itivia	Rankin Inlet	Public Meeting	Rankin Inlet Public Meeting - Itivia with Hamlet, KIA, GN. Information and consultation on Itivia Boat Launch and Johnson's Cove Boat Launch, dust control, road maintenance, by-pass road, snowmobile trail, shooting range relocation, caribou migration and gravel pits	Community - Community Development / Infrastructure / Investment Environment - Vibration Environment - Dust Environment - Caribou Project - Construction Activities Issues or Concerns - Complaint
2017-07-18 00:00	Rankin Inlet - Open House Itivia	Rankin Inlet	Open House	Rankin Inlet - Open House Itivia	Environment - Dust Project - Construction Activities Issues or Concerns - Complaint
2016-11-28 12:28	Meeting Itivia Permitting	Rankin Inlet	Meeting	Meeting held with Hamlet, Nunavut Airport, GN-CGS before Hamlet Council Meeting. Agnico Eagle also attended Hamlet Council Meeting same day but at 13h30. Manon, Mark, and Matt attended. Discussed Rankin Inlet bypass road, Itivia Quarry, Laydown and fuel farm area. Boating season, bypass road and people going to cabins. Topics raised: Pipeline location in relation to snowmobile trail, anticipated security measures being implemented by Agnico Eagle, operating timelines, and construction duration of bypass road.	Community - Community Development / Infrastructure / Investment Government - Permitting Project - Construction Activities

Table 13: Community Consultation after April 2016

Date/Time	Title	Location	Type of Communication	Description	Subject Categories
2017-08-02 12:30	Hamlet Council Meeting - Itivia	Rankin Inlet	Meeting	Attended Hamlet Council Meeting to obtain approval on Itivia quarry, fuel farm and laydown area and bypass road. Approval obtained. Pujjuut attended meeting.	Community - Community Development / Infrastructure / Investment Government - Permitting Project - Construction Activities
2017-01-25 00:00	Meeting with Nunavut Airports - Itivia Permitting project	Rankin Inlet	Meeting	Bypass road, laydown area, and barge landing area discussed. Topics raised: storage time of hazardous materials on-site, blasting at the laydown area, ownership of barge landing area (NAD or CGS).	Government - Permitting
2017-02-27 00:00	Meeting with Nunavut Airports - Itivia Permitting project	Rankin Inlet	Meeting	Bypass road application and laydown area discussed.	Government - Permitting
2017-02-27 00:00	Hamlet Council Meeting - Itivia Permitting project	Rankin Inlet	Meeting	Topics raised: construction schedule start time of bypass road, presentation on blasting, importance of the snowmobile trail at laydown area	Government - Permitting
2017-04-24 00:00	Hamlet Council meeting - Itivia Permitting project	Rankin Inlet	Meeting	Bypass road and Itivia Quarry discussed. Topics raised: Development permit bypass road approvals and applications, lease application of bypass road, approval conditions of Itivia Quarry	Government - Permitting
2018-02-19 14:00	Rankin Hamlet - Working Committee - Diffuser + Huckleberry	Rankin Inlet	Public Meeting	Rankin Hamlet - Working Committee - Diffuser + Huckleberry	Community - Impacts Community - Consultation Environment - Caribou Environment - Water Environment Government - Permitting Project - Exploration
2018-02-26 14:00	Rankin Community Meeting - Diffuser + Huckleberry	Rankin Inlet	Public Meeting	Rankin Community Meeting - Diffuser + Huckleberry	Community - Consultation Environment - Caribou Environment - Water Environment Government - Permitting
2018-03-06 19:00	Rankin Inlet - Diffuser - Community Meeting	Rankin Inlet	Public Meeting	Community Meeting to present the project.	Community - Community Visits Environment - Water
2018-03-06 13:30	Rankin Inlet - Diffuser - Hamlet meeting	Rankin Inlet	Public Meeting	Hamlet meeting to present the diffuser project.	Community - Impacts Community - Consultation Environment - Water
2018-03-15 16:39	Rankin Inlet - Diffuser - Community Meeting	Rankin Inlet	Public Meeting	Community meeting to present the diffuser project.	Community - Consultation Community Environment - Water

Table 13: Community Consultation after April 2016

Date/Time	Title	Location	Type of Communication	Description	Subject Categories
2017-03-31 16:39	Rankin Inlet - Itivia Open House March 2017	Rankin Inlet	Public Meeting	Rankin Inlet - Itivia Open House	Human Resources - Labour Pool Process Project - Construction Activities
2017-11-24 16:39	By Pass road site visit with Elder/HTO representative	Rankin Inlet	Public Meeting	Site visit of By pass road to see possible ramps and road conditions. Also discussed access for skidoos and hunters.	Environment - Visual Impacts Community - Impacts Community - Hunters and Trappers' Organization (HTO) Community - Hunting / Harvesting / Fishing Community - Community Development / Infrastructure /
2017-07-17 16:39	Dust Control Meeting with SAO	Rankin Inlet	Meeting	Meeting with SAO on dust control measures	

5.1 Traditional and Community Knowledge

The results of the Inuit Quajimajatugangit (IQ) studies are presented in the FEIS (Agnico Eagle 2014, Volume 9, Section 9.3), and included interviews with Elders, focused on traditional land use, past and present, and on the concerns of the local Inuit regarding mining developments. A summary of those findings as they relate to the marine environment and the proposed amendment activities in this FEIS Addendum are presented in this section. Some additional information from the marine baseline report is also included (Nunami Stantec 2012, Appendix B).

From these studies, it is known that since the mid-1900s most people living in Rankin Inlet had wage-labour jobs or were in primary/secondary school in the winter months. Recreation consequently became an increasingly important activity. While the lifestyles of the people of Rankin Inlet became increasingly less traditional compared to the early to mid-1900 period, caribou, seals and fish still made up a large part of the Inuit diet and lifestyle (Freeman 1976).

Marine mammal hunting still occurs along a wide range of the Hudson Bay shores, including areas around Rankin Inlet. Winter and early spring hunting is most often carried out as far as 24 km offshore along the floe edge. Young seals are hunted in the early spring in their birth lairs on the sea ice. The most intensively hunted area ranges from Whale Cove to the Baker Foreland, particularly at the heads of bays where the water is the freshest (Freeman 1976). Summer seal hunting expands in May and June for a long distance offshore, while winter hunting is limited by the floe edge limit. During interviews, Rankin Inlet participants explained that the ice floe edge normally reaches its maximum extension in March, stretching out about 30 – 40 miles (48 – 64 km) from Rankin Inlet. The ice begins to break up and flow south during the months of May, June, July and August. While harvesters in Rankin Inlet have indicated that seals are no longer as plentiful in the inlet, possibly due to past blasting activities associated with the former Rankin Inlet Nickle Mine prior to 1962, they are still hunted for their skins. During the May and September fish runs, cabins are still used by the people of Rankin Inlet to serve as a base for fishing, particularly on weekends.

Arctic char are an important food species for the residents of Rankin Inlet – residents have cabins on the north shore of Melvin Bay and harvest Arctic char, sculpin and cod in the Itivia Harbour area (Nunami Stantec 2012; Appendix B). Itivia Harbour is heavily used by residents in the summer for launching boats (it's the only place accessible during low tide), and in the winter for snowmobile travel in and out of the community (Nunami Stantec 2012; Appendix B).

SECTION 6 • EXISTING ENVIRONMENT

The proposed discharge location is located in Melvin Bay, northwest Hudson Bay approximately 1.2 km west of the proposed landing barge footprint (Figure 2). The proposed amendment activities are located within the Chesterfield Inlet High Biological Importance area where important habitats of five species/species groups overlap (Stephenson and Hartwig 2010). These species/species groups include toothed whales (killer whale (*Orcinus orca*), beluga whale (*Delphinapterus leucas*), narwhal (*Monodon monoceros*), bowhead whale (*Balaena mysticetus*), seals (ringed seal (*Pusa hispida*), bearded seal (*Erignatus barbatus*), harp seal (*Pagophilus groenlandica*), walrus (*Odobenus rosmarus*), and fishes (e.g., Arctic char (*Salvelinus alpinus*), Greenland cod (*Gadus ogac*), Arctic cod (*Boreogadus saida*).

In August of 2011, a field program was conducted by Nunami Stantec at Itivia Harbour and at two nearby reference sites and an impact site in Melvin Bay (see Site Figure in Appendix 8.2-A of the FEIS; Agnico Eagle 2014). The baseline report is provided in Appendix B. A detailed baseline summary of all marine VCs is provided in Volume 8, Section 8.3.2 of the FEIS (Agnico Eagle 2014).

A brief summary of baseline conditions relevant is provided herein that highlights the key information relevant to the amendment.

6.1 Marine Physical Environment

6.1.1 Oceanography

- 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). Formation of ice increases the salinity of underlying water, increasing its density and enhancing mixing of the water column (Prinsenberg 1988a, b).
- There is a strong vertical density gradient between fresh, warm water at the surface and cold, saline deeper water, and results in a difference between inshore and offshore oceanographic conditions.
- In nearshore areas mixing and productivity is higher due to wind-driven mixing (upwelling) and stronger tidal energy (Freeman et al. 1982).
- In general, water salinity and temperature in Hudson Bay increase with distance from shore.
- Surface salinity in Hudson Bay ranged from 10 parts-per-trillion (ppt) near major rivers to 30 ppt in offshore locations of the bay (Anderson and Roff 1980; Prinsenberg 1986).
- At a deep-water offshore station in southeastern Hudson Bay, surface salinity ranged from 24 ppt in August to 28 ppt in April; at this same station at depths greater than 50 m, salinity was relatively stable throughout the year and increased with depth; at approximately 100 m water depth, salinity was above 33 ppt (Ingram and Prinsenberg 1998).
- Lower salinities in the inshore region as compared to the offshore region are due to dilution effects.

- Surface water temperatures vary spatially ranging from 4°C in nearshore areas to 11°C in offshore locations during the summer months (Anderson and Roff 1980; Prinsenberg 1986). At the deep-water offshore station in southeastern Hudson Bay, temperature at depths greater than 50 m was relatively stable throughout the year and progressively decreased with depth; at approximately 100 m water depth, mean water temperature was below -1.4°C (Ingram and Prinsenberg 1998).
- Lower nearshore as compared to offshore temperatures are due to strong northwesterly wind effects causing upwelling of colder deep water to the surface.
- At Rankin Inlet, there is a general southward current of about 19 km/day (CCG 2008). Tidal range varies between 2.0 m and 4.6 m usually flowing south-west at about 1.85 km/h. Flow through the access passage is 0.93 km/h.

6.1.2 Bathymetry

Bathymetry data was collected by Agnico Eagle in 2017 to better characterize water depths and the ocean bed in Melvin Bay to consider the placement of the engineered marine outflow. Water depths at Itivia Harbour and in Melvin Bay were determined to be shallow. Figure 2 illustrates the water bottom and respective depths at Melvin Bay in the area of interest for the discharge pipe and diffuser location.

6.1.3 Water Quality

- Mean surface water temperature (at 1 m depth, ± SD) in the harbour, near the location of the proposed engineered marine outflow, was 8.9 ± 0.5°C, with a salinity of 29.32 ± 0.03 ppt, and a pH of 8.08 ± 0.03. Bottom water was slightly colder than surface water at 8.5 ± 0.6°C; with similar salinity and pH values.
- Total dissolved solids values were similar at all three sampling locations (ranging from 34,200 to 34,300 mg/L), sampled within the harbour. Approximately 78% of all analyzed metals (33 of 42) were below detection limits, and concentrations were lower than the CCME Protection of Marine Aquatic Life guidelines.

6.1.4 Sediment Quality

- Cobble and gravel were the dominant substrates in the nearshore environment in the harbour (Appendix B, Table 4-2).
- Sediment chemistry was found to be relatively similar between samples, with a relatively high total phosphorous content (ranging from 775 ± 28.15 mg/kg at I1 sampling area to 850 ± 36.86 mg/kg at R1 sampling area). Metal concentrations were variable, ranging from below analytical detection limits to detectable but lower than the CCME Interim Sediment Quality Guidelines. The exception was for chromium.

6.2 Marine Biological Environment

- Phytoplankton abundance, richness, and diversity were similar across all sites within the marine LSA, 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 sites. Zooplankton abundance, richness, and diversity varied among sites, and a total of 44 taxa were recorded.
- Nearshore macrophyte coverage was found to be sparse at all three sampling locations, in the harbour (ranging from 2 to 5% coverage).
- Seaweeds are not locally harvested in the proposed amendment activities' area in Melvin Bay.
- Benthic invertebrate abundance, richness, and diversity varied amongst sites. Polychaete worms (class Polychaeta) of subclass Sedentaria (burrowing or tube-dwelling) families Capitellidae, Cirratulidae and/or Paraonidae were the most dominant taxonomic group
- Benthic species are not thought to occupy the intertidal zone in Hudson Bay on a permanent basis; rather, they occur seasonally when the habitat is not influenced by ice (Stewart and Lockhart 2005). Few invertebrate species were observed in the nearshore habitat, and abundance was low.
- The harvest for shellfish species mainly occurs outside the harbour due to related health advisories from the Department of Health and Social Services. Scallops collected from the stomachs of hunted walruses are highly regarded by elders.
- Six species of marine fish (n=156) were identified during gill net and beach seine sampling in the marine LSA, including Greenland cod (*Gadus ogac*) (52%), slender eelblenny (*Lumpenus fabricii*) (27%), fourhorn sculpin (kanayok in Inuktitut) (*Myoxocephalus quadricornis*[2]) (15%), unidentified sculpin (possibly juvenile; 3%), Arctic staghorn sculpin (*Gymnocanthus tricuspis*) (2%), and Arctic sculpin (*Myoxocephalus scorpioides*) (1%).
- Arctic char, Arctic cod, and other species contribute directly to the domestic fishery, and indirectly to the food chain of marine and terrestrial mammals and birds. Those species with overlapping ranges with the Regional Study Area (RSA) and considered important to the local commercial, recreational, and Aboriginal Fisheries (CRA) fishery (refer to Volume 8, Table 8.3-2 of the FEIS [Agnico Eagle 2014]).
- Marine birds and mammals generally occupy the Hudson Bay area, but no critical habitat or key bird areas/sanctuaries occur at Melvin Bay (within the LSA) or in the immediate surroundings (Agnico Eagle 2018g; Nunami Stantec 2012).
- 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 2018g). Few of these species are year-round residents.

[2] Referenced by it's European (*Triglopsis quadricornis)* name in Appendix 8.2-A pf the FEIS (Agnico Eagle 2014) Nunami Stantec Marine Baseline Report for Itivia Harbour, Rankin Inlet, NU

- The baseline study conducted in 2011 indicated that most marine birds that occur in the vicinity of Rankin Inlet are summer residents and no *Species at Risk Act* (SARA) listed marine bird species occur near Rankin Inlet (Nunami Stantec 2012, Appendix B).
- Marine mammals potentially present within the RSA 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 2018g). 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 2018g).
- There is a pronounced geographic bias on the distribution of several species within Hudson Bay; for example, beluga are strongly associated with the western part of Hudson Bay primarily in estuarine waters of the Churchill River (south of Rankin Inlet). Beluga are hunted during the open-water season (primarily in August and September) – mainly near Marble Island. Most individuals summer near Churchill and migrate north along the west coast of Hudson Bay beginning in late August. Some individuals overwinter in recurring polynya areas (when ice conditions allow) in northwestern Hudson Bay, Roes Welcome Sound, and Hudson Strait.

6.3 Atmospheric Conditions

Existing air quality, based on background air concentrations from these stations is summarized in Table 14. Relevant baseline information for air quality and noise is presented below.

Table 14: Existing Air Quality Data (µg/m3)

Indicator Compound	Iqaluit	Inuvik	Fort Liard	Norman Wells	Yellowknife	Average
TSP – 24-hour	—	—	—	—	—	—
TSP – Annual	—	—	—	—	—	—
PM_{10} – 24-hour	—	40.68	18.41	34.26	30.21	30.89
PM2.5 – 24-hour	—	4.81	9.07	7.02	9.23	7.53
NO_2 – 1-hour	—	—	3.76	5.64	28.22	12.54
NO_2 – 24-hour	—	—	3.90	6.42	22.58	10.97
NO_2 – Annual	—	—	1.91	3.24	11.64	5.60
SO_2 – 1-hour	—	5.24	2.62	2.62	2.62	3.27
SO_2 – 24-hour	—	5.03	4.04	2.62	3.35	3.76
SO_2 – Annual	—	1.89	0.74	0.86	1.23	1.18
CO – 1-Hour	—	—	—	—	343.56	343.56
CO – 8-Hour	—	—	—	—	372.19	372.19

Notes:
All values, except for annual averages, are based on 90th percentile
— = not available
Source: FEIS (Agnico Eagle 2014, Volume 5, Table 5.2-5)

- It is expected that Rankin Inlet has similar existing air quality; however, existing air quality along the AWAR would be expected to be lower than existing data from northern monitoring stations.

- Modelling to predict the maximum monthly and annual dust deposition or dustfall (as total suspended particle deposition), resulting from the construction of the By-Pass road and operation of the Itivia quarry around the community of Rankin Inlet, was completed during construction in 2017 (Golder 2017a). Model results showed that the predicted maximum monthly and annual dust deposition were well below the respective dustfall criteria during construction (Golder 2017a).
- An increase in measured dustfall has occurred since 2012 as site activity has increased, and rates were highest during the summer months when site activity peaks (Agnico Eagle 2018b). However, no exceedances of Alberta's Ambient Air Quality Guidelines (June 2016) for recreational areas occurred for any sample location. These results indicate very low rates of dustfall overall, despite elevated traffic compared to the FEIS predictions (Agnico Eagle 2014).
- Near Rankin Inlet, the noise environment along the AWAR would be similar to the levels in Rankin Inlet. The remainder of the AWAR is located in a remote area, and the existing noise levels are expected to be similar to those established for the Mine Site (which are anticipated to range between 23 – 40 A-weighted decibels (dBA), with an average hourly noise level of 35 dBA). Noise levels measured for Rankin Inlet indicate that existing noise levels range between 35 – 52 dBA, comprised of various human activities at Rankin Inlet.
- Modelling to assess the effects of noise during construction of the By-Pass road (including associated activities at the Itivia quarry) around the community of Rankin Inlet was completed, prior to construction activities (Golder 2017b). Noise effects model results indicated that construction noise would likely be difficult to perceive against baseline noise levels (per the FEIS; Agnico eagle 2014) in most parts of Rankin Inlet.
- The results of the 2017 annual monitoring (Agnico Eagle 2018b), the 24-hour equivalent sound levels (Leq 24 h) recorded during monitoring were lower than those predicted in the FEIS (Agnico Eagle 2014) for the AWAR and Rankin Inlet monitoring locations.

6.4 Terrestrial Baseline Conditions

- Heath vegetation encompasses 142,562 ha (58%) of the RSA, while wetlands and riparian areas are distributed over 29,177 ha (12%) of the RSA. Detailed descriptions of land cover classes mapped within the RSA are provided in SD 6-2 2009 Terrestrial Synthesis Baseline, Section 4.2 of the FEIS (Agnico Eagle 2014).
- Within the LSA, heath vegetation encompasses 5,429 ha (51%), with the heath tundra community type dominating the landscape at 4,036 ha (38%). Wetlands are distributed over 2,767 ha (26%) of the LSA and are predominately comprised of the sedge community, which accounts for 2,449 ha (23%) (FEIS Volume 6, Section 6.5.3.2; Agnico Eagle 2014).
- Soils, lichen tissue, and vascular plants samples were collected in August 2017 at the Mine site area, along the AWAR, and reference areas (10 to 15 km from the site infrastructure). No listed or non-native plant species were found at any of the sampling locations. Dustfall on vegetation was observed at some of the locations along the AWAR.

- Some territorial listed plant species have the potential to occur in habitats along the AWAR along the LSA and RSA (refer to FEIS Volume 6, Table 6.5-6 [Agnico Eagle 2014]).
- Traditional use plant species as country foods, particularly activities such as berry picking was, and continues to be, an important fall activity throughout the Meliadine valley and the wider RSA. Berry picking typically occurs wherever there are low slopes with heath tundra, and in hummocky areas at the edges of wetlands. The most commonly picked berries were sampled for metal baseline conditions at the Mine site area, AWAR, and reference areas, including paungait (black berry) or crowberry (*Empetrum nigrum*), kigutangirnaq or blueberry (*Vaccinium uliginosum*) and kakautit or lingonberry (*Vaccinium vitis-idaea*).
- Baseline wildlife surveys were completed in the vicinity of the proposed AWAR during 1998, 1999, 2000, 2008, and 2009 (Volume 6, Section 6.6.2, Agnico Eagle 2014; Agnico Eagle 2013).
- Species of concern that were observed during surveys within the RSA are outlined in Volume 6, Section 6.1.1.2 (Agnico Eagle 2014). Of these species of concern, four species (polar bear, barren-ground caribou, peregrine falcon, short-eared owl) are listed federally and territorially.
- Technicians at site maintain a daily log of wildlife observations from site and the AWAR. The results of 2017 observations are included in the Terrestrial Environment Management and Monitoring Plan (TEMMP) Annual Report (Golder 2018). The most commonly observed species by observation and number of individuals were Arctic fox (82) and caribou (>60,000) respectively. Barren-ground caribou (Qamanirjuaq and Lorillard herds) and wolf have the potential to interact with the AWAR. Based on annual and seasonal range estimates (Agnico Eagle 2013), Lorillard Caribou Herd should not be influenced by the AWAR in most years. It is during migration and the post-calving period that the Qamanirjuaq Caribou Herd may interact with AWAR.

6.5 Land Uses

- Between mid-May and early June, families would travel down river valleys to the sea coast where they would begin hunting seals in birth lairs, on the open ice, and at the floe edge.
- During the ice break-up in June and July, canoes were used to hunt seals along the coast and in many harbours. Walrus were also hunted from large boats used along the northern coast near Rankin Inlet and Walrus Island.
- During late July and August, caribou would migrate to the seashore to avoid the inland insects. Here they were hunted from canoes by the Inuit.
- Late summer was also a time for the netting of arctic char (Freeman 1976).
- While the lifestyles of the people of Rankin Inlet became increasingly less traditional, caribou, seals and fish still made up a large part of the Inuit diet (Freeman 1976). Arctic char are still an important food species for the residents of Rankin Inlet.
- Itivia Harbour is heavily used by residents in the summer for launching boats (it's the only place accessible during low tide), and in the winter for snowmobile travel in and out of the community (Nunami Stantec 2012; Appendix B).

- The area in the vicinity of the pipe infrastructure is currently used for snowmobile races, and the AWAR between Rankin Inlet and the Meliadine Mine serves as an access route for land use between the two locations.
- Non-traditional land use in the area includes hunting and outfitting, guided fishing and sightseeing, and other recreational activities.

6.6 Heritage Resource Baseline Conditions

Archaeological baseline studies related to the Itivia Harbour and support infrastructure have been carried out for the Meliadine Mine by Golder. This included an assessment of the fuel tank and laydown area under Permit 2010-05A (Murphy 2011), as well as assessment of the Rankin Inlet Bypass Road (and revision) as part of the AWAR under Permit 2012-024A (Ross 2014) and Permit No. 20176-07A (Young 2017). Earlier academic research near the community of Rankin Inlet and Itivia Harbour was also undertaken in the 1970's (Linname and Clark 1975 and 1976; Linname 1977).

- No archaeological sites were identified during the 2010 assessment of the fuel tank and laydown area where the proposed engineered marine outfall will be placed (Murphy 2011).
- One site was revisited (KeJm-5) and a new site identified (KfJm-194) during assessment of the By-pass Road (Ross 2014); and one new site (KeJm-11) was identified during assessment of the By-pass Road Re-route (Golder 2017c; Young 2017). Only one additional site (KeJm-10) from Linname and Clark's 1970's studies occurs within 1 km of the proposed amendment activities' area (Table 15).
- All sites will be avoided and are greater than 800 m from the proposed groundwater discharge location.

Table 15: Status of Archaeological Sites within the Rankin Inlet Local Study Area

Borden Number	Cultural Affiliation	Site Type	Archaeological Significance	Distance from Development	Status of Site	Details of Status	Permit Report Detailing Status	Recommendations
KeJm-5	Neoeskimo	Hunting site	low to moderate	2.5 km NW of Itivia Harbour discharge pipe; 330 m from bypass road re-route	Not Mitigated	Documented	2012-024A; 2016-07A	Continued avoidance by 30 m buffer or additional mitigation required
KeJm-10	Palaeoeskimo	Lithic scatter	low to moderate	0.8 km SE of Itivia Harbour discharge pipe	Not Mitigated	Site not revisited; location not confirmed	Linnamae 1977	Continued avoidance by 30 m buffer or additional mitigation required
KeJm-11	Neoeskimo	Cache	low to moderate	4 km NW of Itivia Harbour discharge pipe; 160 m from bypass road re-route	Not Mitigated	Documented	2016-07A	Continued avoidance by 30 m buffer or additional mitigation required
KfJm-194	Neoeskimo	Campsite	low	3 km NW of Itivia Harbour discharge pipe; 130 m from bypass road re-route	Not Mitigated	Documented	2012-024A; 2016-07A	Continued avoidance by 30 m buffer or additional mitigation required

SECTION 7 • EA METHODOLOGY

7.1 Spatial and Temporal Boundaries

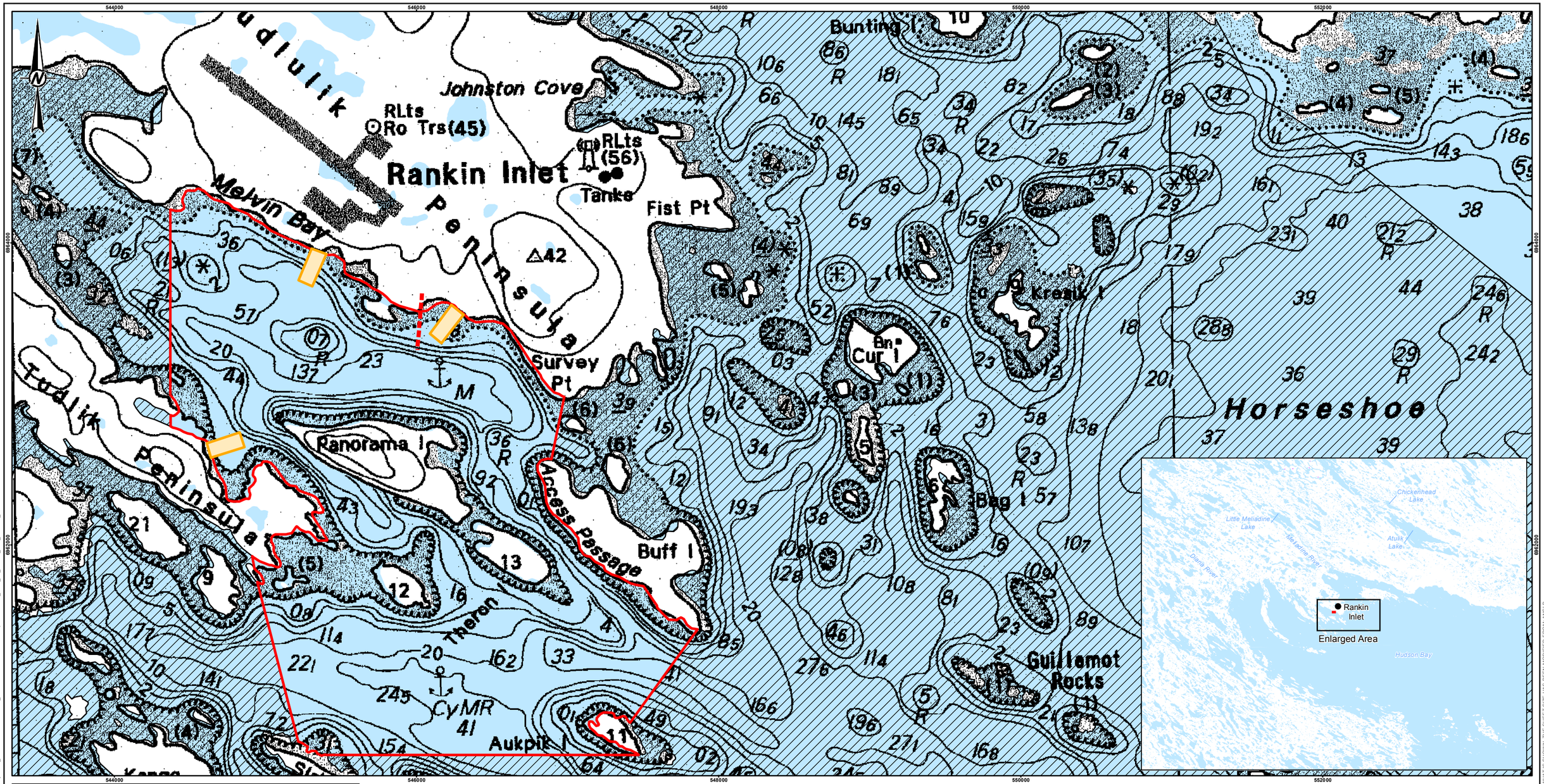
For the proposed amendment activities assessed in this FEIS Addendum, as part of the activities for the Meliadine Mine, the study area boundaries were developed based on:

- Extent of the marine environmental compliance point for the discharge of effluent (set at 100 m from outfall)
- Predicted extent of residual effects from the Air Quality Emissions on the AWAR.

The boundaries were set so that all the potential residual effects (direct and indirect) of the proposed amendment activities would fall within the study area boundaries. Boundaries have also been kept consistent with those defined in the FEIS (Agnico Eagle 2014).

7.1.1 Local Study Area

- The marine LSA for the marine environment is the area where there exists the reasonable potential for direct effects on the marine environment due to the proposed amendment activities, such as near-field effects from the treated groundwater effluent discharge, as presented in Figure 4 and consistent with the FEIS (Agnico Eagle 2014, Volume 8), including the I1, R1 and R2 sampling areas for reference, per the Nunami Stantec (2012; baseline study provided in Appendix B).
- The terrestrial LSA boundary for the access road was defined based on the anticipated spatial extent of the immediate direct (e.g., amendment footprint) and indirect (e.g., dust deposition) effects from the proposed amendment activities on the surrounding terrestrial environment, as presented in Figure 5 (as that defined for the FEIS; Volume 6, Agnico Eagle 2014).
- The LSA for air quality and noise were defined in the FEIS (Volume 5, Section 5.1.1.; Agnico Eagle 2014). For air quality, the LSA considered a rectangle 21x30 kilometres (km) in size, centered on the Mine site, plus a 3 km wide band along the AWAR (1.5 km on either side of the travel surface) and the boundaries of the community of Rankin Inlet. For noise, direct effects were considered for a buffer of 500 m for the Mine site, and the LSA included an additional 5 km buffer from this 500 m buffer, centered on the Mine site, and also around the AWAR and Rankin Inlet community
- The heritage LSA boundary for the access road and Mine was defined based on the anticipated spatial extent of the immediate direct effects from the proposed amendment activities on the surrounding heritage resources, as presented in Figure 5, per the FEIS (Volume 9; Agnico Eagle 2014).
- The socio-economic LSA boundary considers the Kivalliq Region and the five communities of Arviat, Baker Lake, Chesterfield Inlet, Rankin Inlet, and Whale Cove (Figure 6), per the FEIS (Volume 9; Agnico Eagle 2014).



LEGEND

- BASELINE SAMPLING AREA
- MARINE REGIONAL STUDY AREA (MARINE RSA)
- MARINE LOCAL STUDY AREA (MARINE LSA)
- BATHYMETRIC DEPTH CONTOUR
- WATERBODY
- GENERAL AREA FOR THE PROPOSED DIFFUSER LOCATION

0 500 1000
METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM AGNICO EAGLE MINES LIMITED (AEM).
2. BASELINE SAMPLING OBTAINED FROM NUNAMI STANTEC ON BEHALF OF AGNICO EAGLE MINES LIMITED (AEM).
3. ATLAS OF CANADA DATA OBTAINED FROM © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
4. NAUTICAL CHART DATA OBTAINED FROM THE CANADIAN HYDROGRAPHIC SERVICE.
5. COUNTRY BACKGROUND DATA OBTAINED FROM ESRI.

DATUM: NAD 83 PROJECTION: UTM ZONE 15

CLIENT
AGNICO EAGLE MINES LIMITED

CONSULTANT
GOLDER

YYYY-MM-DD	2018-06-14
DESIGNED	JR
PREPARED	CDB
REVIEWED	
APPROVED	

PROJECT
SITE LAYOUT
MELIADINE MINE SITE

TITLE
MARINE LOCAL STUDY AREA

PROJECT NO.	CONTROL	REV.	FIGURE
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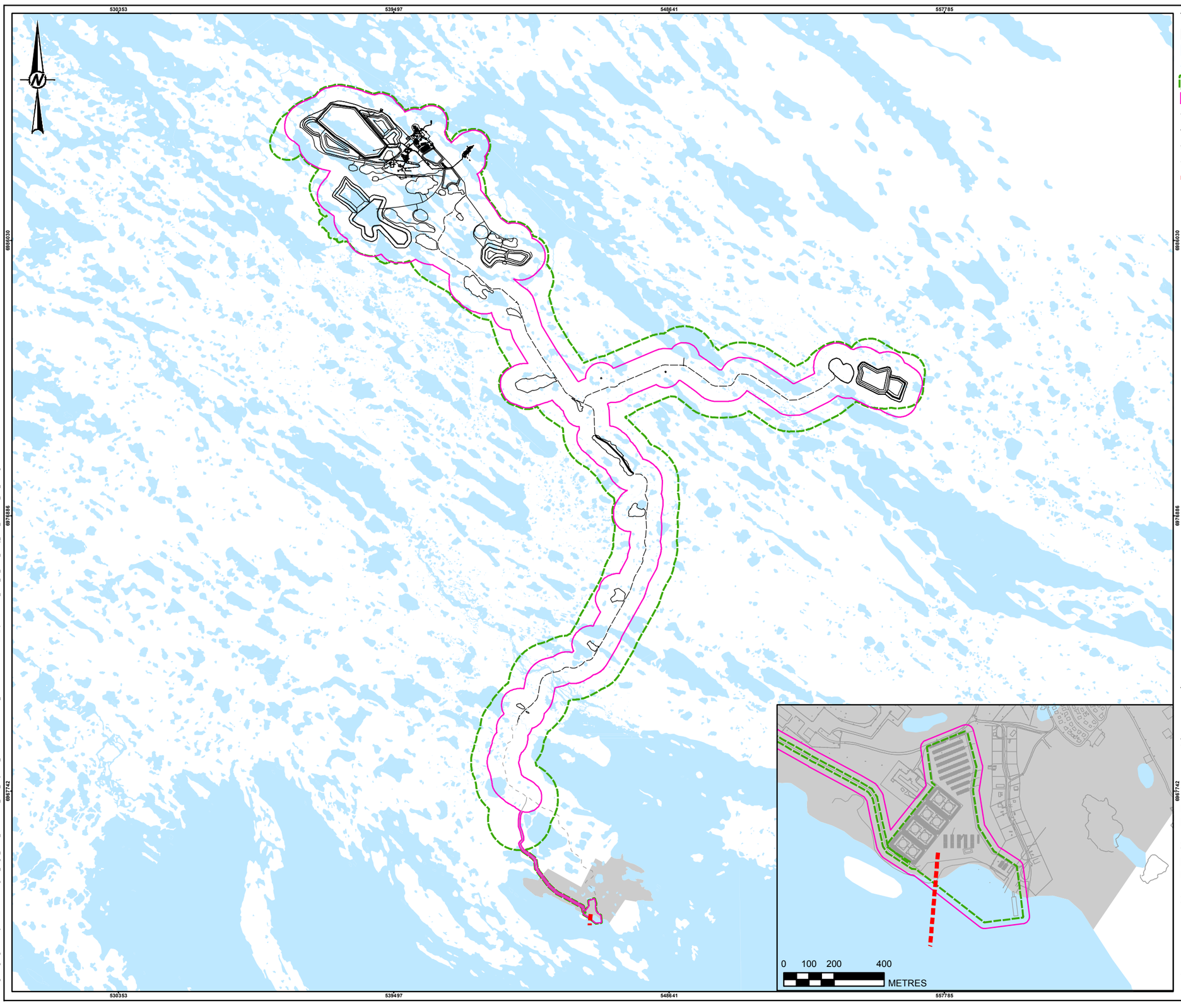

LEGEND

- MUNICIPAL BOUNDARY
- WATERBODY
- WATERCOURSE
- LOCAL STUDY AREA - TERRESTRIAL
- LOCAL STUDY AREA - HERITAGE RESOURCES
- ALL-WEATHER ACCESS ROAD (AWAR)
- PROJECT INFRASTRUCTURE
- ROAD - NEW
- ROAD - EXISTING
- GENERAL AREA FOR THE PROPOSED DIFFUSER LOCATION

0 3000 6000
METRES

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

CLIENT
AGNICO EAGLE MINES LIMITED

PROJECT
MELIADINE GOLD PROJECT
NUNAVUT

TITLE
LOCAL STUDY AREAS – TERRESTRIAL AND HERITAGE RESOURCES

CONSULTANT
GOLDER

YYYY-MM-DD	2018-06-14
DESIGNED	JR
PREPARED	CDB
REVIEWED	
APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
1773384	1100	A	5

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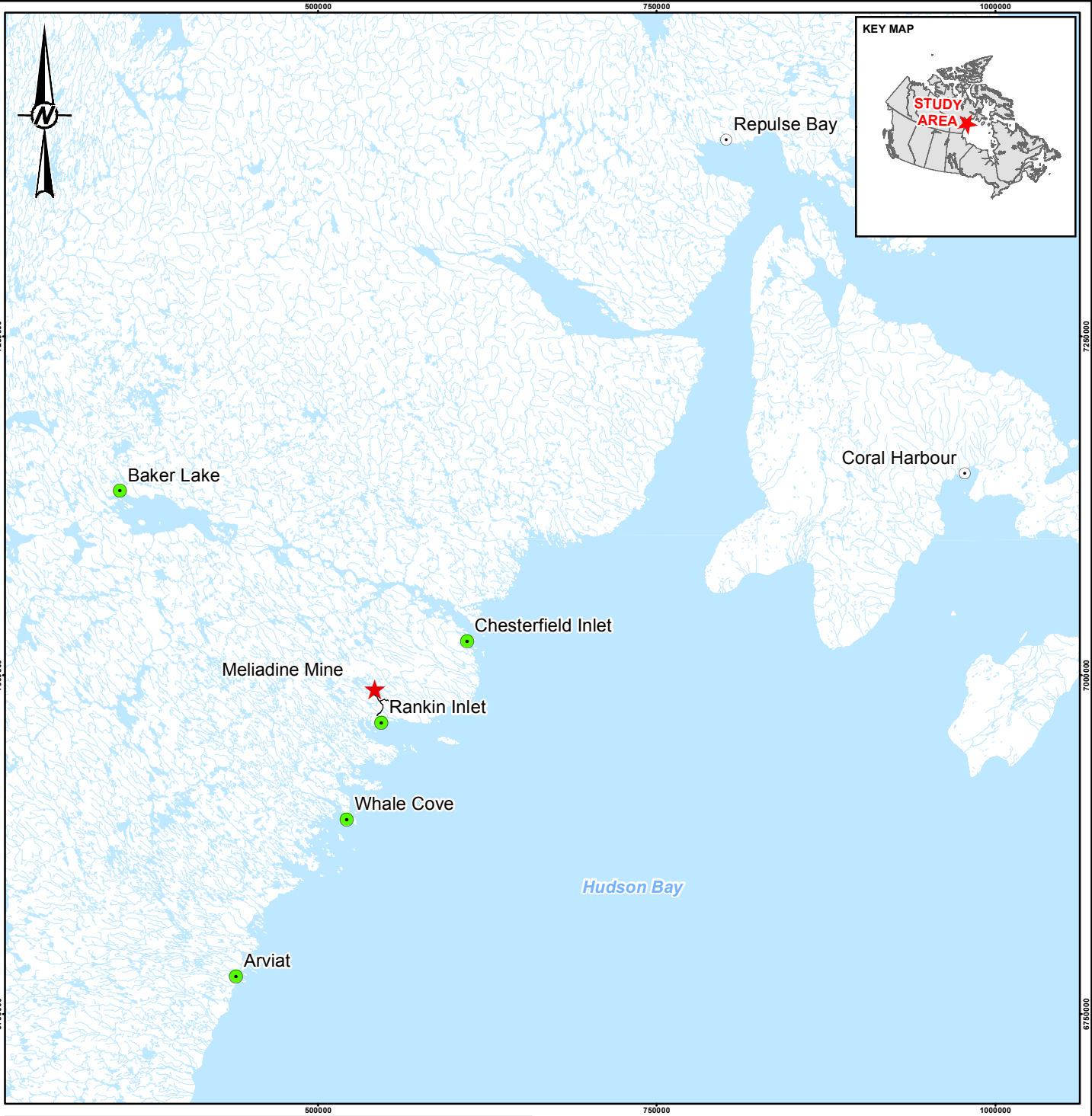

LEGEND

- LOCAL STUDY AREA (LSA) COMMUNITY
- COMMUNITY
- COMMUNITY
- PROJECT LOCATION
- ALL-WEATHER ACCESS ROAD (AWAR)
- WATERCOURSE
- WATERBODY

0 100 200
KILOMETRES

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

CLIENT
AGNICO EAGLE MINES LIMITED

CONSULTANT
GOLDER

YYYY-MM-DD	2018-06-14
DESIGNED	JR
PREPARED	CDB
REVIEWED	
APPROVED	

PROJECT
MELIADINE GOLD PROJECT
NUNAVUT

TITLE
SOCIO-ECONOMIC BASELINE LOCAL STUDY AREA

PROJECT NO.	CONTROL	REV.	FIGURE
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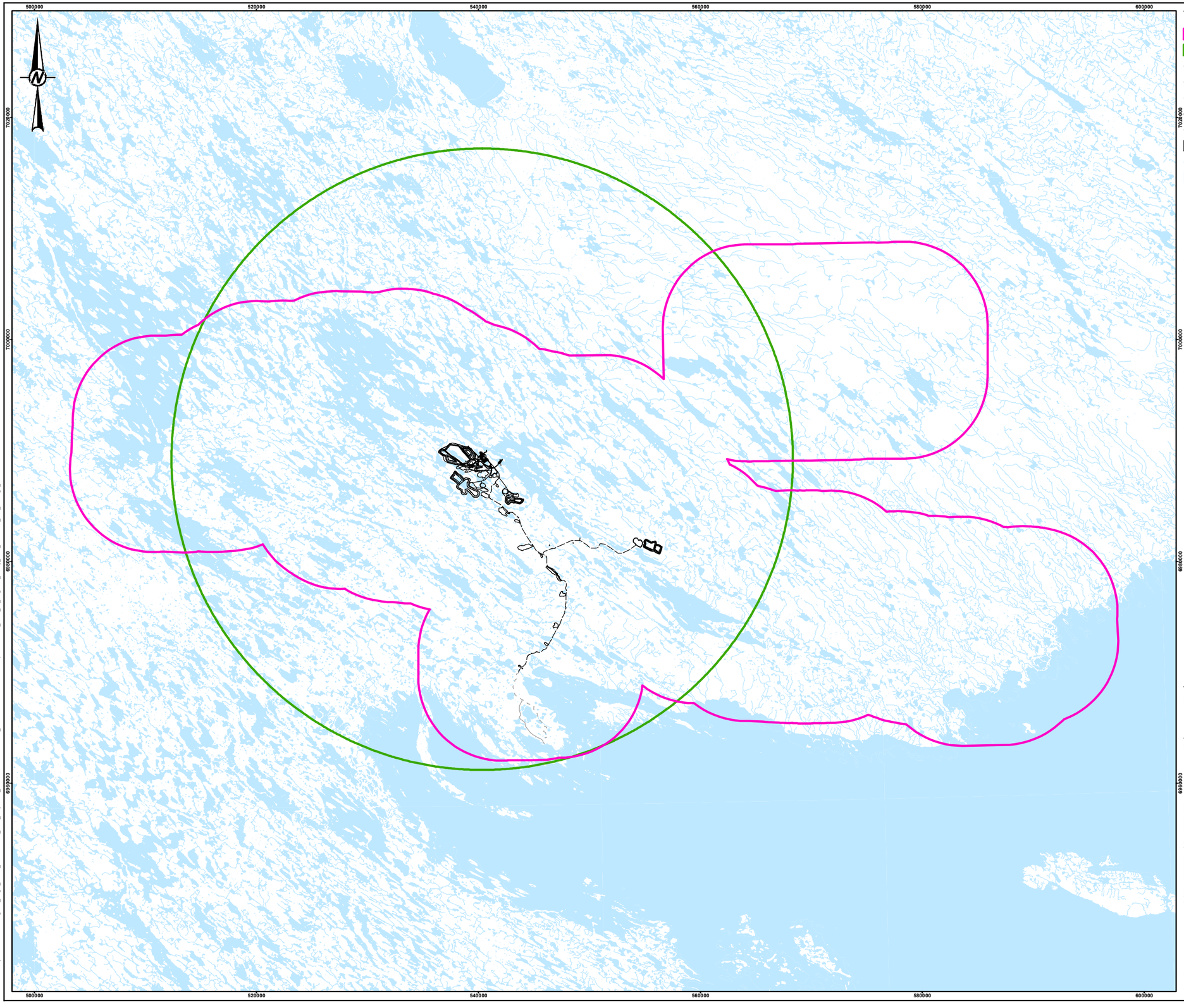
7.1.2 Regional Study Area

- The marine RSA (Figure 4) is the area within which there exists the potential for residual effects, including direct and indirect effects, as well as incremental effects from the amendment and cumulative effects from historical, existing, and reasonably foreseeable developments. The extent of the RSA includes a 5-km buffer area extending outside Melvin Bay consistent with the FEIS (Agnico Eagle 2014, Volume 8).
- The terrestrial RSA (Figure 7) boundary is the same as that defined for the FEIS (Volume 6; Agnico Eagle 2014) and encompasses the area within which the amendment activities of the proposed treated groundwater effluent disposal will be taking place.
- A single RSA was defined for the Mine site, AWAR and Rankin Inlet for air quality in the FEIS (Volume 5; Agnico Eagle 2014). The RSA covers a 40x45 km area generally centered on the Mine site, and encompasses the area surrounding the AWAR and the Rankin Inlet community. An RSA was not explicitly defined for noise as effects are expected to be limited to the LSA and specifically in and around the community of Rankin Inlet.
- The RSA for heritage resources (Figure 7) was chosen to be consistent with the FEIS (Volume 9; Agnico Eagle 2014).
- Nunavut is the RSA for socio-economic effects, consistent with the FEIS (Volume 9; Agnico Eagle 2014).



LEGEND

- HERITAGE REGIONAL STUDY AREA
- TERRESTRIAL REGIONAL STUDY AREA
- ALL-WEATHER ACCESS ROAD (AWAR)
- ROAD - NEW
- ROAD - EXISTING
- PROJECT INFRASTRUCTURE
- WASTE ROCK STORAGE FACILITY
- BORROW PIT/QUARRY
- WATERCOURSE
- WATERBODY

0 8000 16000
METRES

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

CLIENT
AGNICO EAGLE MINES LIMITED

PROJECT
MELIADINE GOLD PROJECT
NUNAVUT

TITLE
REGIONAL STUDY AREAS – TERRESTRIAL AND HERITAGE RESOURCES

CONSULTANT
GOLDER

YYYY-MM-DD	2018-06-14
DESIGNED	JR
PREPARED	CDB
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APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
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7.1.3 Temporal Boundaries

The approach used to determine the temporal boundaries of potential effects were similar to the approach used to define spatial boundaries and are linked to two concepts:

- the development phases of the Project (i.e., construction, operation and maintenance, and closure), focused on the proposed amendment activities
- the predicted duration of effects from the proposed amendment activities on a VEC or VSEC, which may extend beyond closure (i.e., post-closure)

The projected life of the proposed amendment activities is anticipated to extend for the duration of the mine life (10 years), but may be extended as exploration continues. This includes estimated 2 months of construction, 13 years of operations to coincide with mine life, and a two-month decommissioning period. For the purpose of this assessment, a conservative estimate of 25 years is considered as the temporal boundary to account for the mine life of the Meliadine Mine and potential mine expansion. The proposed amendment activities are anticipated to be completed over a couple of months during the open water season (summer months) for the construction phase, and extend for the duration of the Mine life, during the open water season months, up to decommissioning.

7.2 Valued Components

VECs and VSECs represent physical, biological, cultural, social and economic properties of the environment that are either legally, politically, publically, or professionally recognized as ecologically and socially important to a particular region, community, or by society as a whole. Several VCs were selected to assess Project-related effects per the proposed Project activities on terrestrial and marine wildlife and wildlife habitat (Table 16). VCs were selected based on their role in the ecosystem, and value placed on them by humans for traditional use and cultural purposes, where appropriate.

Factors considered when selecting VCs included the following:

- biophysical components identified by NIRB during Project scoping and Agnico Eagle community and stakeholder consultation
- cultural components identified by NIRB during Project scoping and Agnico Eagle community and stakeholder consultation
- territorial (CESCC 2016) listed species
- components that play roles in important ecosystem processes
- federally listed species under Committee on the Status of Endangered Wildlife in Canada (2017) and SARA (2017)
- biological communities or species that reflect the interests of regulatory agencies, Inuit groups, and communities
- components that can be measured or described with measurement endpoints
- components that allow cumulative effects to be considered
- experience with EAs and effects monitoring programs in Nunavut and the Northwest Territories

Table 16: Valued Ecosystem and Socio-Economic Components

Valued Components (VCs)	Inclusion in the Effects Assessment	Rationale
Air Quality/Emissions	Yes	■ Potential for chemical changes or and physical/physiological effects on vegetation and wildlife
Climate and Meteorology	No	■ No effects are expected with the small-scale proposed Project activities than what was assessed in the FEIS (Agnico Eagle 2014)
Greenhouse and Climate Change	No	■ No effects are expected with the small-scale proposed Project activities than what was assessed in the FEIS (Agnico Eagle 2014)
Noise	Yes	■ Potential for sensory disturbance of wildlife and marine birds
Geology	No	■ No potential for effects due to the proposed Project activities
Permafrost	No	■ No potential for effects due to the proposed Project activities
Soils and Terrain	No	■ No potential for effects due to the proposed Project activities
Hydrogeology and Groundwater Quality	No	■ No potential for effects due to the proposed Project activities
Hydrology	No	■ No potential for effects due to the proposed Project activities
Freshwater quality and sediment quality	No	■ No potential effects as no discharge to surface freshwater bodies will be undertaken
Marine Sediment and Water Quality	Yes	■ Potential to be affected from near shore and in-water construction for discharge pipe installation ■ Accidental release of treated groundwater effluent from an unknown location along the discharge pipe can have direct adverse effects on marine water quality and associated indirect effects on marine wildlife
Marine Fish and Fish Habitat (including Benthic Invertebrates)	Yes	■ Commercial, social, cultural, and ecological importance of Fish and Fish Habitat in Project area ■ Cultural and ecological importance of Benthic Invertebrates in Project area ■ Melvin Bay potentially supports spawning, rearing, and feeding areas for Fish ■ Potential to be affected by Project activities ■ Fish and Fish Habitat identified as important during IQ studies and during stakeholder / agency consultation
Marine Birds	Yes	■ Cultural and aesthetic value to society ■ Ecological importance in Project area ■ Biological indicators for marine and terrestrial ecosystem health ■ Migratory and non-migratory species protected by provincial and federal regulations ■ Include several federally listed species ■ Potential to be affected by Project activities ■ Identified as important during IQ studies and during stakeholder / agency consultation
Marine Mammals	Yes	■ Commercial, social, cultural and ecological importance in the Project area ■ Biological indicators for marine and terrestrial ecosystem health ■ Include several federally listed species ■ Potential to be affected by Project activities ■ Identified as important during IQ studies and during stakeholder / agency consultation

Table 16: Valued Ecosystem and Socio-Economic Components

Valued Components (VCs)	Inclusion in the Effects Assessment	Rationale
Vegetation	Yes	■ Plant populations and communities important for support of ecosystem processes and services, ecosystem resiliency, and spiritual and aesthetic values and are characterized within Ecological Landscape Classification (ELC) types ■ Listed (rare) plant species (i.e., listed as "At Risk", "Vulnerable" or "Imperiled" in Nunavut or by Committee on the Status of Endangered Wildlife in Canada; which therefore, may be disproportionately affected by Project activities) ■ Traditional use plant species used in Nunavut primarily by aboriginal persons, including edible plants, medicinal plants, and plants used for construction or other purposes
Wildlife	Yes	■ Biological indicators for terrestrial ecosystem health ■ Migratory and non-migratory species protected by territorial and federal regulations ■ Potential to be affected by Project activities ■ Identified as important during IQ studies and during stakeholder / agency consultation
Upland Birds and Raptors	No	■ No potential effects on upland birds and raptors as the proposed Project activities will be undertaken in the marine environment and coast
Fish and Fish Habitat	No	■ No potential effects as no discharge to surface freshwater bodies will be undertaken
Freshwater plankton and benthos	No	■ No potential effects as no discharge to surface freshwater bodies will be undertaken
Heritage resources	Yes	■ Are unique and non-renewable resources that provide information about Nunavut's human and natural past
Employment and Procurement	Yes	■ The Project could generate employment and contracting opportunities
Population; Housing; Infrastructure and Services	Yes	■ Employment generated by development can spur migration to near-by communities by job-seekers, which can in turn place additional demand for and pressure on housing, infrastructure and services
Non-Traditional Land Use	Yes	■ Changes to the land and its resources can impact non-traditional land uses such as guiding, hunting, trapping, fishing, camping, and other recreation
IQ and Traditional Land and Resource Use	Yes	■ Changes to the land and its resources can impact traditional use of the land, and can impact the transmission of IQ to current and future generations
Individual and Community Wellness	No	■ No effects are expected with the small-scale proposed Project activities than what was assessed in the FEIS (Agnico Eagle 2014)
Governance and Leadership	No	■ No effects are expected with the small-scale proposed Project activities than what was assessed in the FEIS (Agnico Eagle 2014)

SECTION 8 • EFFECTS ASSESSMENT

8.1 Pathway Analysis

8.1.1 Methods

Pathway analysis identifies and assesses the linkages between the proposed amendment components or activities, and the correspondent potential residual effects to VECs and VSECs. A detailed description of the methods for the pathway analysis is provided in Section 6.5.4 for Vegetation, Section 6.6.2 for Wildlife, Section 8.3.4 for the Marine Environment, and Section 9.1 for both Socio-Economic and Heritage of the FEIS (Agnico Eagle 2014). Each are summarized here. Potential pathways through which the proposed amendment activities could affect VECs and VSECs are presented in Table 17.

Each potential pathway is assessed and described as follows:

- no linkage – pathway is non-existent or is removed as it was previously assessed and the proposed amendment activities represent a negligible change, or is removed by environmental design features and mitigation so that the proposed amendment activities result in no detectable environmental change and residual effects to VECs and VSECs or the associated habitat relative to baseline or guideline values. Not carried through the effects assessment
- minor – pathway could result in a minor environmental change, but would have a negligible residual effect on VECs and VSECs or the associated habitat relative to baseline or guideline values. Not carried through the effects assessment
- primary – pathway is likely to result in a measurable environmental change that could contribute to residual effects on VECs and VSECs or the associated habitat relative to baseline or guideline values. Require further effects analysis to determine the environmental significance from the proposed amendment activities on VECs and VSECs or the associated habitat

Table 17: Potential Pathways for Effects

Proposed Amendment Activity	Potentially Impacted Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Analysis
Marine Environment				
Installation and presence of discharge pipe	Marine Fish and Fish Habitat	Change in fish habitat quality due to in-water works and presence of discharge pipe.	Placement of pipe will avoid sensitive natural habitats. Construction and installation of the discharge pipe will adhere to DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2013). Vessels will follow established speed restrictions (≤2 knots in Melvin Bay, per the Shipping Management Plan). Best management practices for erosion and sedimentation control will be used to control sediment releases during construction and installation of the discharge pipe and associated structures (e.g., silt curtains, runoff management). On-land works will adhere to mitigation measure section of the Type A Water Licence (2AM-MEL1631).	Minor
	Marine Fish and Fish Habitat (including Benthic Invertebrates)	Change in health and survivorship of marine fish and benthic invertebrates due to in-water works and presence of discharge pipe.	Placement of pipe will avoid sensitive natural habitats. Construction and installation of the discharge pipe will adhere to DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2013). Vessels will follow established speed restrictions (≤2 knots in Melvin Bay, per the Shipping Management Plan). Best management practices for erosion and sedimentation control will be used to control sediment releases during construction and installation of the discharge pipe and associated structures (e.g., silt curtains, runoff management). On-land works will adhere to mitigation measure section of the Type A Water Licence (2AM-MEL1631).	Minor
	Marine birds and marine mammals	Change in marine habitat quality due to in-water works and presence of discharge pipe.	Placement of pipe will avoid sensitive natural habitats. Vessels will follow established speed restrictions (≤2 knots in Melvin Bay, per the Shipping Management Plan). Best management practices for erosion and sedimentation control will be used to control sediment releases during construction and installation of the discharge pipe and associated structures (e.g., silt curtains, runoff management). On-land works will adhere to mitigation measure section of the Type A Water Licence (2AM-MEL1631). Tank arrangement is designed to be compact and reduce the overall Project footprint and within the Itivia Fuel Storage Facility laydown area. Use existing roads. Design, construct, and install a diffuser with the discharge pipe to aid in mixing and minimize the Project footprint. Minimize footprint of laydown area for discharge pipe and diffuser installation.	No linkage

Table 17: Potential Pathways for Effects

Proposed Amendment Activity	Potentially Impacted Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Analysis
Installation and presence of discharge pipe *(cont'd)*	Marine birds Air Quality	Sensory disturbance from structural lighting may result in changes in health and mortality risk in marine birds due to collisions with infrastructure.	Sensory disturbance mitigation will be adhered to as per the approved TEMMP. Where feasible, lights on infrastructure will be shielded and/or angled to minimize direct illumination and reflection of the sea surface. Activities will be scheduled during daylight hours whenever practical to minimize the need for staging lights. Work will occur during summer when daylight is extended, minimizing the need for site lighting. Vessels will follow established speed restrictions (≤2 knots in Melvin Bay, per the Shipping Management Plan). Pre-construction surveys (i.e., seasonally relevant) will be completed prior to any construction activities to determine presence of denning sites (e.g., Arctic foxes), nesting sites or other areas of high wildlife use per the TEMMP. Depending on the findings, appropriate mitigation and/or management options will be discussed with regulators.	Minor
	Marine birds Air Quality Noise	Sensory disturbance from structural lighting and in-air noise from nearshore human activities may alter marine bird behavior.		Minor
	Marine Sediment and Water Quality	Disturbance of nearshore or seabed material from in-water construction will impact both sediment and water quality	Short-term in-water construction period during the early open water season. On-land works will adhere to mitigation measure section of the Type A Water Licence (2AM-MEL1631) Minimal to no disturbance of the seabed during construction (inert materials will be used - rock protection around discharge pipe on the surface through the tidal zone; discharge pipe and diffuser will be slowly sunk to the seabed and held in place with inert material to weigh it down). Vessels will follow established speed restrictions (≤2 knots in Melvin Bay, per the Shipping Management Plan). Adherence to DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2013). Design, construct, and install a diffuser with the discharge pipe to aid in mixing and minimize the Project footprint.	Minor
Discharging treated groundwater effluent into marine environment	Marine Fish and Fish Habitat (including Benthic Invertebrates)	Change in fish habitat quality due to discharge of groundwater effluent from the Meliadine Mine	Discharge of effluent will meet regulatory requirements for both temperature and water quality guidelines, including Metal and Diamond Mining Effluent Regulations (MDMER, once they come into effect, GC 2017), and Canadian Council of Ministers of the Environment (CCME) Guidelines for the Protection of Aquatic Life (Marine). Parameters without regulated limits or guidelines will be treated to meet background concentrations at Melvin Bay. Design, construct, and install a diffuser with the discharge pipe to aid in mixing and minimize the Project footprint. Adherence to DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2013). Implementation of the EMPP monitoring program and adaptive management implemented if negative impacts are detected.	Minor

Table 17: Potential Pathways for Effects

Proposed Amendment Activity	Potentially Impacted Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Analysis
Discharging treated groundwater effluent into marine environment *(cont'd)*	Marine Fish and Fish Habitat (including Benthic Invertebrates)	Change in health and survivorship due to the quality of the groundwater effluent discharge	Discharge of effluent will meet regulatory requirements for both temperature and water quality guidelines, including Metal and Diamond Mining Effluent Regulations (MDMER, once they come into effect, GC 2017), and CCME Guidelines for the Protection of Aquatic Life (Marine). Parameters without regulated limits or guidelines will be treated to meet background concentrations at Melvin Bay. Toxicity testing will be completed on the treated groundwater effluent to confirm it is acceptable for release and non-acutely toxic. Design, construct, and install a diffuser with the discharge pipe to aid in mixing and minimize the Project footprint. Adherence to DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2013). Implementation of the EMPP monitoring program and adaptive management implemented if negative impacts are detected.	Minor
	Marine Birds and Marine Mammals	Change in habitat quality due to the quality of the groundwater effluent discharge	Discharge of effluent will meet regulatory requirements for both temperature and water quality guidelines, including Metal and Diamond Mining Effluent Regulations (MDMER, once they come into effect, GC 2017), and CCME Guidelines for the Protection of Aquatic Life (Marine). Parameters without regulated limits or guidelines will be treated to meet background concentrations at Melvin Bay. Design, construct, and install a diffuser with the discharge pipe to aid in mixing and minimize the Project footprint. Implementation of the EMPP monitoring program and adaptive management implemented if negative impacts are detected.	Minor
	Marine Birds and Marine Mammals	Change in health and survivorship due to the quality of the groundwater effluent discharge		Minor
	Benthic Invertebrates Marine Fish and Fish Habitat Marine birds and Marine Mammals	Accidental release of groundwater effluent from an unknown location along the discharge pipe can have direct adverse effects on marine water quality and associated indirect effects on marine wildlife	Implementation of secondary containment for the storage tank within the Itivia Fuel Storage Facility. Operational activities will be engineered to use handling systems to minimize the risk of accidental spills into the marine environment. Visual inspections of equipment will be carried out regularly, and spills kits will be available Implementation of the Spill Contingency Plan and Risk Management and Emergency Response Plan. The Shipping Management Plan may also be implemented, as appropriate. Spills and leaks will be contained, cleaned-up and documented per applicable guidelines and regulations, spill kits will be restocked after use.	Primary
Discharging treated groundwater effluent into marine environment *(cont'd)*	Benthic Invertebrates Marine Fish and Fish Habitat Marine birds and Marine Mammals	Reduction in sea ice thickness and or timing of seasonal freeze-up could impact habitat quality	No discharge under-ice – discharge during the open water season (summer months) only. Treated ground water effluent discharge temperature will be managed via the diffuser within the 100 m mixing zone radius, per regulatory guidance (BC MOE 2017a).	No linkage

Table 17: Potential Pathways for Effects

Proposed Amendment Activity	Potentially Impacted Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Analysis
Terrestrial Environment				
Building of discharge facility including: • Construction of storage tank • Installation of discharge pipe and diffuser	Wildlife Vegetation	Physical loss or alteration of vegetation or available habitat from construction of the storage tank, discharge pipe and diffuser	Tank arrangement is designed to be compact and reduce the overall Project footprint and within the Itivia Fuel Storage Facility laydown area. Use existing roads. Design, construct, and install a diffuser with the discharge pipe to aid in mixing and minimize the Project footprint. Minimize footprint of laydown area for discharge pipe and diffuser installation.	Minor
Trucking of treated groundwater effluent to discharge location	Vegetation and Wildlife	Air emissions and dust deposition can cause changes to chemical properties of vegetation, affecting wildlife habitat	Dust will be actively suppressed from roads (water and/or other dust suppressants) and monitoring will continue along the AWAR per the Air Quality Monitoring Program, and reported on annually to determine the impacts from dust. Potential use of chemical dust suppressants in accordance with the Environmental Guidance for Dust Suppression published by the Government of Nunavut Department of Environment. Traffic volumes will continue to be monitored and reported as part of annual reporting requirements. Enforcing speed limits will assist in reducing dust. Road surfaces will be maintained through grading and the addition of granular material. Equipment and vehicles will comply with relevant non-road emission criteria at that time of purchase. Regular maintenance of equipment and vehicles to meet emission standards. Adherence to the Roads Management Plan and the Dust Management Plan (Appendix C to Roads Management Plan). Habitat loss will be assessed annually as per the approved TEMMP.	Minor
		Dust deposition may cover vegetation and lead to physical and/or physiological damage to plants, affecting wildlife habitat		Minor
		Spills or accidental release of treated groundwater effluent from trucks along the trucking route can affect vegetation and wildlife	Implementation of the Spill Contingency Plan and Risk Management and Emergency Response Plan. The Shipping Management Plan may also be implemented, as appropriate. Spills and leaks will be contained, cleaned-up and documented per applicable guidelines and regulations, spill kits will be restocked after use. Hazardous materials and fuel will be stored according to regulatory requirements to protect the environment and workers (i.e., Hazardous Materials Management Plan). Trucking equipment will be regularly maintained.	No Linkage

Table 17: Potential Pathways for Effects

Proposed Amendment Activity	Potentially Impacted Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Analysis
Trucking of treated groundwater effluent to discharge location *(cont'd)*	Wildlife	Collision with vehicles causing injury or mortality to individual animals, which can affect population sizes	Adherence to Caribou Migration Procedure (Appendix IV in the TEMMP). Follow mitigation and monitoring for wildlife as outlined in the Wildlife Protection and Response Plan (Appendix III in the TEMMP). Caribou Specific mitigation: Increased awareness for traffic management during post-calving caribou movements in late June through mid-July. Any mortalities of caribou will immediately trigger an investigation and will be reported upon annually Road surveillance monitoring to determine when caribou are near, including height of land surveys. Site roads have been designed and constructed to use finer material size that facilitate caribou crossing (i.e., coarse boulders are not used). Sensory disturbance mitigation, caribou monitoring, and implementation of the work suspension protocol procedure when ≥ 50 caribou and/or ≥ 10 muskox are within 100 m of the AWAR or Mine Site, consistent with the TEMMP. Blasting activities will not occur when caribou herds (i.e., >50 animals) are known to be within 5 km of the Project or associated components. Maximum speed limit on all site roads is 50 km/h and will be reduced to a maximum of 30 km/h when caribou or other wildlife are known to be on-site.	Minor
Heritage Record				
Building of discharge facility (including installation of discharge pipe and diffuser)	Heritage Record	Construction and other activities leading to ground alteration that affect physical heritage resources	Continue to adhere to the legal requirements related to archaeological and palaeontological work in Nunavut, which include Section 33 of the Nunavut Agreement, and the *Nunavut Archaeological and Paleontological Site Regulations* developed pursuant to Section 51(1) of the *Nunavut Act* (GC 1993a,b; GN 2003). Agnico Eagle will also follow the *Guidelines for Applicants and Holders of Nunavut Territory and Palaeontology Permits.* Implementation of the Heritage Resource Protection Plan and reported on as part of the annual reporting requirements for the Meliadine Mine. The storage tank will be within the Itivia Fuel Storage Facility laydown area. Provide awareness training and a manual for recognizing heritage resources to all staff and contractors. Avoid previously recorded heritage resource sites. Adhere to any mitigation strategies that are required if an avoidance mitigation strategy cannot be implemented. Monitor condition of known heritage resource sites near the Project footprint**.**	No linkage

Table 17: Potential Pathways for Effects

Proposed Amendment Activity	Potentially Impacted Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Analysis
Socio-economics				
Construction; Discharging treated groundwater effluent into marine environment	Employment and Procurement	Construction and operation for the proposed amendment activities could generate modest employment through the use of a local contractor	The construction period is short, and the number of employment opportunities would be very small and could likely be filled by the contractor's existing workforce. The Project's operational workforce requirements for the proposed amendment activities will also be low, associated with trucking of discharge to the diffuser, and will be filled by qualified local seasonal employees. Identify a suitable local contractor with capacity to meet the labour force demand for the proposed amendment activities, in line with the Human Resources Plan.	Minor
	Population; Housing; Infrastructure and Services	Employment opportunities could prompt job-seekers to relocate to Rankin Inlet in hopes of employment, introducing additional demand for housing, infrastructure and services	The construction period is short. The Project's construction workforce requirements for the proposed amendment activities will be low, and will likely be met by an existing local contractor with an existing workforce. The Project's operational workforce requirements for the proposed amendment activities will also be low, associated with trucking of discharge to the diffuser, and will be filled by qualified local seasonal employees. Agnico Eagle will communicate these details in advance of construction to avoid speculative movement of job seekers from other areas to Rankin Inlet.	No Linkage
	Non-Traditional Land Use	Construction and operations for the proposed amendment activities could impact recreational use (e.g., snowmobiling) in the immediate vicinity	Engagement with impacted land users regarding the identification of suitable and comparable space for specific recreational land use (e.g., snow mobile racing), in line with the Community Involvement Plan. No under-ice discharge to Melvin Bay.	Minor

Table 17: Potential Pathways for Effects

Proposed Amendment Activity	Potentially Impacted Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Analysis
Construction; Discharging treated groundwater effluent into marine environment *(cont'd)*	IQ and Traditional Land and Resource Use	Impacts from the proposed amendment activities on marine wildlife and fish behaviour and health could result in adverse impacts to traditional harvesting	Best practices for erosion and sediment control measures for construction. Adherence to DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2013). Adhere to the Oil Pollution Emergency plan, as required.	Minor
		Impacts from the proposed amendment activities on terrestrial wildlife and bird behaviour and health could result in adverse impacts to traditional harvesting	Applicable management or monitoring plans for the various terrestrial and marine species, as required, and reported on as part of the annual reporting requirements for the Meliadine Mine. This will include the TEMMP and the Conceptual Ocean Discharge Monitoring Plan, amongst other applicable plans and programs.	Minor
		Discharge pipe location could impact access to traditional land use areas during summer months	Engagement with traditional land users regarding the location of the discharge pipe and its diffuser, per the Community Involvement Plan to avoid impacts to snowmobile use for traditional pursuits. Avoidance of the boat launch area to facilitate continued use of the area and sea ice. Where the discharge pipe runs over land, markers will be placed to warn snowmobile drivers. Ramps of an appropriate grade and slope may be considered for safe snowmobile travel along the shore over the discharge pipe, provided pipeline integrity is not compromised.	Minor
		Construction and operation of the proposed amendment activities could result in the perception that water, marine wildlife, and fish are no longer safe for traditional use	Engagement with traditional land users regarding the safety of water and fish, per the Community Engagement Plan. Provide accessible information on the efficacy of mitigation measures and the lack of potential for contamination of water and aquatic species for consumption.	Minor

The Groundwater Management Plan (Appendix D) was developed per Condition #25 in the NIRB Project Certificate No.006 (2015) and the Type A Water Licence (2AM-MEL1631, Part E, Item 14).

Federal regulations refers to the Metal and Diamond Mining Effluent Regulations (MDMER) once the regulations come into effect and, Fisheries and Oceans Canada (DFO) Measures to Avoid Causing Harm to Fish and Fish Habitat (2013).

AEMP = Aquatic Effects Monitoring Plan (Golder 2016c); AWAR = All-weather Access Road; DFO = Fisheries and Oceans Canada; EMPP = Environmental Management and Protection Plan (Agnico Eagle 2015b); FEIS = Federal Environmental Impact Statement (Agnico Eagle 2014); TEMMP = Terrestrial Environmental Management and Monitoring Program (Golder 2015)

8.1.2 Pathways with No Linkage

A pathway may have no linkage if the pathway is removed as it was previously assessed and the amendment activities represent a negligible change or is removed by environmental design features and mitigation so that the proposed amendment activities result in no detectable environmental change and residual effects to VECs and VSECs at relative to baseline or guideline values. The following pathways have no linkage to the VECs and VSECs and will not be carried through the effects assessment:

- **Alteration of marine bird and mammal habitat from installation of the discharge pipe**
- **Reduction in sea ice thickness and or timing of seasonal freeze-up could impact marine bird and mammal habitat quality**
- **Spills or accidental release of treated groundwater effluent from trucks along the trucking route can affect vegetation and wildlife**
- **Trucking of treated groundwater effluent to discharge location can affect heritage resources**
- **Building of discharge facility (including installation of the discharge pipe and diffuser) can affect heritage resources**
- **Employment opportunities could prompt job-seekers to relocate to Rankin Inlet in hopes of employment, introducing additional demand for housing, infrastructure and services**

8.1.3 Pathways with Minor Linkage

In some cases, both a source and a pathway exist, but the change caused by the proposed amendment activities is anticipated to result in minor environmental changes, and would have a negligible residual effect on VECs relative to baseline or guideline values. Pathways that are anticipated to be minor, and will not be carried through the effects assessment are as follows:

- **Change in fish habitat quality due to in-water works and presence of discharge pipe**
- **Change in health and survivorship of marine fish and benthic invertebrates due to in-water works and presence of pipe**
- **Change in marine habitat quality due to in-water works and presence of discharge pipe**

A limited area of potential marine fish, benthic invertebrate, bird and mammal habitat will be altered by the presence of the discharge pipe and diffuser. Given the limited area of habitat impacted of up to approximately 0.14 ha, on land (up to approximately 0.09 ha) and within Melvin Bay, due to the approximately 350 m long 4” pipe extending from the storage tank to the end of the diffuser plus a 5 m buffer, and rock protection on land and through the tidal zone. The installation area is next to the shore in a shallow environment that is currently being used as a community ramp or launch area, and marine fish and benthic invertebrates are not expected to use this shallow, disturbed habitat. The overall availability of habitat for marine fish, benthic invertebrate, bird and mammal use is not expected to substantially change. Installation of the discharge pipe and diffuser is thus anticipated to have a negligible residual effect on fish and marine habitat quantity and quality.

Aquatic habitat in the area consists of sparse nearshore macrophyte coverage and mainly cobble and gravel with some boulders and fines; few invertebrate species were observed in the nearshore habitat, and abundance was low. Most of the individuals observed were less than 1 cm, suggesting a low biomass (Nunami Stantec Ltd. 2012). Given that the area has already had human disturbance and that

the shallow, disturbed habitat is not critical fish habitat directly or indirectly supporting a commercial, CRA fishery, the location of the discharge pipe and diffuser follows Fisheries and Oceans Canada (DFO's) Measures to Avoid Causing Harm to Fish and Fish Habitat (2013). These are measures and standards to avoid, mitigate or offset serious harm to fish that are part of or that support a commercial, recreational or Aboriginal fishery. As outlined by DFO, avoidance measures may include:

- **locating the project infrastructure in areas where no harm will occur or where impacts are minimized**
- **designing a project and employing measures so that no harm occurs**
- **timing certain activities to prevent interactions with fish at key life stages such as spawning or migration**

By designing and placing the discharge pipe and diffuser (with a 5 m buffer) into the area shown in Figure 2, it is anticipated that the chosen location will aid in preventing impacts to CRA fisheries from occurring within the total area of fish habitat impacted. The discharge pipe will be placed in an area that is not critical to sustaining the life processes and histories of fish in the area. By implementing erosion and sediment controls, and following DFO operation of machinery guidelines it is anticipated that mitigation and proper practices will result in a negligible residual effect in fish habitat quality due to in-water works and presence of pipe.

In-water work and work near waterbodies has the potential to increase suspended sediment concentrations in water. The extent of potential effects to marine life, if any, will be through local increases in TSS and sediment deposition. The nature and extent of adverse physiological effects of increased TSS is influenced by both the TSS concentrations and the duration of the exposure. For example, fish can tolerate low TSS concentrations for long periods and high concentrations for short periods without suffering adverse effects (Newcombe and Jensen 1996). The effects of sediment deposition can include infilling of interstitial spaces between substrate particles that provide habitat for earing of fry or incubation of eggs. Fish would also show a behavioral response, moving away from the area with a high sediment load. Benthic invertebrates may be affected by sedimentation, directly through smothering, or indirectly through interference with feeding and reductions in available habitat resulting from infilling of interstitial spaces between substrate particles (Wiederholm 1984). Effects on benthic invertebrates depend on both concentration and duration of exposure (Newcombe and MacDonald 1991). Benthic species are not thought to occupy the intertidal zone in Hudson Bay on a permanent basis; rather, they occur seasonally when the habitat is not influenced by ice (Stewart and Lockhart 2005). Baseline studies completed in the LSA support this assumption (Nunami Stantec Ltd. 2012).

The shoreline at Itivia Harbour fairly rocky, with cobbles and pebbles along the shore. As such, the potential for erosion is slim. To minimize the potential for sedimentation, installation of the discharge pipe and diffuser for near-shore and in-water works will be minimal and when possible restricted during frozen or low tide conditions. All construction activities will be subject to an erosion and sediment control plan, and best management practices will include standard erosion and sediment control (ESC) measures (e.g., erosion mats, silt curtains or fences, boom curtains, or similar). ESC measures will be maintained throughout construction and site isolation measures for containing suspended sediment where in-water work is required will be in place. Timing of in-water works will adhere to any applicable

DFO timing windows in Nunavut to protect fish, including their eggs, juveniles, spawning adults and/or the organisms upon which they feed. In-water work will try to be completed during periods of low flow, or at low tide, to further reduce the risk to fish and their habitat or to allow work in water to be isolated. Work will also be scheduled to avoid wet, windy and rainy periods that may increase erosion and sedimentation. In addition, a water quality monitoring and reporting plan will be conducted during construction to observe conditions. Overall, the effects to health and survivorship of marine fish and benthic invertebrates would be negligible, in large part because sediment control plan and best management practices will be used for all construction activities. Installation of the discharge pipe is anticipated to have a negligible residual effect with marine benthic invertebrates. As a result, the potential effects from the installation of the discharge pipe on marine fish and benthic invertebrates due to in-water works and presence of the discharge pipe is not assessed further. Any minor effects to local fish or fish habitat, if any, would be followed by a quick rebound to baseline fish populations given the adaptive life history strategies of fish species.

Given the placement for the discharge pipe and diffuser and the limited area impacted, the availability of this habitat for marine birds and mammal use is not expected to substantially change, and the fact that this shallow, disturbed habitat area is used by the local community, effects on habitat for marine birds and mammals is considered to result in negligible residual effects. While birds and mammals may avoid the area during construction and installation activities, this is short-term and would be followed by a rebound to baseline levels. The construction of the discharge pipe will primarily affect the heath tundra plant community type; however, as heath tundra represents the most abundant plant community type in the LSA and RSA (Volume 6, Section 6.5.3.2 of the FEIS; Agnico Eagle 2014), and the area is disturbed and partially rocky, anticipated effects on plant abundance and distribution is considered negligible. In addition, the mitigation measures described for the protection of fish and benthic invertebrates will also effectively mitigate potential effects on marine birds and mammals. Potential effects due to in-water works and presence of the discharge pipe is not assessed further.

Based on the above, these pathways were determined to have a minor linkage to effects on marine fish, benthic invertebrates, bird and mammals and their habitat, and the continued opportunity for CRA fisheries. The overall effects to the abundance and distribution of marine fish, benthic invertebrate, birds and mammals in the in the LSA and RSA will be minor and not measurable (i.e., abundance and distribution will remain within baseline values). Proper construction practices are expected to minimize negative impacts on fish, fish habitat and CRA fisheries. In addition to specific mitigation measures outlined for the proposed amendment activities to protect aquatic resources, any conditions and/or mitigations outlined by regulatory agencies under the Project Certificate and Type A Water Licence conditions, as well as any licence or regulatory requirements under the *Fisheries Act*, *Nunavut Agreement* or Land Use Permit will be additionally adhered to.

- **Sensory disturbance from structural lighting may result in changes in health and mortality risk in marine birds due to collisions with infrastructure**
- **Sensory disturbance from structural lighting and in-air noise from nearshore human activities may alter marine bird behaviour**

Only a limited area of potential marine bird habitat will potentially be altered by the structural lighting and nearshore activities, largely during the short construction period for the storage tank, discharge pipe and diffuser. Given the limited area impacted, the availability of this habitat for marine birds use is not expected to substantially change. The installation area is next to the shore in a shallow environment that is currently being used as a community ramp or launch area. The discharge pipe and diffuser that will go underwater in Melvin Bay will be put together next to the shore, and floated out via boat or other marine vessel and connected to the discharge pipe over land. Once connected, the pipe will gradually be sunk by suitable weights made of inert materials to the seabed.

Where feasible, any required lights on infrastructure will be shielded and/or angled to minimize direct illumination and reflection of the sea surface. In addition, activities will be scheduled during daylight hours whenever practical to minimize the need for staging lights and/or signaling/warning lights around vessels. Work will occur during summer when daylight is extended, minimizing the need for site lighting.

Sensory or in-air noise disturbance from activities along the AWAR are expected to be minor during operations. As described in Section 6.3, modelling to assess the effects of noise during construction of the By-Pass road (including associated activities at the Itivia quarry) around the community of Rankin Inlet was completed, prior to construction activities (Golder 2017b). Noise effects model results indicated that construction noise would likely be difficult to perceive against baseline noise levels (per the FEIS; Agnico eagle 2014) in most parts of Rankin Inlet, and would likely be noticeable during the early stages of construction in the southern parts of Rankin Inlet but at a level unlikely to be disturbing either indoors or outdoors. Per the results of the 2017 NIRB Project Certificate No.006 Annual Report (Agnico Eagle 2018b), the 24-hour equivalent sound levels ($L_{eq\ 24\ h}$) recorded during monitoring were lower than those predicted in the FEIS (Agnico Eagle 2014), and were also lower than the site's monitoring criterion of 45 dBA ($L_{eq\ 24\ h}$). Traffic during operations will be less than during construction, and these results suggest that effects from noise will be negligible to minor.

The effect from the sensory disturbance from structural lighting and in-air noise that may potentially result in changes in health and mortality risk in marine birds due to collisions with infrastructure is not assessed further.

- **Disturbance of nearshore or seabed material from in-water construction will impact both sediment and water quality**

As discussed under the first pathways with minor linkages, the limited area of habitat impacted of up to approximately 0.14 ha, on land and within Melvin Bay (approximately 350 m long 4" pipe from the storage tank to the end of the diffuser plus a 5 m buffer, and rock protection on land and through the tidal zone). The installation area is next to the shore in a shallow environment that is currently being used as a community ramp or launch area. In-water work and work near waterbodies has the potential to increase suspended sediment concentrations in water (i.e., local increases in TSS and sediment deposition).

The discharge pipe overland will be placed on the surface with rock protection, requiring minimal disturbance of the ground surface. The section of the discharge pipe and diffuser that will go underwater in Melvin Bay will be put together next to the shore and floated out via boat or other marine vessel and connected to the discharge pipe over land. Once connected, the pipe will gradually be sunk by suitable weights made of inert materials to the seabed, to minimize potential seabed disturbance. To minimize the potential for sedimentation, installation of the discharge pipe and diffuser for near-shore and in-water works will be minimal and when possible restricted during frozen or low tide conditions. All construction activities will be subject to an erosion and sediment control plan, and best management practices will include standard erosion and sediment control (ESC) measures (e.g., erosion mats, silt curtains or fences, boom curtains, or similar). ESC measures will be maintained throughout construction and site isolation measures for containing suspended sediment where in-water work is required will be in place.

Overall, the effects to sediment and water quality would be negligible, in large part because sediment control plan and best management practices will be used for all construction activities. Any minor effects, if any, would be followed by a quick rebound to baseline sediment and water quality values, upon completion of construction and discharge pipe and diffuser installation activities allowing sediments to settle. As a result, the potential effects from the installation of the discharge pipe on sediment and water quality due to in-water construction is not assessed further.

- **Change in fish and benthic invertebrate habitat quality due to the quality of the groundwater effluent discharge from the Meliadine Mine**
- **Change in health and survivorship of fish and benthic invertebrates due to the quality of the groundwater effluent discharge from the Meliadine Mine**
- **Change in marine bird and mammal habitat quality due to the quality of the groundwater effluent discharge from the Meliadine Mine**
- **Change in health and survivorship of marine birds and mammals due to the quality of the groundwater effluent discharge from the Meliadine Mine**

Discharge of treated groundwater effluent into the marine environment could result in negative changes in habitat quality for marine fish, benthic invertebrates, marine birds and mammals. Resulting impacts from changes in habitat can also impact health and survivorship of marine fish, benthic invertebrates, marine birds and mammals.

As described in Section 3.4.8, the Cornell Mixing Zone Expert System (CORMIX model) was applied to calculate numerical simulations of the near-field mixing and dilution behavior of treated groundwater effluent entering the nearshore coastal receiving environment at the coastal water of Melvin Bay to then assess the possible impacts on the habitat and health and survivorship of marine fish, benthic invertebrates, marine birds and mammals. The intention was to set allowable effluent concentrations at the edge of a regulatory mixing zone (established as 100 m radius from the point of discharge). These allowable concentrations can then be used to determine the dilution ratio within the mixing zone that can be achieved by the diffuser. The dilution ratio represents the effluent concentration in excess of the background concentration required to meet the water quality criteria applicable for the area for discharge.

Since chloride ions mainly constitute the salt content in the marine water and treated groundwater effluent plume, chloride guidelines are used to assess the near field mixing zone, following the BC MOE (2017a) guideline for chloride in marine and estuarine waters as described in Section 3.4.6.1 - the chloride concentration at the mixing zone boundary should not exceed by 2.9 g/L for ambient salinity of 29.3 g/L. In addition, for thermal discharges, temperature at the mixing zone boundary should not change by + or - 1°C from natural ambient background and the hourly rate of change should not exceed 0.5 °C.

Based on the modelling results obtained, the treated groundwater effluent plume met the required regulatory dilution well within the 100 m distance for the ambient and discharge condition scenarios tested (within 1-3 m from the discharge point; refer to Appendix F). The thermal plume met the regulatory guideline of temperature at the mixing zone boundary within 2 m from the discharge point (refer to Appendix F). In addition, the moderate tide in Melvin Bay is also expected to provide and promote good flushing and mixing conditions. A conservative approach was used for selecting the ambient flow conditions for the mixing zone analysis both for treated groundwater effluent and thermal plumes for expected discharge volumes and treated groundwater effluent water quality.

Based on the above, the discharge of effluent will meet regulatory requirements for both temperature and water quality guidelines and is not anticipated to have any negative impacts on the marine environment. The changes in habitat and health and survivorship of benthic invertebrates, marine fish, marine mammals and birds are anticipated to have a negligible residual effect on marine VECs relative to baseline or guideline values. As a result, the potential effects due to elevated levels of chloride, sodium and calcium from discharge water are not assessed further.

- **Air emissions and dust deposition can cause changes to chemical properties of vegetation, affecting wildlife habitat**
- **Dust deposition may cover vegetation and lead to physical and/or physiological damage to plants, affecting wildlife habitat**

The effects of the accumulation of dust (i.e., particulate matter and TSP deposition) and concentrations of air emissions produced from the Meliadine Project on vegetation were assessed in detail in Volume 6, Section 6.5.4.2 of the FEIS (Agnico Eagle 2014). With the increase in truck traffic along the AWAR and access road, dust deposition is expected to result in minor and localized changes to vegetation and wildlife habitat along the right-of-way for the AWAR and access road, and concentrations of air emissions from increased truck traffic may result in a local indirect change on the quality of vegetation and associated wildlife habitat within the terrestrial LSA.

Environmental design features and mitigation have been incorporated into the Project to reduce potential effects from dust deposition, which will continue to be applied for the proposed amendment activities (Table 17).

Dust generation due to Project vehicles travelling along the AWAR would occur annually, but would likely be higher during the non-winter period and not continuous (i.e., would occur less frequently during wet and cool conditions). As described in Volume 6, Section 6.5.4.2 of the FEIS (Agnico Eagle 2014), most dust effects are confined to within 50 m of a road, with less obvious effects observed

between 50 m and 500 m from a road. Therefore, dust deposition from vehicles along the AWAR is predicted to result in negligible residual effects to vegetation and wildlife habitat.

The results of the air quality modelling in the FEIS predicted that the maximum annual dust deposition resulting from the Project is 1.83 grams per square metres per year ($g/m^2/y$) within the Project disturbance areas, and 0.54 g/m2/y outside of the Project disturbance areas (FEIS Volume 6, Section 6.5.4.2, Table 6.5-10; Agnico Eagle 2014). In general, emissions from the roads are small, and if extended over the whole year, a negligible effect from annual depositions was predicted (FEIS Volume 5, Section 5.2; Agnico Eagle 2014).

In addition, modelling to predict the maximum monthly and annual dust deposition or dustfall (as total suspended particles [deposition), resulting from the construction of the By-Pass road and operation of the Itivia quarry around the community of Rankin Inlet (which connects to the AWAR), showed that the predicted maximum monthly and annual dust deposition were well below the respective dustfall criteria during construction (Golder 2017a).

Results from annual reporting (Agnico Eagle 2018b) indicate very low rates of dustfall overall, with no exceedances of Alberta's Ambient Air Quality Guidelines (June 2016) for recreational areas, despite elevated traffic compared to the FEIS predictions (Agnico Eagle 2014). In addition, NO_2 and SO_2 calculated annual average concentrations were well below the Government of Nunavut Ambient Air Quality Standards, and FEIS maximum predicted values.

The addition of the treated groundwater effluent trucking will add a maximum of 16 trips per day during operations, however, the overall annual emissions from vehicles on the roads are anticipated to result in no detectable changes to soils (FEIS Volume 6, Section 6.4.2.2; Agnico Eagle 2014) and are expected to have no detectable effects to vegetation or wildlife habitat relative to baseline conditions. Agnico Eagle will continue to monitor air quality and dust as per the Air Quality Monitoring Plan (Agnico Eagle 2015c), as well as wildlife and vegetation per the EMPP (Agnico Eagle 2015b) and TEMMP (Golder 2015).

- **Collision with vehicles causing injury or mortality to individual animals, which can affect population sizes**

The likelihood of a collision with wildlife is related, in part, to the occurrences, or activity of local wildlife in the area. The AWAR Project area is on the periphery of the ranges of the Qamanirjuaq and Lorillard caribou herds. Caribou of the Qamanirjuaq herd are regular but transient visitors during their spring migration and calving periods. For the Lorillard herd, telemetry data show very few occurrences of caribou in the AWAR Project area travelling to breeding grounds. No known calving grounds are near the proposed AWAR. Arctic fox are the most common carnivore in the AWAR Project area. Wolves and polar bears, along with muskoxen, were infrequently observed during baseline surveys. Grizzly bear, wolverines, or their sign were not observed during baseline wildlife surveys, although there was on report of a grizzly bear near the Discovery (Meliadine East) Exploration Project during the summer of 2011 (Agnico Eagle unpublished data).

At Meliadine, procedures for monitoring caribou movements across and near the AWAR, including regularly broadcasted wildlife warnings and closing the AWAR when >50 caribou are present, have shown to be effective. For the full caribou migration procedures please see Appendix IV of the TEMMP (Golder 2015). To date there have been no wildlife mortalities along the Meliadine AWAR reported - the results of 2017 observations are included in the TEMMP Annual Report (Golder 2018). The most commonly observed species by observation and number of individuals were Arctic fox (82) and caribou (>60,000) respectively.

Traffic speed and volume are the primary factors that contribute to road-related wildlife mortality. These factors directly affect the success of an animal reaching the opposite side of the road. An increase in either factor reduces the probability of an animal crossing safely (Underhill and Angold 2000). To mitigate the increase in injury and mortality risk along the AWAR, several mitigation measures will be implemented (Section 5.3.4, Table 5.3.4-1 of Agnico Eagle 2013).

In summary, given the success of mitigation to date, additional traffic on the AWAR from the proposed amendment activities is expected to result in minor changes to injury and mortality rates from wildlife-vehicle collisions relative to baseline conditions.

- **Physical loss or alteration of vegetation from construction of the storage tank, discharge pipe and diffuser**

The discharge pipe will be put together on the shore before being floated out into Melvin Bay, in an area that is disturbed and used by the local community. The section that will be constructed overland will have a minimal footprint, and will primarily affect the heath tundra plant community type; however, as heath tundra represents the most abundant plant community type in the LSA and RSA (Volume 6, Section 6.5.3.2 of the FEIS; Agnico Eagle 2014). As such, the anticipated effects to the maintenance of plant population abundance and distribution of plant populations and communities is considered negligible.

No territorially or federally listed plant species were noted to occur, though there is potential for listed plant species to occur along the coastline where suitable habitat occurs (Volume 6, Section 6.5.3.2, Table 6.5-5 and 6.5-6 of the FEIS; Agnico Eagle 2014). The absence of listed plant observations does not preclude the potential for listed plants to inhabit the area.

Given the limited area that is expected to be impacted (expected to be less than 0.09 ha on land) and the degree to which this area is already disturbed, the construction of the storage tank and installation of the discharge pipe and diffuser is predicted to result in negligible residual effects to the maintenance of plant population abundance and distribution of plant populations and communities, including listed plant species and the opportunity for traditional and non-traditional use of plant species. Therefore, the potential effect from the construction of the access road, heated tank and installation of the discharge pipe on vegetation is not assessed further.

- **Construction and operation for the proposed amendment activities could generate modest employment through the use of a local contractor**

The construction period is short, and the number of employment opportunities would be very small and could likely be filled by the contractor's existing workforce. The operational workforce requirements for the proposed amendment activities will also be low, associated with trucking of discharge to the diffuser, and will be filled by a small number of qualified local seasonal employees. Agnico Eagle will identify a suitable local contractor with capacity to meet the labour force demand for the proposed amendment activities, in line with the Human Resources Plan and their Inuit Impact and Benefit Agreement. As a result, while local employment opportunities may arise due to construction and operations for the proposed amendment activities, they are expected to be of minor consequence.

- **Construction and operations for the proposed amendment activities could impact recreational use in the immediate vicinity**

Agnico Eagle will engage with impacted land users regarding the identification of suitable and comparable space for specific recreational land use (e.g., snowmobile racing), in line with the Community Involvement Plan. No discharge to Melvin Bay during the ice-covered season will occur; therefore the snowmobile races should be able to continue unimpeded. The proposed amendment activities are not expected to hinder boating at 5 m from the shoreline, markers will be placed where the discharge pipe runs over land and, if appropriate and designed such as to not hinder pipeline integrity, a single or two-way ramp, of an appropriate grade and slope at a suitable location between the storage tank and the shoreline, may be placed over the discharge pipe to facilitate access in the area. As a result, the impacts on recreational use of the local area due to the proposed amendment activities is expected to be of minor consequence.

- **Impacts from the proposed amendment activities on marine wildlife and fish behaviour and health could result in adverse impacts to traditional harvesting**

Impacts on the behaviour or health of marine wildlife and fish due to the proposed amendment activities can impact the availability of or access to traditional use species. To minimize impacts on the behaviour or health of these species, best practices for erosion and sediment control measures for construction will be followed. Further, adherence to DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2013) and the Oil Pollution Emergency plan are expected to further reduce risks to marine wildlife and fish. Given that no primary pathways of effect have been identified impacting marine wildlife and fish behaviour or health, and assuming effective implementation of mitigation, effects on traditional harvesting of these species are expected to be minor.

- **Impacts from the proposed amendment activities on terrestrial wildlife and bird behaviour and health could result in adverse impacts to traditional harvesting**

Impacts on the behaviour or health of terrestrial wildlife and birds due to the proposed amendment activities can impact the availability of or access to traditional use species. To minimize impacts on the behaviour or health of these species, applicable management or monitoring plans for the terrestrial marine species will be implemented, as required. Given that no primary pathways of effect have been identified impacting terrestrial wildlife and bird behaviour or health, and assuming effective implementation of mitigation, effects on traditional harvesting of these species are expected to be minor.

- **Discharge pipe location could impact access to traditional land use areas during summer months**

The location of the discharge pipe could inhibit access to areas used for traditional purposes during the summer months. Agnico Eagle will engage with traditional land users regarding the location of the discharge pipe and its diffuser, per the Community Involvement Plan, to minimize potential impacts to summer traditional use. With the incorporation of engagement results into planning, effects on traditional use of the area around the diffuser pipe are expected to be minor.

- **Construction and operation of the proposed amendment activities could result in the perception that water, marine wildlife and fish are no longer safe for traditional use**

Despite implementation of mitigation measures aimed at preventing environmental contamination, concerns may persist that the water, marine wildlife and fish are unsafe to consume as a result of treated groundwater effluent discharge. Agnico Eagle will engage with traditional land users regarding the safety of these species, and will provide information in an accessible format to ensure that the efficacy of mitigation measures is understood is expected to result in only minor effects on continued traditional use of water and aquatic species.

8.1.4 Summary of Primary Pathways

The following primary pathway was determined linking the proposed amendment activities to effects on the marine environment and will be carried through the effects analysis:

- **Accidental release of treated groundwater effluent from an unknown location along the discharge pipe can have direct adverse effects on marine water quality and associated indirect effects on marine wildlife**

8.1.5 General Approach to Primary Pathways

The effects analysis considers all primary pathways that result in expected changes to existing marine habitat and the abundance and distribution of marine wildlife VECs after implementing environmental design features and mitigation. Thus, the analysis is based on the residual effects from the proposed amendment activities.

Residual effects in the marine environment were analyzed using measurement endpoints (FEIS Volume 4, Section 4.2, Table 4.2.1; Agnico Eagle 2014) and are expressed as effects statements:

- Effects from changes in health and mortality risk
- Effects from changes in habitat quality

The magnitude, spatial extent, and duration of potential effects on the measurement endpoints resulting from cumulative effects are expected to be similar to or greater than those related to non-cumulative effects.

The analyses of residual effects from the proposed amendment activities on the marine environment were quantitative (dilution modelling) and qualitative and included professional judgement and/or experience opinion supported by data from field studies, scientific literature, monitoring programs, government publications, and personal communications. IQ and community information were incorporated where available.

8.1.6 Residual Effects Analysis

An effects analysis follows the general approach to analyzing potential project-specific and cumulative (where applicable) effects on the marine environment. The effects analysis for the marine VECs followed the assessment methodology described in Volume 4 of the FEIS (Agnico Eagle 2014). Proposed amendment activities in the marine environment associated with accidental release of treated groundwater effluent from an unknown location along the discharge pipe can have direct adverse effects on marine water quality and associated indirect effects on marine wildlife.

Effects statements are used to focus the analysis of changes to marine VECs that are associated with one or more primary pathways. Section 8.1.6.1 presents a qualitative assessment for criteria such as magnitude, geographic extent, duration, and frequency. Pathways associated with each effects statement are classified using scales (categorical values such as negligible, low, or high) for each impact criterion (e.g., magnitude). Assessment and measurement endpoints as defined in Volume 4, Section 4.2.3 and Table 4.2.1 of the FEIS are unchanged for this FEIS Addendum, as applicable.

To provide transparency, the definitions for these scales were ecologically or logically based on marine VECs. Although professional judgement is inevitable in some cases, an effort was made to classify impacts using scientific principles and supporting evidence where possible. The scale for the residual impact criteria for classifying effects from the proposed amendment activities are specifically defined for marine VECs, and definitions for each criterion are provided, in Table 18.

Table 18: Definitions of Criteria Used in the Residual Impact Classification of Pathways

Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood
Negative: a less favourable relative to baseline values **Positive:** an improvement over baseline values or conditions	**Negligible:** no predicted detectable change from baseline values **Low:** impact is predicted to be within the range of baseline values **Moderate:** impact is predicted to be at or slightly exceeds the limits of baseline values **High:** impact is predicted to be beyond the upper or lower limit of baseline values so that there is likely a change of state from baseline conditions	**Local:** small-scale direct and indirect impacts from the proposed amendment activities (e.g., footprint, and dust deposition) **Regional:** the predicted maximum spatial extent of combined direct and indirect impacts from the proposed amendment activities that exceed local-scale effects (can include cumulative direct and indirect impacts from the proposed amendment activities and other RFFD at the regional scale) **Beyond Regional:** cumulative local and regional impacts from the proposed amendment activities and other RFFD extend beyond the regional scale	**Short-term:** impact is reversible at end of construction **Medium-term:** impact is reversible at end of closure **Long-term:** impact is reversible within a defined length of time beyond closure **Unknown**: Impact may be reversible; however, the length of time cannot be defined **Permanent**: impact will last into perpetuity	**Isolated:** impact confined to a specific discrete period **Periodic:** impact occurs intermittently but repeatedly over the assessment period **Continuous:** impact will occur continually over the assessment period	**Reversible:** Impact will not result in a permanent change of state of the population compared to "similar" environments not influenced by the proposed amendment activities **Irreversible:** impact is not reversible (i.e., duration of impact is unknown or permanent)	**Unlikely:** the impact is likely to occur less than once in 100 years **Possible:** the impact will have at least one chance of occurring in the next 100 years **Likely:** the impact will have at least one chance of occurring in the next 10 years **Highly Likely:** the impact is very probable (100% chance) within a year

RFFD = Reasonably Foreseeable Future Development

8.1.6.1 Accidental Release of Brine from an Unknown Location along the Discharge Pipe

Should treated groundwater effluent be accidentally released along the discharge pipe, on land or in Melvin Bay before reaching the diffuser, this could result in negative changes in habitat quality for marine fish, benthic invertebrates, marine birds and mammals.

As the groundwater effluent will be treated to meet the most stringent of the available acute regulatory guidelines at the discharge point, as described in Sections 3.4.7 and 3.4.8, the changes in habitat are anticipated to have a negligible residual effect on marine VECs relative to baseline values. In addition, appropriate monitoring and mitigation will be applied to prevent spills or follow appropriate procedures to contain and clean up any spills, particularly if they occur on land.

An accidental spill of treated groundwater effluent from the discharge pipe or from the storage tank at the Itivia Fuel Storage Facility is possible during the lifetime of the Project. The storage tank is being designed to hold a capacity of at least 2,000 m^3 (2 ML) of treated groundwater effluent. An accidental release could vary from a rupture of the storage tank, approximately 150 m from the shoreline area, to a large or small leak in the discharge pipe extending from the storage tank and into the marine environment at Melvin Bay.

Residual impact classification methods are provided in Appendix G and the summary of residual impact classifications on marine VECs is listed below in Table 19. A worst-case scenario consisting of the entire storage tank rupturing and spilling or a complete break in the pipe would result in a discharge of a maximum of 2,000 m^3 of treated groundwater effluent. Other lesser scenarios could involve a slow leak along the discharge pipe resulting in negligible amounts of treated groundwater effluent discharge seeping out into the marine environment.

The Project strategy to mitigate the potential effects from spills includes two main components: prevention and response. These two components are addressed in the FEIS Spill Contingency Plan (Agnico Eagle 2017b) and Risk Management and Emergency Response Plan (Agnico Eagle 2015d) for the Meliadine Mine. Risk and hazard assessments of shore-based marine response activities will also be undertaken as part of training the Emergency Response Team. Spills will also be reported to the Environmental Emergencies 24-Hour Report Line, and, if necessary, advice would be requested from the Regional Environmental Emergencies Team and appropriate regulatory authorities. To prevent accidental release all operations will adhere to procedures identified in above documents and comply with all applicable international safety standards, industrial best management practices, and international and local regulations, including the *Arctic Waters Pollution Prevention Act*. Spill prevention measures will include the following aspects:

- Engineering design: storage tanks, pipes and components will meet relevant safety standards for preventing uncontrolled release of stored materials during normal operation and during exposure to natural hazards, and to prevent fires and explosions
- Personnel training and competence: all activities will be conducted by properly trained personnel
- Documented procedures: all activities will be conducted according to pre-established formal procedures to prevent accidental releases and fire and explosion hazards

- Inspection and maintenance: the heated tank, discharge pipe and associated components will be regularly inspected and maintained in proper order to prevent uncontrolled release of treated groundwater effluent
- Record keeping: fuel, lubricants, and other chemicals transfers, and inspection and maintenance activities will be recorded and records will be kept according to the Project records-keeping procedures

Any effects of a potential worst-case release of 2,000 m^3 on the health and mortality of marine fish, benthic invertebrates, marine birds and mammals are considered reversible through natural recruitment, meaning the number of new young that will enter the population over time will offset the number of mortalities or injuries potentially resulting from a spill. Changes at the population level are not anticipated. The magnitude of the potential effect will depend on the time of the year that a spill could occur. During the fall, winter and early spring when ice (both landfast and ice scour impacts) limits the amount of habitat available, most of the species would not be present in the LSA or RSA. If a spill were to occur during the open water summer season it is anticipated that in addition to the spill counter-measures, the natural marine environment in Melvin Bay would lessen the effects of any accidental release of treated groundwater effluent. Melvin Bay is noted to have moderate tides and is expected to provide good flushing and mixing conditions that would dissipate the treated groundwater effluent spill naturally into the marine environment during open water periods.

At the Project level, the magnitude of a potential effect from spill of treated groundwater effluent on the marine environment is considered low given that the LSA does not support critical habitat for benthic invertebrates, fish, birds or marine mammals. The geographic extent is local, and short-term in duration, isolated in frequency, with an unlikely probability of occurrence given the application of proposed mitigation. The lack of range in scale in the residual impact classification was reflective of the singular pathway and related mechanisms predicted to affect marine VECs.

The incremental and cumulative impacts from the proposed amendment activities are predicted to not result in significant impacts that would influence the abundance and distribution of marine fish, benthic invertebrate, marine bird or marine mammal populations. The scale of impacts from the all pathways, independently or combined, should not be large enough to cause irreversible changes at the population level and decrease the resilience of the marine VECs.

Table 19: Summary of Residual Impact Classifications on Primary Pathways

Effects Pathway	Direction	Magnitude		Geographic Extent		Duration	Frequency	Reversibility	Likelihood
		Incremental	Cumulative	Incremental	Cumulative				
Marine Environment									
Accidental release of treated groundwater effluent from an unknown location along the discharge pipe.	Negative	Low	Low	Local	Local	Short-term	Isolated	Reversible	Unlikely

8.1.7 Environmental Significance

The evaluation of significance for VCs also follows the general approach described in Volume 4 of the FEIS (Agnico Eagle 2014). The significance evaluation considers the entire set of pathways that influence an assessment endpoint, as well as qualitative key factors.

Environmental significance is used to identify predicted impacts that have sufficient magnitude, duration and geographic extent to cause fundamental changes to VCs. The following definitions are used for assessing the significance of impacts on VCs, and the associated continued opportunity for traditional use of VCs:

- Not significant – impacts are measurable at the individual level, and strong enough to be detectable at the population level, but are not likely to decrease resilience and increase the risk to population maintenance and opportunities for traditional and non-traditional use.
- Significant – impacts are measurable at the population level and likely to decrease resilience and increase the risk to population maintenance and impact opportunities for traditional and non-traditional use. A number of high magnitude and irreversible impacts at the population level (regional scale) would likely be significant.

As shown in Table 19, the proposed amendment activity pathway influencing marine VECs was determined to be low in magnitude, local in geographic extent and short-term in duration. The likelihood of the impact occurring is predicted to be unlikely for the primary pathway, with an isolated frequency throughout operations. In addition, the scale of the impact is not large enough to cause irreversible change at the population level with the implementation of appropriate mitigation and management measures. The changes to marine habitat quality and marine water quality should not have a significant impact on the structure and function of populations and communities in the marine ecosystem at Melvin Bay and beyond, relative to natural factors occurring over the same period of time and space.

8.1.8 Cumulative Effects

Cumulative effects were considered as part of the overall assessment for the Project in the FEIS (Agnico Eagle 2014). The assessment developed in the FEIS does not change for the current assessment for the proposed treated groundwater effluent discharge, as the proposed amendment activities are within the previously assessed LSA and RSA for the Project.

A summary of cumulative effects considered in the FEIS are presented below:

- Cumulative effects for the atmospheric environment were evaluated in Volume 5 of the FEIS, and indicated there are no other industrial developments either existing or reasonably foreseeable in the vicinity of the Project, and no cumulative effects were considered. Cumulative impact of additional trucks for the proposed amendment activity was evaluated in Section 8.1.1 and only minor additional impacts are predicted.

- Cumulative effects for the terrestrial environment were evaluated in Volume 6 of the FEIS. Though no net cumulative effects were predicted, it was recognized that developments outside the RSA can impact wide ranging species, such as Barren-ground caribou (Qamanirjuaq and Lorillard herds). The cumulative impacts from direct habitat loss and fragmentation from the Project and other developments on population size and distribution of wildlife populations are expected to be low to moderate in magnitude, and low to negligible for birds, and beyond regional in geographic extent. Cumulative impacts to wildlife from additional truck traffic were evaluated in Section 8.1.1 and are not considered to result in impacts beyond what was assessed and predicted in the FEIS.
- Cumulative effects for the marine environment were evaluated in Volume 8 of the FEIS, and considered effects for minor and worst case spills on marine fish and fish habitat, marine birds and mammals. All incremental and cumulative effects from the Project were considered reversible and not expected to have significant effects on the abundance and/or distribution of the VECs.
- Cumulative effects on the socio-economic environment were evaluated in Volume 9 of the FEIS. As there are no other developments in the vicinity of the Project, cumulative effects on NTLU are not expected in the LSA, with the exception of potential cumulative effects to the acoustic environment. In the RSA, cumulative effects related to Project traffic in tandem with traffic from other developments (such as the Ferguson Lake and Churchill Diamond projects) may increase noise levels in the LSA where the Manitoba to Nunavut road enters Rankin Inlet, though this scenario is unlikely and the effect is not considered to be significant.

Additional projects in the region were considered. Dry cargo barges undergo lightering operations at the existing gravel ramp used by the Hamlet of Rankin Inlet during the annual sealift in Itivia Harbour. The assessment of potential effects related to the use of this ramp are consistent with those discussed in Section 8.3.4 of the FEIS (Agnico Eagle 2014; e.g., propeller wash from nearshore Mine vessels berthing at the spud barge / landing ramp may result in adverse effects to marine water quality with associated indirect effects on marine wildlife). The conclusions of the assessment remain the same - given the temporary nature and reversibility of any wash-related effects on fish, benthic invertebrates and their habitat, effects from vessels berthing and de-berthing are not expected to result in adverse residual effects and are not assessed further.

8.1.9 Uncertainty

The purpose of the uncertainty section is to identify the key sources of uncertainty in the impact assessment and to discuss how uncertainty has been addressed to increase the level of confidence that impacts are not worse than predicted. Confidence in the assessment of environmental significance is related to the following elements:

- adequacy of baseline data for understanding current conditions and future changes unrelated to the Project (e.g., extent of future developments, climate change, catastrophic events)
- understanding of Project-related impacts (including those of the proposed amendment activities) on complex ecosystems that contain interactions across different scales of time and space (e.g., exactly how the Project will impact migratory marine birds and mammals)

- knowledge of the effectiveness of the environmental design features and mitigation for reducing or removing impacts

Like all scientific results and inferences, residual impact predictions must be tempered with uncertainty associated with the data and the current knowledge of the system. It is anticipated that the baseline data are moderately sufficient for understanding current conditions, and that there is a moderate level of understanding of Project-related impacts on the ecosystem.

It is understood that development activities will directly and indirectly affect marine habitat, and behaviour / movement of marine wildlife species; however, long-term monitoring studies documenting the resilience of marine animals to development and the time required to reverse impacts are lacking. Direct disturbance from previous, existing, and future development footprints was estimated to affect a small fraction of the natural range of most marine wildlife VECs. However, uncertainty remains surrounding the degree to which some effects may occur (e.g., magnitude and duration).

Forecasting a future that may be outside the range of observable baseline environmental conditions is clearly challenging (because of climate change for example; Walther et al. 2002). Quantifying changes to habitat provides a static assessment of a species' environment, ignoring change that may occur over time as a result of ecological succession and natural disturbances such as climatic events. Thus, there is less certainty in long-term predictions of reversibility (e.g., over periods extending beyond 100 years). However, there is a high level of confidence that the regional landscape will be different with or without the Project in future decades.

Prediction confidence for impacts to fish habitat as a result of installation of the discharge pipe is high as the extent of the habitat loss/alteration is small and well known. There are uncertainties in the impact predictions for impacts to marine birds related to night-time lighting associated with the installation because limited research exists on the introduction of artificial light on Arctic marine habitats and related effects on marine fauna. In other parts of the world, studies of ambient artificial light impacts on marine species have demonstrated that responses to light can vary widely by species and environmental conditions.

Prediction confidence is moderate for impacts on marine flora and fauna associated with the elevated levels of chloride, calcium and sodium from the treated groundwater effluent discharge, as the available literature focuses on regions that greatly differ from the Arctic environment.

8.1.10 Monitoring and Follow-Up

Results of follow-up monitoring should be provided to the relevant agency with management responsibility for each species. Environmental monitoring for the marine environment will include erosion and sediment control plans and water quality monitoring for the treated groundwater effluent discharge. Monitoring and Management plans applicable to the proposed amendment activities, as presented in Section 4.1, will continue to be implemented, as appropriate, and any regulated reporting required under these plans will continue (e.g., annual reporting under the TEMMP and the Air Quality Management Plan).

A conceptual Ocean Discharge Monitoring Plan (ODMP) is included in Appendix E, in compliance with the NIRB Guidance for stand-alone management and monitoring plans (EIS Guidelines sections 9.3 and 9.4; NIRB 2018). The ODMP outlines the proposed methodology, location and frequency for water quality monitoring in Melvin Bay, in compliance with applicable regulations and guidelines, particularly the MMER including the amended MDMER (GC 2017; anticipated to come into effect in 2018-2019 - any discharge exceeding 50 m^3 should conduct Environmental Effects Monitoring Studies [EEM]). 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. While the ODMP has been developed as a separate and stand-alone plan, the intent is to align it with 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 Groundwater Management Plan [Agnico Eagle 2018a]).

8.1.11 Potential Effects of Climate Change and the Environment

Global climate change is expected to result in warming temperatures, and in the Arctic, an increase in sea levels from the melting snow and ice (IPCC 2007). IQ from residents of Baker Lake and Arviat observed the following trends in climate change; generally warmer temperatures year-round, changes in the quality and accumulation of snow, sea ice freeze-up occurs later and breaks up sooner with an overall shorter ice season, and ice appears to be thinner than in previous years (GN 2005). The rate of sea level rise, estimated at 0.0033 m/year (Smith 2011) near the Project area (including the area near Itivia Harbour for the proposed amendment activities), would result in a rise of 0.066 m over the approximate 20 year lifetime of the Project. The dynamic coastal geomorphology of the coastal zone near the Project area is presently experiencing exposure of new shoreline at a rate of up to 15 m/year (horizontal) and 1 m/100 years (vertical; or 0.2 m over an approximate Project life of 13 years of Operations) as part of an isostatic rebound of the land from the weight of the Laurentide Ice Sheet, which once covered this entire region (Stewart and Lockhart 2004; Parks Canada 2009). An isostatic rebound of 0.2 m would counter the effect of sea level rise; therefore, the impact on the Project due to sea level rise as a result of climate change is anticipated to be negligible.

Variations in ice melt and generation annually may affect the timing of ocean discharge, as discharge will only occur during the open water season (no under ice discharge). As indicated in Table 5, the annual discharge schedule considers the period between May and October of any given year during operations for active discharge, to capture the maximum possible period during which discharge can occur. It is recognized that this may vary from year to year due to different conditions which may influence ice melt or generation, but is not anticipated to affect operations and discharge for the proposed amendment activities.

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APPENDIX A • FEIS ADDENDUM – EIS GUIDELINES CONCORDANCE TABLE

		FEIS Amendment				
Guideline Section	**Guideline Requirement Text**	**Section**	**Table/ Figure**	**Page Number**	**Appendix**	**Page Number**
4.6.1 and 4.6.2	Executive and Popular Summaries	Popular Summary and Executive Summary (including translations)		i to xviii		
	Description of Saline Effluent Discharge project and related activities, including rationale for the project, and timelines;	3.0		5 to 28		
		4.0		29 to 38		
			Table 5	15 to 16		
			Table 10	29 to 30		
4.5	Charts, diagrams, tables, maps, and photographs to clarify the text as appropriate	Complete document		All		
4.5	Drawings that clearly convey the various components of the Project		Figures 1 to 7	7, 17, 20, 53, 54, 55, 57		
4.5	Maps presented in a consistent and clearly identified datum and at appropriate and clearly identified scales to allow for comparison and overlay of mapped features		Figures 1 to 7	7, 17, 20, 53, 54, 55, 57		
7.5	Identification of spatial and temporal boundaries for this project assessment	7.1.1		52		
		7.1.2		56		
		7.1.3		58		
7.1	A summary of public consultation conducted with affected communities, residents, Inuit Organizations, Indigenous groups, and other governments or other organizations. The summary should include the issues raised and the Proponent's responses	5.0		39 to 43		
			Table 13	40 to 42		
7.2	A summary of Inuit Qaujimaningit, Inuit Qaujimajatuqangit, Traditional and Community Knowledge collected in regards to saline groundwater management and the current proposal and how it was incorporated within the proposal	5.1		43		
	Summary of environmental effects assessment for each valued ecosystemic component (VEC) and valued socio-economic component (VSEC) expected to interact with the proposed project including the following:		Table 10	29 to 30		
			Table 16	59 to 60		
		7.2		58 to 60		
7.3, 7.4, 8.1, 8.2	Description of the baseline by incorporating the latest available monitoring data	6.0		44 to 51		
					B	Complete document
	Anticipated changes to the environment	8.0		61 to 86		
	Anticipated effects (i.e., potential interactions)		Table 17	62 to 68		
	Indicate explicitly what potential effects were or were not previously assessed	4.0		29 to 38		
			Table 11	31 to 36		
7.13	Identify the indicators (measures) and criteria used to assess impacts for each VEC/VSEC	8.1.1		61 to 68		
		8.1.6		79 to 82		
	Update all models as required for this proposal (e.g., noise and air quality modelling).	3.4.7		22 to 27		
		3.4.8		28		
					F	Complete document
8.1,, 8.2, 8.4	Mitigation Measures		Table 17	62 to 68		
		8.1.3		69 to 78		
		8.1.6		79 to 82		
	Identification and classification of residual effects for each VEC/VSEC, clearly indicating for each residual effect identified	8.1.5		78 to 79		
		8.1.6		79 to 82		
	Probability of effect;		Table 19	82		
	Direction or nature of impact (i.e., positive/beneficial versus negative/adverse);		Table 19	82		
	Magnitude and complexity of effect		Table 19	82		

		FEIS Amendment				
Guideline Section	**Guideline Requirement Text**	**Section**	**Table/ Figure**	**Page Number**	**Appendix**	**Page Number**
	Geographic extent of effect		Table 19	82		
	Frequency and/or duration of effect		Table 19	82		
	Reversibility or irreversibility of effect		Table 19	82		
	Determination of significance for each residual effect	8.1.7		83		
	Where applicable, link back to the predictions made in the FEIS for each VEC/VSEC and indicate what, if any, changes are predicted in terms of potential effects, residual effects, and significance determination	4.0		29 to 38		
			Table 11	31 to 36		
	As an example, and in particular, provide the traffic volumes originally predicted on the all-weather access road (AWAR) and update this number to include the expected traffic volumes for the proposed project when assessing the potential effects of dust, disturbance to wildlife, disturbance to traditional land use activities, etc.	3.4.5		16		
		6.3		47 to 48		
		8.1.3		69 to 78		
9.3, 9.4	Stand-alone management and monitoring plans with details such as monitoring methodology (including parameters to be measured), approximate sampling locations (provide a map), monitoring frequency, and thresholds/triggers for adaptive management. Further, the following management plans shall be included/updated to incorporate the Saline Effluent Discharge Proposal	4.1	Table 12	37 to 38		
					E	Complete document
	Air Quality Monitoring Plan		Table 12	37 to 38		
	Marine Environmental Management Plan (Appendix D of the Shipping Management Plan)		Table 12	37 to 38		
	Groundwater Management Plan				D	Complete document
	Mine Waste Management Plan		Table 12	37 to 38		
	Mine Water Management Plan		Table 12	37 to 38		
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MELIADINE GOLD PROJECT

Marine Baseline Report
Itivia Harbour, Rankin Inlet, NU

FINAL REPORT

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EXECUTIVE SUMMARY

Agnico Eagle Mines Ltd. (AEM) is currently undergoing environmental impact review for advancement of its Meliadine Gold Project (MGP) from its exploration phase to an operating mine. The MGP is situated approximately 25 km north of Rankin Inlet, Nunavut, and is comprised of six gold deposits. In May 2011, AEM submitted a project proposal to the Nunavut Impact Review Board (NIRB) for development of the MGP. AEM has proposed to construct and operate an 8,500 tonnes per day gold mine and mill, combining open pit and underground techniques at six deposits. Following recommendations from NIRB, the Minister referred AEM's MGP project proposal to a Part 5 review, which commenced in September 2011.

To support the MGP, AEM will require equipment and other supplies to arrive by barge from Churchill, Manitoba, or Canada's eastern ports, to Itivia Harbour in Rankin Inlet. To accommodate these barges, AEM has proposed to install a spud barge in Itivia Harbour. Nunami Stantec Ltd. (Nunami) was retained by AEM to collect information on baseline environmental conditions and characteristics in and around Itivia Harbour where the proposed spud barge will be installed. Nunami's baseline study investigated the water and sediment quality, aquatic ecology and fisheries values in Itivia Harbour (Project footprint, "I1" sampling area) and at two nearby reference sites ("R1" and "R2" sampling areas) in Melvin Bay in August 2011. A desktop review was also undertaken to evaluate marine mammal and bird occurrence in the vicinity of Itivia Harbour and Melvin Bay. Nunami also met with the Kangiqliniq Hunters and Trappers Organization prior the field investigation to obtain Inuit Qaujimajatuqangit about the Rankin Inlet area and the local fishery.

Results of the baseline study showed the Project footprint (I1 sampling area) was shallower, had a gentler slope and a larger proportion of intertidal habitat than the two reference sampling areas. Cobble and/or gravel were the dominant substrates in all nearshore sampling areas although the Project footprint had a higher proportion of small substrates (gravels and fines) due to the addition of gravel for the development of the harbour's boat launch. Macrophytes were sparse across all sampling areas.

In situ water quality was relatively constant across the sampling areas and through the water column. Nutrient levels were low with only total ammonia being above detection limits. Total organic carbon was also relatively low. The majority of metals were below detection or less than five times the detection limit in water samples taken at all three sampling areas. All of the samples were found to be below Canadian Council of Ministers of the Environment (CCME) Protection for Marine Aquatic Life (PMAL) guidelines for all of the parameters tested.

Precision analyses indicate some heterogeneity of sediments across the study area. Total phosphorous was relatively high while nutrients and total carbon were low. Chromium was the only metal to exceed its recommended guideline at all sampling areas.

Phytoplankton abundance, richness and diversity were comparable among the three sampling areas. Dinoflagellates (*Peridinium/Gonyaulax* spp. and *Dinophysis* spp.) were the predominant phytoplankton taxa across the study area. Zooplankton abundance, richness and diversity were more variable than phytoplankton and the R2 sampling area exhibited the lowest values.

Zooplankton diversity values imply less diverse zooplankton community and an unidentified rotifer species (possibly *Notommatidae*) was the predominant taxa. Benthic invertebrate richness and abundance were greatest at the R2 sampling area and lowest at the Project footprint and R1 sampling area, respectively. The R1 sampling area also exhibited a more homogenous benthic community than the other two areas and Polychaetes were the dominant taxa across the study area.

Arctic char were not captured during Nunami's baseline study at Itivia Harbour and Melvin Bay. The numerically dominant fish species (i.e., ≥ 10% of the total catch) were Greenland cod (52%), slender eelblenny (27%) and fourhorn sculpin (15%). No statistically significant differences in fish catch rates or species richness were observed between the Project footprint and reference areas or between nearshore and offshore areas. An interaction between sampling area and nearshore/offshore was detected for total catch rates and was attributed to a statistically different mean catch rate between nearshore and offshore sites at the R1 sampling area.

No marine mammals were observed during the baseline study. A black guillemot and a pair of sandhill cranes were observed anecdotally. The desktop review of marine mammals and birds suggested nine marine mammal species typically occur along the west coast of Hudson Bay while 37 marine bird species may be present in the vicinity of Rankin Inlet.

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ABBREVIATIONS AND ACRONYMS

%	percent
<	less than
>	greater than
µ	micro
µg/L	micrograms per litre
mg/kg	milligrams per kilogram
mL	millilitre
AEM	Agnico Eagle Mines Ltd.
ANOVA	analysis of variance
CCME	Canadian Council of Ministers of the Environment
CPUE	Catch per Unit Effort
CRM	Certified Reference Materials
CV	Coefficient of Variation
DFO	Fisheries and Oceans Canada
GPS	Global Positioning System
HTO	Hunters and Trappers Organization
IQ	Inuit Qaujimajatuqangit
ISQG	Interim Sediment Quality Guidelines
NIRB	Nunavut Impact Review Board
Nunami	Nunami Stantec Ltd.
PEL	Probable Effects Level
PMAL	Protection for Marine Aquatic Life
QA/QC	Quality Assurance/Quality Control
SRC	Saskatchewan Research Council
TOC	Total Organic Carbon

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1 INTRODUCTION

Agnico Eagle Mines Ltd. (AEM) is currently undergoing environmental impact review for advancement of its Meliadine Gold Project (MGP) from its present exploration phase to an operating mine. The MGP is situated approximately 25 km north of Rankin Inlet, Nunavut, and is comprised of six gold deposits: Tiriganiaq, F Zone, Wolf, Pump, Wesmeg and Discovery. The area has been subject to mineral exploration since the late 1980s when the Discovery deposit staked. In 2010, AEM acquired all of Comaplex Minerals and its 100% interest in the MGP.

In May 2011, AEM submitted a project proposal to the Nunavut Impact Review Board (NIRB) for development of the MGP. AEM has proposed to construct and operate an 8,500 tonnes per day gold mine and mill, combining open pit and underground techniques at the six deposits. Mine operations are anticipated to last 10 years, following two (2) years of construction. Following screening and receipt of comments from various parties, the NIRB in July 2011 recommended the Minister refer AEM's MGP project proposal to a Part 5 or 6 review under Article 12 of the Nunavut Land Claims Agreement. The Minister concurred and the Part 5 review commenced in September 2011.

To support the MGP, AEM will require equipment, fuel and other supplies to arrive by barge or ship from Bécancour, Quebec, or other eastern Canadian ports, to Itivia Harbour in Rankin Inlet. To accommodate these barges, AEM has proposed to install a spud barge in Itivia Harbour. Nunami Stantec Ltd. (Nunami) was retained by AEM to collect information on baseline environmental conditions and characteristics in and around Itivia Harbour where a spud barge will be installed. Nunami completed baseline studies in August 2011 at Itivia Harbour and two nearby reference sites in Melvin Bay. Prior to the baseline study, a Nunami biologist met with members of the Kangiqliniq Hunters and Trappers Organization to obtain Inuit Qaujimajatuqangit specifically related to the marine environment in the study area. This technical data report presents the results of the physical environment, aquatics and fisheries baseline data collected, as well as a desktop review of marine mammals and birds.

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2 BACKGROUND

This technical data report presents the results of the marine aquatics and fisheries baseline study at Itivia Harbour in Rankin Inlet, NU. The study investigated the water and sediment quality, aquatic ecology and fisheries values in Itivia Harbour and at two reference sites in Melvin Bay. A desktop review was also undertaken to evaluate marine mammal and bird occurrence in and adjacent to Itivia Harbour and Melvin Bay.

2.1 Objectives

The objectives of the baseline study were to:

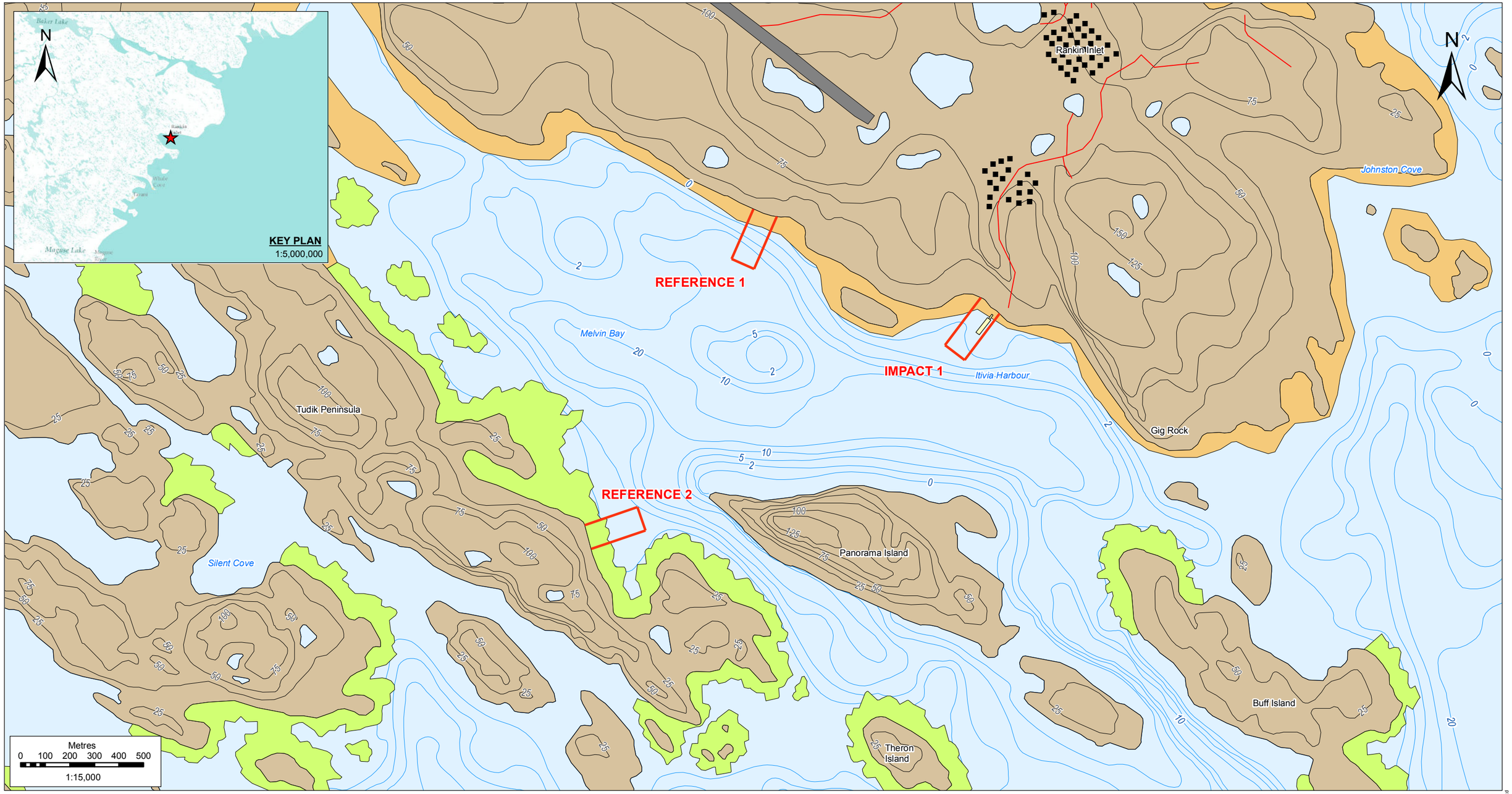
- Characterize baseline water and sediment quality at Itivia Harbour and nearby reference sites
- Describe the lower trophic aquatic community through collection of phytoplankton, zooplankton and benthic invertebrates
- Map and assess the physical fish habitat at Itivia Harbour and nearby reference sites, including bathymetry and identification of available habitat
- Determine fish species presence at Itivia Harbour and nearby reference sites
- No marine mammals were observed during the study and few birds were observed during field sampling. This document provides a cursory overview of marine mammal and bird occurrence in the study area based on the available literature and the meeting with the Kangiqliniq Hunters and Trappers Organization (Appendix G).

2.2 Study Area

The hamlet of Rankin Inlet (Kangiqliniq in Inuktitut, meaning “deep bay/inlet”) is located in the Kivalliq region of Nunavut (NU) and has a population of approximately 2,730 people (NBS 2010). Rankin Inlet is situated on the Kudlulik Peninsula which protrudes into Rankin Inlet of Hudson Bay. The hamlet is located approximately 1,175 km west of Iqaluit, NU, and 1,140 km east of Yellowknife, Northwest Territories (NT). Rankin Inlet itself has two main rivers entering it, including the Diane River in its northwest and the Meliadine River in the northeast.

The assessment site, I1, is located in Itivia Harbour which is situated on the northeast shore of Melvin Bay in Rankin Inlet and located south of the hamlet (Figure 2-1). It is connected to the hamlet by one access road and has been minimally developed with only a coarse gravel fill ramp. In the open water season, Itivia Harbour provides a place for residents to launch their boats and is used for the loading and unloading of community supply vessels. In the winter, it is used by residents for snowmobile access to Melvin Bay and Rankin Inlet.

The two reference sites within Melvin Bay have not been developed and remain natural habitat. Reference site 1 is situated downslope of the Rankin Inlet airport. A few cabins are situated to the east of the site; and some debris and refuse were noted on shore however the shoreline has not been developed or altered. Reference site 2 is located on the south shore of Melvin Bay; the area is natural and no development has occurred at this site. The Reference sites were selected for their proximity to Itivia Harbour and similarity of physical habitat (e.g., exposure, depth, shoreline substrate).



- Building
- Road
- Contour
- Bathymetric Depth Contours
- Sampling Area
- Proposed Spud Barge
- Sand
- Rock
- Waterbody
- Land

MARINE EFFECTS ASSESSMENT OF THE MELIADINE GOLD PROJECT - RANKIN INLET, NU

OVERVIEW OF SAMPLING AREAS ITIVIA HARBOUR AND MELVIN BAY

Sources:

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 03-FEB-12	PROJECTION: UTM 15	DRAWN BY: N. PUREWAL
FIGURE ID: 123510575	DATUM: NAD 83	CHECKED BY: C. SIBBALD

PREPARED BY: NUNAMI STANTEC

PREPARED FOR: **AGNICO-EAGLE MINES LTD.**

FIGURE NO: **2-1**

Path: R:\2011\Stantec\123510575\gis\workingf\123510575 Fig 2-1_OverviewMap.mxd

2.3 Project Description

Agnico-Eagle Mines (AEM) is proposing to install a spud barge at Itivia Harbour to support its proposed MGP and to accommodate the required supply vessel traffic. One end of the spud barge will be connected to the shore via a hinged bridge while the other end is anchored in place; this will allow the spud barge to rise and fall with the tide. The spud barge will measure approximately 76 m long by 17 m wide (250 by 56 feet) and have a crane to lift containers and equipment directly off of the barges and onto trucks.

2.4 Inuit Qaujimajatuqangit

A Nunami biologist met with members of the Kangiqliniq Hunters and Trappers Organization (HTO) in Rankin Inlet on July 15, 2011. This meeting provided Inuit Qaujimajatuqangit (IQ) about the area and the local fishery, including presence and relative abundance of fish, invertebrates, marine plants, marine mammals and birds; harvest timings and locations; and, community use areas of interest (see Appendix G).

Members of the Kangiqliniq HTO reported that Arctic char are an important food fish species for the residents of Rankin Inlet and that residents harvest Arctic char, sculpin and cod in the Itivia Harbour area. Sculpin are only eaten occasionally by Elders, but used to be harvested more commonly in the past. Harvesting of Arctic char by residents typically takes place in August and the HTO reported that the Arctic char usually originate from the Diane and Meliadine rivers. The HTO also reported that some residents participate in commercial fishing for Arctic char. To catch higher numbers of Arctic char, the commercial fishing usually occurs 40 to 50 km (25 to 30 miles) from the community, though fishermen previously caught char closer to the hamlet.

Shellfish harvesting (i.e., mussels and clams) previously occurred along the north shore of Melvin Bay during low tide, however due to warnings from the Department of Health and Social Services about shellfish harvesting in close proximity to the community, residents now travel further away to harvest shellfish. The HTO also reported that seaweed harvesting does not occur in the community.

The HTO stated that they have noticed a change in Itivia Harbour since there has been an increase in traffic to the area. In the 1960s and 1970s, the harbour was a very good fishing spot for Arctic char, sculpin and cod. Seal harvesting also took place in the harbour as seals would come into the harbour and Melvin Bay. They noted that currently seals rarely come into the harbour or Melvin Bay and it appears there is less fish in the area than previously.

During the meeting, the HTO expressed the importance of Itivia Harbour and Melvin Bay to the residents of Rankin Inlet. The HTO noted that several residents have cabins along the north shore of Melvin Bay, and Itivia Harbour is heavily used in the summer for launching boats (it is the only place accessible during low tide) and in the winter for snowmobile travel in and out of the community. The HTO reported their concerns that the installation of the spud barge in Itivia Harbour will either restrict or prevent the community's use of the harbour. The HTO communicated they would pursue further discussion with AEM and their plans for Itivia Harbour.

2.5 Arctic Char Biology

Arctic char were selected as a fish species of focus in this study due to their importance as a subsistence species and a valued environmental component (VEC) for the residents of Rankin Inlet. Arctic char can be either freshwater resident or amphidromous[1]. Amphidromous char make summer migrations to feed in the coastal waters of Hudson Bay. Arctic char spawning occurs in freshwater during fall, typically in September or October over gravel beds (Johnson 1980). Spawning by Arctic char often takes place in lakes (Johnson 1980), though spawning can occur on a river bed where suitable substrate or gravel occurs and ice does not freeze to the river bed (Hunter 1976). Age-at-first seaward migration for amphidromous Arctic char vary depending upon the geographic location. Radtke *et al*. (1997) showed most char from a Labrador river make their first seaward migration at ages 2+ or 3+ years while Babaluk *et al*. (2010) observed age-at-first migration ranging from ages 3+ to 6+ years from a lake on Baffin Island. The summer migration to the sea provides the Arctic char with greater food resources, enabling higher growth rates than would be possible in the freshwater system alone. Fisheries studies conducted in Nain and Tikkoatokak Bay (Labrador) determined that Arctic char spend 50 – 60 days at sea (Johnson 1997). In the fall, Arctic char return to freshwater to avoid sea temperatures below zero degrees Celsius (Johnson 1980).

Fishery assessments of Arctic char were conducted near Rankin Inlet from the mid-1970s to the early 1990s (i.e., Kristofferson *et al*. 1987; McGowan 1987, 1992) and from 1997 – 2001 (Comaplex Minerals Corp., 2007) on the Diane and Meliadine Rivers In the earlier studies, fish weirs were set up to count numbers of fish migrating upstream in the Diane and Meliadine rivers; fish counts were conducted over a specified time period from August to September of each year. In 1976, approximately 88,000 Arctic char were counted migrating upstream on the Diane River (Kristofferson *et al.* 1987), though this number declined to 69,405 in 1986 (McGowan 1987). In 1990, 1,210 Arctic char were counted over a 20 day period on the Meliadine River (McGowan 1992). From 1997 – 1999 a fish fence was set up near the mouth of the Meliadine to capture, measure, and tag char returning from the ocean. Telemetry data showed that the migration of char from Meliadine Lake to Hudson Bay is via both the Meliadine River and Peter Lake/Diane River. It is presumed that any Arctic char present in Itivia Harbour and Melvin Bay would be part of the Diane River and/or Meliadine River stocks.

[1] Amphidromous fish are diadromous whose migration from fresh water to the ocean is not for the purpose of breeding; rather it occurs at a particular stage of the life cycle.

3 METHODOLOGY

3.1 Background Data and Literature Review

Information on marine fish, mammal and bird species presence, abundance, and conservation status was compiled based on standard literature search techniques. Review of available information included:

- Published scientific literature
- Reports and documents from the Federal Government (e.g., Fisheries and Oceans Canada (DFO), Canadian Wildlife Service (CWS), Environment Canada)
- Reports and documents from the Government of Nunavut (e.g., Department of Environment, Wildlife Research Group, Parks)
- Nunavut Wildlife Management Board (NWMB), Regional Wildlife Organizations (RWOs) and the local HTO
- Resources from universities and colleges (e.g., ArcticNet, Canadian Arctic Shelf Exchange Study, Nunavut Arctic College, the Arctic Science and Technology Information System database, International Polar Year).

3.2 Field Studies

Field studies for aquatics and fisheries were conducted in Itivia Harbour and Melvin Bay from August 15 to 21, 2011. Field studies were designed to collect baseline information on the aquatic environment and fish and fish habitat conditions at the Project footprint, where marine development has been proposed, and at two reference sites, where no development is proposed. These three sampling areas were distributed around Melvin Bay: the two sampling areas on the north shore were located in separate bays and separated by a distance of 0.9 km while the third sampling area was located on the south shore, 1.5 km from Itivia Harbour. The Project footprint was labeled “I1” while the reference sites were labeled “R1” and “R2” (see Figure 2-1).

3.2.1 Physical Environment

3.2.1.1 Bathymetry

A bathymetric depth profile was produced for one transect in each sampling area. Each transect was oriented perpendicular to shore and spanned from the shore into the subtidal zone; see Figures A-1 to A-3 in Appendix A for locations of bathymetric profiles in each sampling area. When conducting each survey, depths were measured using a portable depth sounder and locations were determined using a handheld GPS. Measured depths were translated into depths below chart datum (i.e., lowest normal tide) using tide predictions made by the Canadian Hydrographic Service for Rankin Inlet (Station #5100).

3.2.1.2 Water Quality Profiles

Water quality profiles were collected at each sampling area on August 21, 2011. Water quality station locations were recorded using a handheld GPS. Water quality profiles were collected using an YSI 600QS multi-meter. Measured parameters included temperature, conductivity, pH, dissolved oxygen, salinity and oxidation-reduction potential. Parameters were recorded on prepared datasheets every 1 m from the surface to the bottom. See Figures A-1 to A-3 in Appendix A for locations of water quality stations in each sampling area.

3.2.1.3 Nearshore Habitat Survey

The upper and mid intertidal zone were visually inspected during low tides to estimate percent substrate composition, slope, and percent coverage by attached macrophytes; and to identify macro-invertebrate species presence. Substrate composition was estimated using methods consistent with standard methods in Coastal/Estuarine Fish Habitat Description and Assessment Manual (Williams 1993) and DFO's Marine Habitat Information Requirements (DFO 2007) which recognizes the following substrate size categories: fines (< 2 mm), gravel (2 – 64 mm), cobble (64 – 256 mm), boulder (256 – 4,000 mm), and bedrock (> 4,000 mm).

3.2.2 Water and Sediment Chemistry

3.2.2.1 Water

Physical and chemical parameters determine the physiological performance of individual aquatic organisms and influence characteristics at the population and community levels in terms of distribution, diversity and density. Marine coastal waters are also relied on heavily by the local Inuit for traditional harvesting. Therefore it is important to determine baseline water and sediment quality conditions to allow for monitoring of potential effects from development, and ensure compliance with territorial and federal standards.

The water quality assessment was designed to provide data on general water chemistry, nutrients, organic carbon content, and metal levels. These parameters are relevant to toxicity and physical habitat parameters for plants, plankton, benthos, fish eggs and juvenile fish.

The objectives of the water quality assessment were to:

- Obtain baseline water quality data that can be used to assess changes related to installation, operation and decommissioning of the spud barge;
- Identify parameters that may be present at elevated levels, and to use this information to propose site-specific water quality objectives, if needed; and,
- Provide baseline data that can be used to support potential future monitoring programs.

Sample Collection

Water samples were collected from each sampling site at one station located in the subtidal zone. Water was collected using a Van Dorn sampler at mid-depth as temperature was relatively constant throughout the water column and there was no evidence of thermal stratification.

Samples requiring preservation were preserved immediately after sample collection. All samples and blanks were kept in coolers with ice packs until arrival at the laboratory. Chain of custody forms describing sampling times and required analyses were submitted to the laboratory.

Laboratory Methods

Water samples were analyzed at ALS Laboratories in Vancouver, British Columbia (BC), for routine parameters. These included major anions, alkalinity, total suspended solids, total dissolved solids, pH, conductivity, total metals, total Kjeldahl nitrogen, ammonia, nitrate and nitrite, total phosphate, and total organic carbon.

Data Analysis

All general chemistry results were compared to available Canadian Council of Ministers of the Environment (CCME) guidelines (maximum levels) for Protection of Marine Aquatic Life (PMAL) (CCME 2007). The CCME water quality guidelines are listed in Table 3-1.

Table 3-1: Canadian (CCME) Water Quality Guidelines for Protection of Marine Aquatic Life

Parameter	CCME Water Quality Guideline Maximum
Temperature	± 1°C change from background
Dissolved oxygen	>8.00 mg/L and narrative
pH (units)	7.00 – 8.70
Total suspended solids	Narrative
Turbidity	Narrative
Nitrate-N	3.6 mg/L
Salinity	<10% change from background
Arsenic, total	12.5 µg/L
Cadmium, total	0.12 µg/L
Chromium, total	56 µg/L
Mercury, total	0.016 µg/L

NOTES:

Additional parameters analysed, for which marine guidelines do not exist, include: conductivity (field and lab), fluoride, chloride, ammonia-N, total hardness, total dissolved solids, total alkalinity, bicarbonate, carbonate, hydroxide, bromide, nitrite nitrogen, total Kjeldahl nitrogen, total phosphorus, total organic carbon, aluminum, antimony, barium, beryllium, boron, bismuth, calcium, cesium, cobalt, copper, iron, lead, magnesium, manganese, molybdenum, nickel, potassium, rubidium, selenium, silicon, silver, sodium, strontium, tellurium, thallium, thorium, tin, titanium, tungsten, uranium, vanadium, zinc and zirconium.

The majority of the analytical detection limits were below the CCME guidelines and therefore had no bearing on screening results. For mercury, analytical detection limits were above WQG mostly due to analytical interferences and laboratory limitations. This should not be considered and exceedance to the WQG. Re-evaluation of mercury in collected samples is not possible at this time.

All sample parameters for which CCME PMAL guidelines exist were within acceptable limits across all three sampling locations.

QA/QC

The Quality Assurance/Quality Control (QA/QC) program was designed to provide reliable monitoring data by minimizing sampling error, contamination and erroneous results, and by quantifying any bias in the results. Another important component of the QA/QC program was to assure data quality regarding precision, bias, adequate sample hold times and detection limits. The examination of environmental data for potential artifacts due to contamination or reporting errors was thorough. Laboratory results and field notes were verified in relation to replicate and blank results, hold times and occurrence of unusual events.

Field and Travel Blanks

Field blanks (bottles filled in the field with lab-supplied de-ionized water) and travel blanks (sealed de-ionized water supplied by the lab) were analyzed. The blanks were examined to determine whether there were detectable levels of any of the measured parameters. The majority of field and travel blank results were below detection limits with the exception of two field blanks (boron and zinc) and one travel blank (Silver). Blank results are presented in Appendix B.

Replicates

One field replicate was collected during sampling. Results for the field replicate were examined to determine if precision thresholds were exceeded: field replicates should have a difference of no more than 25% of their mean for parameters equal to or greater than five times the detection limit. Results for duplicate samples are presented in Appendix B.

Hold Times

All samples were submitted within applicable hold times.

3.2.2.2 Sediment

Sediment metal analysis is widely used as an indicator of environmental quality in baseline monitoring and environmental assessments. Sediments serve as a repository for metals in both the particulate and dissolved fractions within sediment pore water, often containing higher metal concentrations than are found in water. When sediment is disturbed, metals can be re-suspended and/or recycled into the water column. Metals that enter aquatic systems may cause acute or chronic toxicity to benthic and planktonic organisms (e.g., biochemical and physiological changes), which can potentially lead to altered community structure and to effects on other organisms in the aquatic food web (Hook and Fisher 2001; Grosell, *et al*. 2006; Wilding and Maltby 2006; Shaw *et al*. 2006).

Metals accumulate in sediments when metal particles are washed into water and settle onto the substrate or when soluble metals become absorbed by sediment particles. The fate of these metals depends on local physical and chemical conditions in the sediment. Therefore sediments can potentially act as either a source or a sink for metals, depending on redox potential, cation exchange capacity, particle size of sediments and organic carbon content (Salomons *et al*. 1987).

Particle size influences sediment quality and binding behaviours for metals and other contaminants. Fine (< 63 µm) and coarse (> 63 µm) particles differ in their mineralogical, morphological, physicochemical and mechanical properties (Salomons and Forstner 1984).In general, metals absorb more readily to fines (Brook and Moore 1988), with the highest metal concentrations in clay-sized particles. The exceptions are iron and manganese, which preferentially bind to larger particles > 300 µm. Other characteristics, such as water depth, pH, hardness, nutrient concentration, temperature, dissolved oxygen and water circulation, also affect the behaviour of metals (Mudroch and MacKnight 1991).

The interaction between metals and sediment can strongly influence the toxicity of metals in aquatic systems. Although there is some debate surrounding the sources and mechanisms of metal toxicity for benthic organisms (i.e., water vs. sediment) or absorption of dissolved metals vs. ingestion of particulate metals, the bioavailability and toxicity of metals can largely be determined by metal ion activity in sediment pore water (Carbonaro *et al*. 2005). Thus, chemical interactions that produce insoluble metal species reduce the potential for metal toxicity. For example, the natural presence of iron monosulphide (FeS) lowers dissolved concentrations of Cu^{2+}, Cd^{2+}, Ni^{2+}, Pb^{2+}, Zn^{2+}, and Ag^{+} through formation of insoluble metal sulphides (Carbonaro *et al*. 2005). The potential for metal toxicity also depends on oxygen levels, which oxidize metal sulphides, releasing metal ions back to the sediment pore water (Carbonaro *et al*. 2005). Binding of metal ions to organic carbon also affects metal concentrations in pore water (Ankley *et al*. 1996).

In the present assessment, samples from each sampling area were analyzed for total metals, particle size, total carbon, organic and inorganic carbon, Total Kjeldahl Nitrogen, and total phosphorus in the fine fraction.

Metal concentrations were compared to CCME Interim Sediment Quality Guidelines (ISQG) (CCME 2002). CCME SQGs are provided as two values: ISQG, representing concentrations below which adverse biological effects are not expected, and probable effects levels (PELs), above which adverse biological effects are usually or always observed. Both levels are derived from available literature however, at present, metal SQG are considered interim due to a lack of data. It is also noted that the ISQG are not defined for a particular sediment particle size range.

Sample Collection

Sediment samples were collected on August 19 and August 20, 2011, using a petite ponar sediment grab (2.4 L, 152 x 152 mm). Three sampling stations at least 20 m apart were established in the subtidal of each sampling area and sediment grabs were collected at each station. The top 5 cm of sediment from each of three grabs was removed with a clean stainless steel spoon and composited in a clean stainless steel bowl. The composited sample was placed in clean sample jars for analyses of general sediment chemistry and total metals at each station.

After collection, samples were kept in coolers with ice packs until arrival at the laboratory. Chain of custody forms describing sampling times and required analyses were submitted to the laboratory.

Laboratory Methods

Sediment samples were analyzed at ALS for general chemistry and metals. General chemistry parameters included total carbon, organic and inorganic carbon, total Kjeldahl nitrogen, total phosphorus, total metals and particle size. Detection limits were generally suitable for comparison with sediment quality guidelines.

Data Analysis

Summary statistics were generated for all parameters at each sampling area; these statistics included mean, standard deviation, and coefficient of variation (CV). For results below detection limits, a value of half of the detection limit was used in the calculations. Analytical detection limits were always well below CCME ISQG and PEL for protection of aquatic life and did not influence the interpretation of results. Metal data were compared to available CCME SQG for protection of marine aquatic life (CCME 2002), as shown in Table 3-4.

Table 3-2: Analytical Detection Limits and Canadian (CCME) Working Sediment Quality Guidelines for Protection of Marine Aquatic Life

Parameters	Detection Limit (mg/kg)	Sediment Quality Guidelines (mg/kg)	
		CCME ISQG[1]	CCME PEL[2]
Arsenic, total	0.10	7.24	41.6
Cadmium, total	0.020	0.7	4.2
Chromium, total	1.0	52.3	160
Copper, total,	1.0	18.7	108
Lead, total	0.20	30.2	112
Mercury, total	0.050	0.13	0.70
Zinc, total	10	124	271

NOTES:

[1] ISQG = Interim Sediment Quality Guideline

[2] PEL = Probable Effects Level

Additional parameters analysed, for which no guidelines exist, include: inorganic carbon, total organic carbon, total carbon, $CaCO_3$ equivalent, total Kjeldahl nitrogen, total phosphorus and total aluminum, antimony, barium, beryllium, bismuth, boron, calcium, cesium, cobalt, iron, magnesium, manganese, molybdenum, nickel, potassium, rubidium, selenium, silver, sodium, tellurium, thallium, tin, titanium, tungsten, uranium, vanadium and zirconium.

QA/QC

QA/QC protocols consisted of standard procedures in the field to avoid sample contamination, examination of certified reference materials (CRM) and laboratory duplicates, and assessment of the precision of field replicates.

Field Procedures

Quality assurance in the field included cleaning the equipment (stainless steel bowl, stainless steel spoons), rinsing thoroughly with site and deionized water between replicates and stations, and

wearing new nitrile gloves at each station. The glass sampling jars were acid-washed and supplied uncontaminated from the laboratory. Upon collection, samples were immediately placed in a clean cooler, with ice packs. Care was taken to not contaminate the inside of the jar or the cap. Samples were kept in coolers until they were sent to the laboratory for analysis.

Laboratory Procedures

Certified Reference Materials

ALS Laboratories provided results for analysis of CRM, reporting the analyses, certified values and percent of target value. The laboratory analyses generally met the criteria of less than 20% difference in the value of metals found in the CRM samples compared to the target value as determined by the National Research Council.

Analytical Duplicates

Laboratory replicates were within 20% difference when parameter levels exceeded five times the detection limits.

Field Replicates

Replicate samples provide information about heterogeneity of the sediment within a station. One replicate sample was collected from each sampling area. The three replicate samples were assessed for precision and variability by calculating the CV of each parameter at a sampling area, using the formula CV = [standard deviation/mean]*100. Standard deviation and CV should be no more than 20% of the mean when all replicate values are at least five times the detection limit. Results for which the precision thresholds were exceeded are highlighted in Appendix B.

Of the 153 analyses completed in triplicate (51 parameters at 3 sampling areas) and whose replicate results are all greater than 5 times the detection limit, 13 results (8%) had CV greater than 20% (1 to 7 parameters per sampling area). These results included molybdenum, which exceeded 20% CV at all 3 sampling areas; total organic carbon, total carbon and uranium, which exceeded 20% CV at 2 sampling areas; and, total Kjeldahl nitrogen and boron, which exceeded 20% CV at 1 sampling area.

3.2.3 Aquatic Organisms

3.2.3.1 Phytoplankton

Phytoplankton are small free-floating plant-like organisms mainly consisting of algae and cyanobacteria. These organisms provide a primary source of energy in the marine environment by converting inorganic carbon, nitrogen and phosphorus into organic matter, making it available for secondary consumers such as zooplankton and benthic invertebrates. Phytoplankton exhibit a strong interaction with their physical and chemical environment and this close association was well appreciated by the early 1900s (Franks 2003). Due to the sensitivity of phytoplankton to a variety of changes in the physical or chemical environment (i.e., nutrient loads, TSS, metal levels, etc.), they can be useful tools for evaluating aquatic environment. They also provide a valuable food chain link between water chemistry and the invertebrate and fish communities.

Sample Collection

Phytoplankton were collected from one station in each sampling area in the subtidal zone. Samples were collected using a Van Dorn sampler deployed to 1 m depth. Samples were stored in 250 mL labelled plastic bottles and preserved with Lugol's solution (1/100 mL). Samples were stored in coolers with ice packs and no exposure to light until arrival at the laboratory. Chain of custody forms describing sampling times and analytical requirements were submitted with the sample shipment.

Laboratory Methods

Taxonomy samples were examined at Fraser Environmental Services in Surrey, BC; following procedures outlined in the Fraser Environmental Methods Manual (Looy 2011) and described in Appendix F Depending on the density of organisms, an appropriate volume of the samples (typically 100 mL) were settled in settling chambers for approximately 24 hours and examined in an inverted microscope. The entire chamber was scanned at increasing powers of magnification to determine the species or genera present. At least 20 random fields were counted, to a total count of at least 100 for the predominant species, and data were converted to cells/mL.

Data Analysis

Raw taxonomic data (cells/mL) from the sampling areas are presented in Appendix C. Data are reported by taxonomic group and for the most abundant taxa at each site. The six groups are diatoms (*Bacillariophyceae*), green algae (*Chlorophyta*), cryptophyte algae (*Cryptophyta*), blue-green algae (*Cyanophyta*) and dinoflagellates (*Pyrrophyta*).

Phytoplankton diversity at each sampling area was calculated using Simpson's Diversity Index (Environment Canada 2002):

$$D = 1 - \sum_{i=1}^{S} \left(p_i\right)^2$$

where: p_i is the proportion of the total cell density (cells/mL) for each taxon i and S is the total number of taxa.

Abundance data for many taxa were reported as a less than value, indicating the taxa were observed during the initial visual scan, but not found during the regular counting protocol. The Simpson's Diversity Index was calculated for three scenarios: treating less than values as zero, treating less than values as half the reported value, and treating less than values as their reported non-less than value (e.g., < 4.7 becomes 4.7). Due to the high number of phytoplankton taxa reported, the diversity index did not vary greatly between the three scenarios. As a result, the convention followed was the same as for chemistry data (using one-half the reported less than value) for calculation of Simpson's Diversity Index in agreement with the majority of scientific literature. This ensured that taxa reported as less than values were not excluded from diversity calculations and therefore did not inflate diversity calculations, making rare taxa seem more common.

Percent abundance of diatoms, green, blue-green, cryptophyte and dinoflagellate species was estimated and abundance was summarized as predominant (> 25% abundance), common (5 to 25% abundance) or present.

QA/QC

Quality control procedures involved precautions for ensuring samples were protected from contamination and deterioration (consistency of sampling, correct use of equipment, detailed field notes, use of clean bottles, adequate preservation). Bottles for taxonomy samples were labelled with indelible ink (sample station, collection date and preservative). Care was taken to ensure bottles were kept in a cool, clean environment, either cooler or refrigerator, with no exposure to light.

Fraser Environmental Services followed internal procedures for taxonomy: microscope calibration, counting procedures, Batch Quality Control procedures for precision and accuracy in taxonomic identifications, verification with an in-house reference collection and external review.

3.2.3.2 Zooplankton

Zooplankton are an important ecosystem component because of their role as secondary producers and relationship with phytoplankton and fish production (Mazumder 1994; Vadstein *et al*. 1995). The smallest zooplankton can be characterized as recyclers of water-column nutrients and often are closely tied to measures of nutrient enrichment. Larger zooplankton are important food for forage fish and the larval stages of all fish. The zooplankton community is composed of primary consumers, which eat phytoplankton, and secondary consumers, which feed on other zooplankton.

Sample Collection

Zooplankton samples were collected from one station in each sampling area in the subtidal zone. A 20 cm diameter zooplankton tow net (64 µm mesh size) was deployed for two 3 m vertical tows to collect zooplankton. The zooplankton net was rinsed with filtered ambient water at each sampling station to ensure all capture organisms were collected in the sample bottle.

Zooplankton samples were collected in 500 mL labelled plastic bottles and preserved in 5% buffered formalin. Zooplankton samples were kept in clean coolers until arrival at the laboratory. Chain of custody forms describing sampling times and required analyses were submitted with the sample shipment.

Laboratory Methods

Samples for zooplankton taxonomy were examined at Fraser Environmental Services in Surrey, BC, following procedures outlined in the Fraser Environmental Methods Manual (Looy 2011) and described in Appendix F. The volume of each sample was measured and a 50 mL subsample removed and examined in a petri dish. The entire dish was examined at increasing magnification and taxa identified. A series of 1 mL aliquots of sample were then settled in a Sedgewick-Rafter chamber for 15 minutes, and counted using a strip counting method (see Looy 2011). At least three aliquots were counted, to yield a minimum of 100 organisms. Results were averaged and counts converted to organisms per cubic metre (m^3).

Data Analysis

Raw taxonomic data from the sampling areas are presented in Appendix C as organisms per cubic metre (m^3). Data were reported by taxonomic group and abundance of taxa at each sampling area.

Diversity of zooplankton at each sampling area was calculated using Simpson's Diversity Index (Environment Canada 2002):

$$D = 1 - \sum_{i=1}^{S} \left(p_i\right)^2$$

where: p_i is the proportion of the total zooplankton density (organisms/m^3) for each taxon *i* and *S* is the total number of taxa.

Percent abundance of zooplankton at each sample station was estimated and abundance was characterized as predominant (> 25% abundance), common (5 to 25% abundance) or present, providing a semi-quantitative summary.

QA/QC

Quality control procedures involved precautions for ensuring samples were protected from contamination and deterioration (consistency of sampling, correct use of equipment, detailed field notes, use of clean bottles). Bottles for taxonomy samples were labeled with indelible ink (sample station, collection date, and preservative). Care was taken to ensure sample bottles were kept in a cool, clean environment, either cooler or refrigerator.

Standard protocols for zooplankton samples were followed to maintain sample quality prior to analysis. Fraser Environmental Services followed internal procedures for taxonomy: microscope calibration, counting procedures, Batch Quality Control procedures for precision and accuracy in taxonomic identifications, verification with an in-house reference collection and external review.

3.2.3.3 Benthic Invertebrates

Benthic invertebrates are an important component of both freshwater and marine habitats, as they consume smaller animals and plants, aid in decomposition of organic material and are an important source of food for fish and other animals.

Benthos (benthic invertebrates) are commonly used for biomonitoring purposes. The main advantages of using benthic invertebrates for biomonitoring are: 1) they are ubiquitous, so can be affected by perturbations in many aquatic habitats; 2) the many species involved offer a wide range of responses to environmental stresses; 3) they are relatively sedentary, which allows for the determination of the spatial changes caused by perturbations; and, 4) they have relatively long life cycles, so effects of perturbations over time can be observed (Rosenberg and Resh 1993; Barbour *et al*. 1999).

Sample Collection

Benthos samples were collected on August 19 and August 20, 2011, using a petite ponar sediment grab (2.4 L, 152 x 152 mm). Three stations at least 20 m apart were established in the subtidal of

each sampling area and sediment grabs were collected at each station. Due to sediment characteristics and subsequent difficulty obtaining full grabs, six partial (half full) grabs were collected from each individual station and composited into one sample. A total of 18 partial grabs were collected from each sampling area to produce three composited samples (six partial grabs per composited sample).

Benthos grabs were composited in buckets and transported to shore where the samples were sieved through a box with 500 µm mesh. Sediment and invertebrates that did not pass through the sieve were collected in labeled 500 mL plastic jars. Benthos samples were preserved in 5% buffered formalin. Samples were placed in a clean tote until arrival at the analytical laboratory. Chain of custody forms describing sampling times and required analyses were submitted with the benthos samples.

Laboratory Methods

Benthos samples were examined by Biologica Environmental Services in Victoria, BC, following procedures outlined in their Sample Methods (Biologica 2011) as described in Appendix F. The samples were transferred from formalin to alcohol and gently washed on a geological screen (0.500 mm) to remove the formalin and residual fine sediment. To split the samples, a Caton tray with either 6, 12, 24 or more quadrats with 0.500 mm mesh size was used. The sample was spread evenly over the selected Caton tray, rinsed and drained, and a quadrat is randomly selected for further sorting. The random selection of quadrats continues until 300 to 500 organisms have been collected. Small fractions of the spilt samples are sorted in a dish with a dissecting microscope at increasing magnification until all organisms are recovered. Invertebrates were identified to the lowest practical taxonomic level (genus or family level for most annelids, molluscs, crustaceans and bryozoans, family level for other organisms, and species or phylum in some cases).

Data Analysis

To facilitate data analysis and presentation, the various life stages of individual taxa were combined (i.e., adult, larval, and pupal stages). For comparison and discussion purposes, lower taxonomic levels were often combined into higher levels (usually family). Further, the three samples from each sampling area were composited into one sample set.

For each taxon, the density (number of individuals per unit area; an indicator of habitat availability and fish food abundance), and summary statistics, including minimum, maximum, median, standard deviation and standard error, were calculated. Abundance data were reported as organisms per square metre (m^2), with appropriate conversion of the data. Percent composition of dominant/ indicator taxa (abundance of dominant/indicator taxa relative to the total number of organisms) was also calculated for each site. Dominant/indicator taxon groups were defined as those groups representing greater than 5% of total organism abundance, characterized as predominant (> 25% abundance), common (5 to 25% abundance) or present, providing a semi-quantitative summary.

Community diversity, *D*, of benthic invertebrates at each site was calculated using Simpson's Diversity Index (Environment Canada 2002). This index is a measure of community structure defined by the relationship between the number of distinct taxa and their relative abundances:

$$D = 1 - \sum_{i=1}^{S} \left(p_i\right)^2$$

where: p_i is the proportion of the i^{th} taxon at the station
S is the total number of taxa at the station.

Simpson's Evenness Index, *E*, was calculated as (Environment Canada 2002):

$$E = (1 / \sum_{i=1}^{S} \left(p_i\right)^2) / S$$

The evenness index takes into account relative abundance and number of taxa at each site to provide an indication of community structure. The index ranges from 0 to 1. A higher value (closer to 1) generally indicates a community with relatively uniform distribution of taxa (more homogenous) while a low value (closer to 0) generally reflects a community with a greater distribution of taxon abundance and thus more heterogeneous.

QA/QC

Field and analytical QA/QC measures were based on the BC Freshwater Biological Sampling Manual (MWLAP 2003) and Biologica Environmental Services internal QA/QC procedures (Appendix F). The procedures ensured that all personnel were adequately trained, sampling methods were consistent, samples were correctly collected, labeled and preserved, and equipment was properly cleaned. Detailed field notes were kept, chain of custody forms were used, and safe shipping and storage methods were used.

Analytical QA/QC was based on the Biologica Environmental Services internal QA/QC procedures (Biologica 2011) (Appendix F). Sorting efficiency was assessed by a qualified sorter for 25% of the sorted samples. A portion of each sample is spread in 9 x 13 inch white pan and examined under a dissecting microscope at 10x magnification. If more than three new identifiable organisms are removed per 500 mL, the sample is re-sorted.

3.2.4 Fisheries Assessment

3.2.4.1 Sampling Design

Fish species presence was investigated at all three sampling areas between August 15 and 21, 2011. The sampling areas were stratified by distance from shore, as either "nearshore" or "offshore" samples/sets. Nearshore samples typically occurred within the intertidal zone (an average of 111 m from the high water mark) while offshore samples occurred in both the low intertidal and subtidal zones (an average of 241 m from the high water mark).

3.2.4.2 Fisheries Data Collection

Daytime sets of sinking multi-panel gillnets was the primary fish sampling method used across all sampling areas. Each gillnet consisted of six panels of different mesh sizes strung together to form a

net 91.2 m long and 2.4 m deep. The mesh sizes (in order) were 25 mm, 76 mm, 51 mm, 89 mm, 38 mm and 64 mm. The number of replicate sets in the nearshore and offshore portions of each sampling area ranged from two to three sets with an average soak time of 3.42 hours (range: 2.28 to 5.17 hours).

All captured fish were removed from the nets carefully to minimize injury and placed in a large container of seawater. Fish that were alive and in good condition were measured expediently and released alive. Fish that were alive but injured, such that they were unlikely to survive if released, were euthanized. All fish were identified to species in the field; any uncertain species identifications were photographed for later confirmation. Captured fish were enumerated, and measured for weight and total length (sculpin and cod). Total length of all captured fish was measured in the field using a measuring board. Wet weight of each fish was measured using an electronic scale with 0.1 g precision, or a spring scale (Accu-weigh tubular spring scale, maximum unit of 5 kg) if the fish were too large (i.e., greater than 1,000 g). Each fish was also examined for external parasites or abnormalities such as scars or tumors.

Beach seining was attempted at two sampling areas (I1 and R1). The beach seine net was approximately 20 m long and 1.5 m deep with 5 mm mesh. One end of the net was held on shore while the other end was dragged perpendicularly away from shore by boat until it was two thirds deployed, then parallel to shore until fully deployed, and finally straight towards shore. The ends of the net were pulled together and out of the water to retrieve any fish caught within the seined area. The boulder and cobble intertidal habitat of the sampling areas made it difficult to beach seine as the seine net was continually getting stuck on rocks and freeing the seine net would potentially allow captured fish to escape. The beach seine was not used in the third sampling area (R2) as the slope of the intertidal was very steep and made it difficult to safely hold the seine on shore.

3.2.4.3 Data Analysis

Comparisons among Sampling Areas

Analysis of variance (ANOVA) was used to test for differences in species richness and fish catch rates. Data were organized by “Area” (three sampling areas) and “Distance” (nearshore/offshore) and ANOVA applied to test for differences between the three sampling areas, distance from shore, and any interaction between Area and Distance. Distance was considered a random effect to allow for inferences beyond the three sampling areas while Area was fixed. Species richness values needed to be square-root transformed to meet the ANOVA assumptions of normality and homogeneity of variances. Due to a small sample size, “Tide” (ebb/flood) was not included as a third factor in the ANOVA. A two-tailed *t*-test was used to test for a direct effect of Tide on species richness and fish catch rates.

If the ANOVA indicated that there were significant differences among sampling areas, a posthoc Student’s *t*-test was used to test whether the Project footprint (I1 sampling area) differed significantly from the other two sampling areas. The significance level used to test all effects was $\alpha = 0.05$.

Stock Characteristics

Fulton's condition factor (K) (Fulton 1902) was used to analyze the length-weight data for Greenland cod. Fulton's condition factor describes the relationship between fish mass and length (Murphy and Willis 1996), assessing the state of the fish's health, or its condition. It is calculated for each fish as:

$$K = (W/L^3) \times 10^5$$

where: *W* is the weight of the individual fish
L is the total length for a fish in the statistical population under study.

4 RESULTS

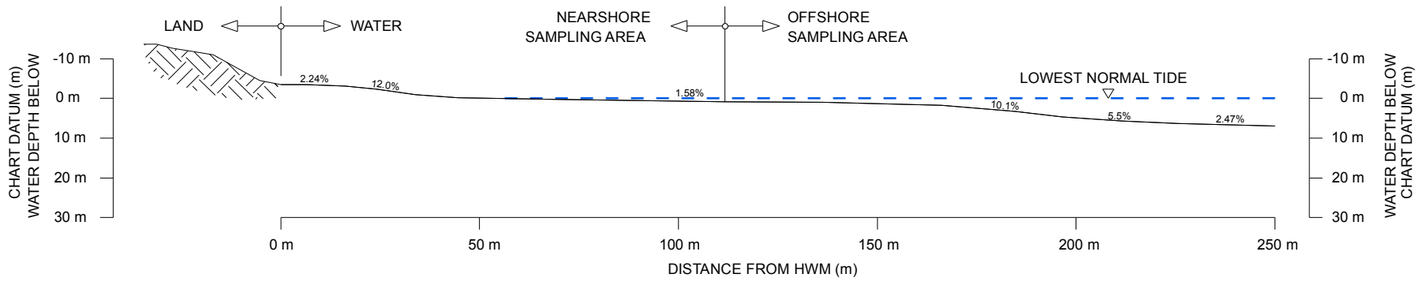
4.1 Physical Environment

4.1.1 Bathymetry

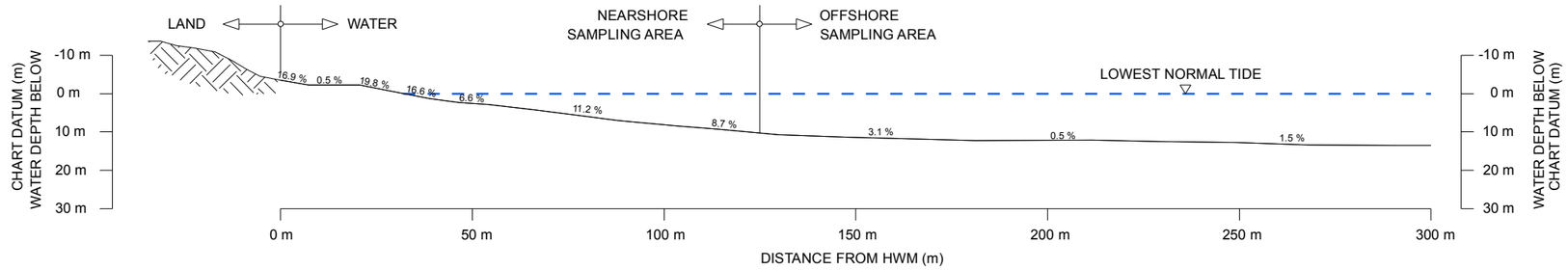
The I1 sampling area was located in the relatively shallow Itivia Harbour of Melvin Bay. A large rock reef is present approximately 125 m offshore (from the high water mark) and intersected the sampling area. Consequently the Project footprint (I1 sampling area) was shallower (mean depth [below chart datum] was 1.4 ± 3.3 m) and had a gentler slope than the other two sampling areas. This resulted in a greater representation of intertidal habitat, which spanned approximately 22% (56 m) of the total sampling area length (Figure 4-1). The maximum depth in the Project footprint was 6.6 m.

The R1 and R2 sampling areas were largely restricted to the subtidal zone and were deeper. The intertidal zone in the R1 and R2 sampling areas accounted for 11% and 14%, respectively, while mean depth ranged from 6.7 ± 6.2 m at R1 to 6.3 ± 4.7 m at R2 (Figure 4-1). Maximum depths in the two reference areas were 13.6 m at R1 and 11.9 m at R2.

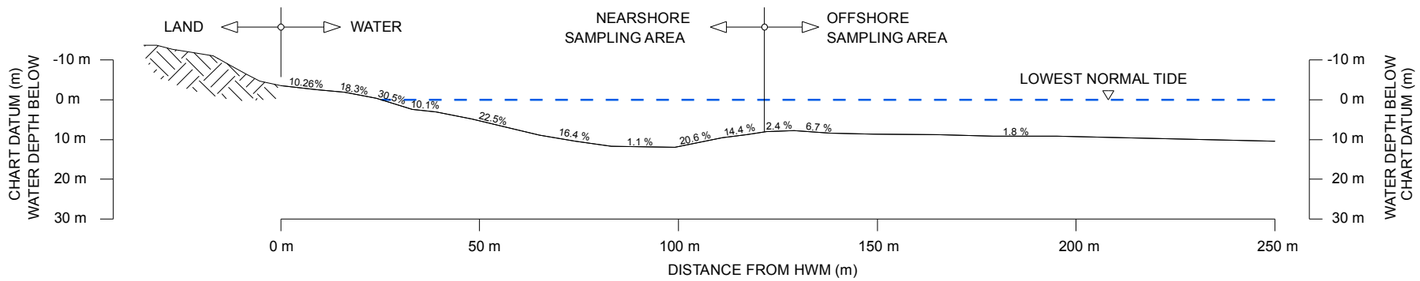
See Figures A-1 to A-3 in Appendix A for the location of each bathymetric profile.



IMPACT AREA



REFERENCE AREA 1



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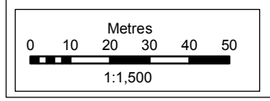

MARINE EFFECTS ASSESSMENT OF THE MELIADINE GOLD PROJECT - RANKIN INLET, NU

BATHYMETRIC PROFILES FOR SAMPLING AREAS

Sources:

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 15-NOV-11	PROJECTION: UTM 15	DRAWN BY: N. PUREWAL
FIGURE ID: 123510575	DATUM: NAD 83	CHECKED BY: C. SIBBALD

PREPARED BY:
NUNAMI STANTEC

PREPARED FOR:
AGNICO-EAGLE MINES LTD.

FIGURE NO:
4-1

Path: R:\2011\Active\123510575\gis\workmxd\123510575 Fig 4-1_BathymetricProfiles.mxd

4.1.2 Water Quality

Averaged across all sampling areas, surface water (1 m depth) had a mean (±SD) temperature of 8.86 ± 0.52°C, a salinity of 29.32 ± 0.03 ppt, and a pH of 8.08 ± 0.03 (Table 4-1). Bottom water was slightly colder (8.49 ± 0.57°C) though salinity and pH were similar from surface to bottom. Thermal stratification was not present at any of the three sampling areas.

Surface *in situ* pH was relatively constant across Melvin Bay (range from 8.05 to 8.10; Table 4-1) and through the water column (Table B1 in Appendix B). Mean *in situ* conductivity and dissolved oxygen were also relatively constant at the sampling areas: mean *in situ* conductivity ranged from 45.6 ± 0.1 mS/cm at surface to 45.7 ± 0.1 mS/cm at bottom, while dissolved oxygen ranged from 114.5 ± 1.0% at surface to 114.1 ± 1.2% at bottom (Table 4-1 and Table B1 in Appendix B).

Table 4-1: Mean *Insitu* Water Quality Parameters

Water Quality Parameter	Statistic	Depth	
		Surface	Bottom
Temperature (°C; n = 3)	Mean	8.86	8.49
	Standard Deviation	0.52	0.57
	Range	8.50 – 9.45	7.93 – 9.07
Salinity (ppt; n = 3)	Mean	29.32	29.33
	Standard Deviation	0.03	0.04
	Range	29.29 – 29.35	29.30 – 29.38
Conductivity (mS/cm)	Mean	45.6	45.7
	Standard Deviation	0.1	0.1
	Range	45.5 – 45.7	45.6 – 45.8
pH (n = 3)	Mean	8.08	8.08
	Standard Deviation	0.03	0.02
	Range	8.05 – 8.10	8.07 – 8.10
Dissolved oxygen (%)	Mean	114.5	114.1
	Standard Deviation	1.0	1.2
	Range	113.6 – 115.6	113.3 – 115.5

4.1.3 Nearshore Habitat

Cobble and/or gravel were the dominant substrates across the nearshore of all three sampling areas (Table 4-2). The nearshore substrate of the R1 and R2 sampling areas was dominated by cobble (40% and 50%, respectively) though R1 also had a large proportion of gravel (35%) (Table 4-2 and site photographs in Appendix A). Boulders and fines were also present at the R1 and R2 sampling areas though in smaller proportions (20% or less) (Table 4-2).

Gravel was predominant in the nearshore at the Project footprint (I1 sampling area) (40%) though a large proportion of cobble (30%) was also present. Compared to R1 and R2, fines made up a higher proportion of the nearshore at the Project footprint while boulders comprised a smaller proportion (Table 4-2). However when combined, the smaller fraction of substrates (gravels and fines) comprised the greatest proportion of the nearshore area at the Project footprint (60%) and was much greater than at R1 and R2 (45% and 25%, respectively). The difference in substrate composition between the Project footprint and the two reference areas is likely a result of the addition of gravel to the area to develop the harbour's boat launch.

Table 4-2: Biophysical Attributes of Nearshore Habitat

Area	Distance from Shore	% Substrate Composition[1]					Macrophyte Cover (% area)	Slope[2] (%)
		Bedrock	Boulder	Cobble	Gravel	Fines		
Project Footprint (I1)	Total	–	–				–	5.6
	Nearshore	–	10	30	40	20	2	5.3
	Offshore	–						4.9
Reference 1 (R1)	Total	–	–	–	–	–	–	8.5
	Nearshore	–	15	40	35	10	5	11.5
	Offshore	–	–	–	–	–	–	1.7
Reference 2 (R2)	Total	–	–	–	–	–	–	6.7
	Nearshore	5	20	50	20	5	2	8.2
	Offshore	–	–	–	–	–	–	2.0

NOTES:
[1] Substrate size ranges include boulders (>256 mm), cobble (64 – 256 mm), gravel (2 – 64 mm) and fines (< 2 mm)
[2] Slope values are averages, estimated from bathymetric profiles of Figure 4-1

Nearshore macrophyte coverage was sparse across all sampling areas, ranging from 2 to 5%, and was greatest at the R1 sampling area (Table 4-2). Macrophytes in the intertidal zone were predominantly rockweeds (*Fucus* spp.) and occupied a small band (approximately 1 to 1.5 m wide) at the low intertidal zone. Kelp (*Laminaria* spp.) was present in the subtidal zone of R2.

Incidential invertebrate species observed during the study included amphipods, barnacles, unidentified bivalves (e.g., mussels, clams), winkles (*Littorina sitkana*), ascidians (sea squirts), and unidentified crab species.

4.2 Water and Sediment Chemistry

4.2.1 Water Chemistry

Total alkalinity was similar across all three sampling locations (142 – 144 mg/L) with bicarbonate (HCO_3^-) being the primary ion (174 – 175 mg/; across all sampling areas versus less than detection carbonate and hydroxide ions) (Table B2 in Appendix B). Nutrients, including nitrate and nitrite, total

Kjeldahl nitrogen, and total phosphorus, were below detection across all three sampling areas, while total organic carbon (3.3 – 4.8 mg/L) and total ammonia (0.023 - 0.028mg/L) were low (Table B2 in Appendix B). Carbon and nitrogen values are expected to fluctuate seasonally with phytoplankton growth and senescence (e.g., Tamelander *et al.* 2009) and thus additional sampling would further the understanding of seasonal baseline nutrient conditions.

Approximately 78% of all analyzed metals (33 of 42) were reported as below detection levels across the sample stations. There were no CCME PMAL exceedances for any of the analyzed parameters (Table B2 in Appendix B).

4.2.2 Sediment Chemistry

Sediment chemistry was relatively constant across the study area. The sediment has relatively high total phosphorus content with concentrations (mean ± SD) ranging from 775 ± 28.15 mg/kg at I1 to 850 ± 36.86 mg/kg at R1. This was generally associated with low nitrogen and carbon values (Table B3 in Appendix B). Average (mean ± SD) total Kjeldahl nitrogen ranged from 0.12 ± 0.02 mg/kg at R1 to 0.15 ± 0.04 mg/kg at R2 while total organic carbon comprised the greatest proportion of total carbon; average (mean ± SD) total organic carbon ranged from 0.68 ± 0.08 mg/kg at R1 to 0.99 ± 0.33 mg/kg at R2 (Table B3 in Appendix B).

Metal concentrations were variable and range from below analytical detection to higher than CCME ISQGs for two metals. Chromium slightly exceeded the CCME ISQG of 52.3 mg/kg for this element at all sample stations with average (±SD) concentrations ranging from 55.8 ± 5.89 mg/kg at I1 to 60.2 ± 6.12 mg/kg at R2 (Table B3 in Appendix B).

The precision analyses (CV) indicate some heterogeneity of marine sediments in the study area. Sediments are generally patchy, therefore some heterogeneity is expected. The number of sampling sites is assumed to account for the majority of variability.

4.3 Aquatic Organisms

4.3.1 Phytoplankton

Phytoplankton abundance, richness and diversity were comparable among the three sampling areas. Phytoplankton abundance and richness were lowest at R1 (20.68 cells/mL and 26 taxa) and highest at I1 (25.62 cells/mL and 28 taxa) (Table 4-3); a total of 33 taxa were reported across the three sampling areas (Table C1 in Appendix C).

Diversity values were similar across all three sampling areas and indicate a diverse phytoplankton community (Table 4-3). However dinoflagellates (*Pyrrhophyta*) were the predominant phytoplankton taxa at all sampling areas and comprised the greatest proportion of all taxa (Table 4-3). Ciliates (*Ciliophora*) were also present at greater proportions than other taxa though at only two sampling areas (R1 and R2) (Table 4-3). Other taxon groups present (less than 5% per taxon) included diatoms (*Bacillariophycae*), green algae (*Chlorophyta*), cryptophytes (*Cryptophyta*) and blue-green algae (*Cyanophyta*). The dominant dinoflagellate taxa were consistent between the three sampling areas

and were comprised of *Peridinium/Gonyaulax* spp. and *Dinophysis* spp. (Table C1 in Appendix C). The ciliate *Tintinnida* was present at R1 and R2 only.

Table 4-3: Phytoplankton Abundance, Richness, Diversity and Predominant Taxa across Sampling Areas in Melvin Bay

Sampling Area	Abundance (cells/mL)	Richness	Diversity	Taxa
Project Footprint (I1)	25.62	28	0.89	Dinoflagellates (72%)
Reference 1 (R1)	20.68	26	0.89	Dinoflagellates (64%) Cilliates (9%)
Reference 2 (R2)	24.68	27	0.85	Dinoflagellates (59%) Cilliates (8%)

4.3.2 Zooplankton

Zooplankton abundance ranged from 190,105 organisms/m^3 at R1 to 219,273 organisms/m^3 at I1 in August 2011 (Table 4-4 and Table C2 in Appendix C). Zooplankton diversity was highest at R1 (0.38) and lowest at R2 (0.15) while richness was the same at I1 and R1 (35 taxa); a total of 44 taxa were reported from the three sampling areas (Table 4-4 and Table C2 in Appendix C).

The three sampling areas exhibited similar but low diversity index values, implying low zooplankton diversity. The predominant taxa was an unidentified species of rotifer, possibly *Notommatidae*, which comprised 77 to 92% of the zooplankton community across the study area (Table 4-4). Calanoid copepods were the second most abundant group at all three sampling areas. Together with the rotifers, the two taxa comprised the majority of the zooplankton community.

Table 4-4: Zooplankton Abundance, Richness Diversity and Predominant Taxa across Sampling Areas in Melvin Bay

Sampling Area	Abundance (organisms/m^3)	Richness	Diversity	Taxa
Project Footprint (I1)	219,273	35	0.27	Rotifers (92%) Copepods (6%)
Reference 1 (R1)	190,105	35	0.38	Rotifers (77%) Copepods (17%)
Reference 2 (R2)	201,803	24	0.15	Rotifers (85%) Copepods (8%)

4.3.3 Benthic Invertebrates

Benthic invertebrate data are summarized in Table 4-5. Summary statistics and data for benthic invertebrates are provided Appendix C in Table C3 and Table C4, respectively. Benthic taxon richness and mean abundance were greatest at the R2 sampling area while mean abundance was lowest at R1 and richness lowest at I1. Due to difficulties sieving one sample at I1, a large range in

abundance was reported from the I1 stations and resulted in a median level of mean abundance at I1. Sampling areas I1 and R2 exhibited a median level of diversity while R1 showed a relatively high level of diversity. The R1 sampling area also exhibited a slightly more heterogeneous benthic community than I1 or R2, as it showed the highest evenness value, however evenness was low across all three sampling areas and implies a relatively homogenous benthic community across the study area.

Table 4-5: Benthic Invertebrate Abundance, Richness, Diversity, Evenness and Predominant Taxa across Sampling Areas in Melvin Bay

Sampling Area	Abundance (Mean [Range]; organisms/m^2)	Richness	Diversity	Evenness	Taxa
Project Footprint (I1)	12,564 (180 – 20,227)	36	0.60	0.07	Polychaeta Sedentaria (66%): ▪ Capitellidae (61%) ▪ Cirratulidae (5%) Polychaeta Errantia (18%): ▪ Syllidae (7%) ▪ Nephtyidae (6%) ▪ Pholoidae (5%)
Reference 1 (R1)	8,632 (8,079 – 9,161)	42	0.85	0.16	Polychaeta Sedentaria (47%): ▪ Capitellidae (19%) ▪ Paraonidae (17%) ▪ Cirratulidae (11%) Polychaeta Errantia (25%): ▪ Nephtyidae (25%)
Reference 2 (R2)	16,305 (13,107 – 18,539)	51	0.68	0.06	Polychaeta Sedentaria (54%): ▪ Capitellidae (54%) Polychaeta Errantia (17%): ▪ Syllidae (11%) ▪ Pholoidae (6%)

Polychaetes were the dominant taxa at all sampling areas in Melvin Bay in August 2011. *Polychaeta Sedentaria* (informal classification), burrowing or tube-dwelling marine worms, were the dominant polychaete type at all sampling areas. In total, *Polychaeta Sedentaria* comprised 47 to 66% of the benthic community with *Capitellidae* as the dominant taxon; *Cirratulidae* and/or *Paraonidae* were also present. *Polychaeta Errantia*, free-swimming marine worms, was the secondary polychaete type at all sampling areas, comprising a total 17 to 25% of the benthic community, with *Nephtyidae*, *Syllidae* and *Pholoidae* being the primary taxa.

Lower density but widespread taxa include the nematode subclass *Hoplonemertea,* the *Myidae* and *Tellinidae* clams, the amphipod families of *Ischyroceridae*, *Oedicerotidae* and *Zopfiaceae*, and 11 additional polychaete families (see Tables C3 and C4 in Appendix C). These taxa were reported from all three sampling areas but at densities less than 5% per taxa (typically less than 2% per taxa). Conversely, the following were identified from only one sampling area: a single sponge (*Porifera*),

two hydrozoan taxa, one flatworm (*Playhelminthes*), *Terebellidae* and *Opheliidae* polychaetes, three gastropod and three bivalve taxa, several crustaceans including two copepod, seven amphipod and one decapod taxa, and one sea squirt (*Urochordata*). These uncommon taxa were primarily reported at densities less than 1% (see Tables C3 and C4 in Appendix C).

4.4 Fisheries Assessment

4.4.1 Fish Catch Composition

A total of 156 fish, representing six species, were caught in 13 gillnet sets made within the three sampling areas (Table 4-6). The numerically dominant fish species were Greenland cod (*Gadus ogac*) comprising 52% of species caught, followed by slender eelblenny (*Lumpenus fabricii*) (27%) and fourhorn sculpin (*Triglopsis quadricornis*) (15%). Less commonly caught species were unidentified sculpin (possibly juvenile; 3%), Arctic staghorn sculpin (*Gymnocanthus tricuspis*) (2%) and Arctic sculpin (*Myoxocephalus scorpioides*) (1%). The range of total lengths for the three dominant fish taxa were 118 to 520 mm for Greenland cod, 180 to 310 mm for slender eelblenny and 205 to 315 mm for fourhorn sculpin species (Table 4-6).

Table 4-6: Species and Length Composition of Fish Caught in Gillnets at Melvin Bay

Fish Species		Species Composition (% of total catch)	Length Composition (Mean [Range]; mm)	Weight Composition (Mean [Range]; g)	Fulton's Condition Factor (k) (Mean [Range]; K)
English Common Name	Scientific Name				
Arctic sculpin	*Myoxocephalus scorpioides*	1%	299 (242 – 370)	353 (149 – 700)	1.16 (1.09 - 1.38)
Arctic staghorn sculpin	*Gymnocanthus tricuspis*	2%	190 (145 – 215)	89 (34 – 122)	1.18 (1.11 - 1.22)
Fourhorn sculpin	*Triglopsis quadricornis*	15%	260 (205 – 315)	174 (84 – 274)	0.96 (0.69 - 1.07)
Greenland cod	*Gadus ogac*	52%	336 (118 – 520)	437 (15 – 1450)	0.97 (0.78 - 1.26)
Sculpin unidentified	*Cottidae* unid.	3%	117 (110 – 120)	14 (9 – 19)	0.84 (0.61 – 1.17)
Slender eelblenny	*Lumpenus fabricii*	27%	246 (180 – 310)	46 (22 – 200)	0.33 (0.16 - 1.14)
Total Count		**156 fish**	**–**	**–**	

Arctic char were not captured during Nunami's baseline study. At the time of Nunami's study, Arctic char were reported to be in the marine environment though located to the west of Melvin Bay, on the west and east sides of the Barrier Islands (approximately 7 km west of Melvin Bay) (R. Mercer, *pers.comm.*).

4.4.2 Rates of Fish Capture and Species Richness

Averaged catch per unit effort (CPUE) (±SD) across the three sampling areas, fish species richness was 2.7 ± 0.8 species per set, total fish catch rate was 3.6 ± 1.2 fish per gillnet hour, and Greenland cod catch was 1.9 ± 1.2 cod per gillnet hour (Table D1 in Appendix D).

There were no statistically significant differences in catch rates or species richness among the sampling areas ($P \geq 0.32$) or between nearshore and offshore sets ($P \geq 0.39$) (Table 4-7 and Figures 4-2 to 4-4). An interaction was detected between sampling area and nearshore/offshore sets for total catch rates ($F_{2,7} = 4.313$, $P = 0.039$) and, following posthoc testing, was attributed to a statistically different mean catch rate between the nearshore and offshore areas at the R1 sampling area (Figure 4-3). There were no significant differences in catch rates or species richness between ebb and flood tides ($P \geq 0.08$).

Table 4-7: Probability Values Associated with the Statistical Analysis (ANOVA) of Factors Affecting Fish Species Richness and Catch Rates

Parameter	Probability Values	
	Area (Impact/Reference)	Distance (Nearshore/Offshore)
Total catch rate	0.32	0.39
Greenland cod catch rate	0.86	0.80
Species richness	0.50	0.40

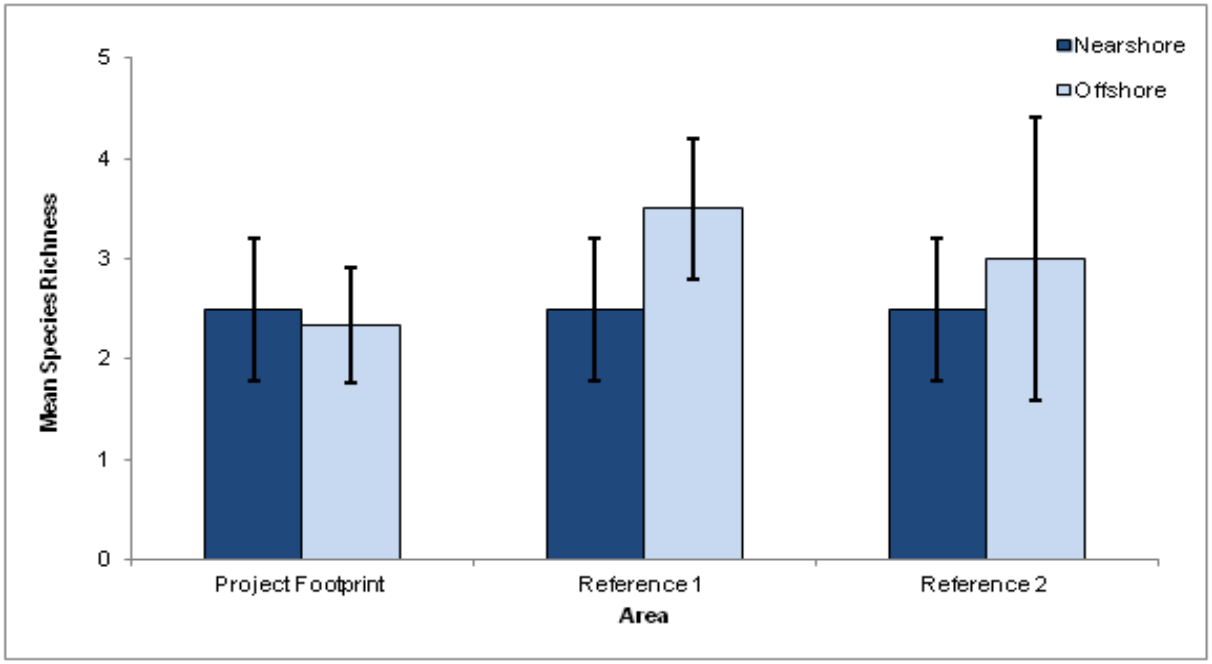

Figure 4-2: Mean (± SD) Nearshore and Offshore Species Richness in Each Sampling Area from Daytime Sinking Gillnets

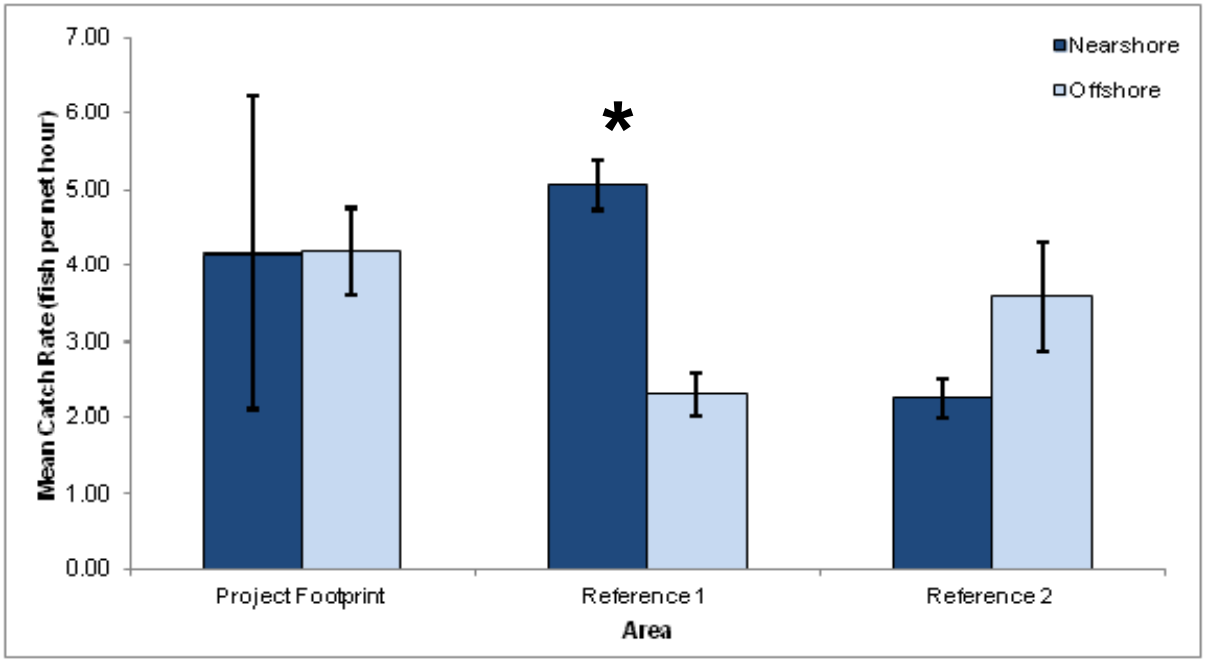

Figure 4-3: Mean (± SD) Nearshore and Offshore Catch Rates for Total Fish in each Sampling Area from Daytime Sinking Gillnets (* defines significant interaction between sampling area and nearshore/offshore)

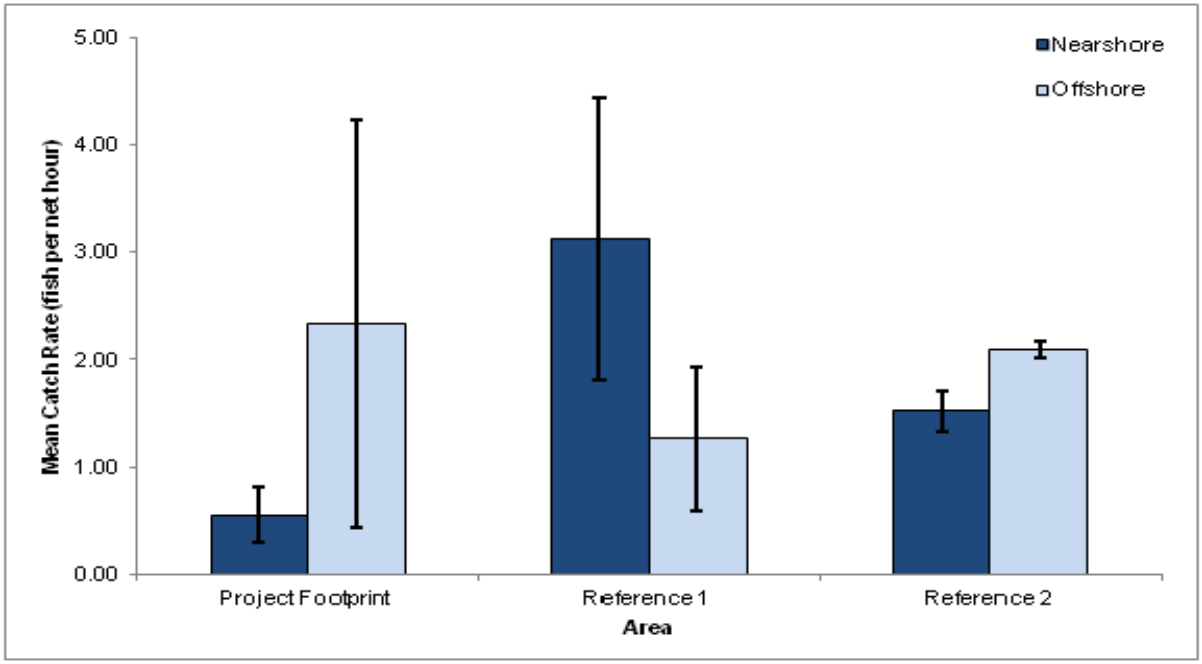

Figure 4-4: Mean (± SD) Nearshore and Offshore Catch Rates for Greenland Cod in each Sampling Area from Daytime Sinking Gillnets

As depicted in Figure 4-2, mean species richness was similar across the study area and within sampling areas. Mean (±SD) species richness ranged from 2.4 ± 0.5 species at the Project footprint (I1) to 3.0 ± 0.8 species at the R1 sampling area and the largest within-area difference was observed at the R1 sampling area (2.5 ± 0.7 species in the nearshore and 3.5 ± 0.7 species in the offshore) (Figure 4-2).

Across the study area, catch rates were generally low with minor variability between and within sampling areas (Figure 4-3). For example, within the individual sampling areas, the range of catch rates was only 1.3 to 1.4 times the sampling area's mean catch rate and only 1.1 to 1.5 times the study area's total mean catch rate of 3.6 ± 1.2. The R1 sampling area had the largest difference in mean catch rate between nearshore and offshore sites and showed statistically different mean values (Figure 4-3), Total mean catch rates by area ranged from 2.91 ± 0.88 to 4.17 ± 1.11 fish per gill net hour.

Mean Greenland cod catch rates were more variable than total catch rates at the Project footprint (I1) and R1 sampling areas and differed most within R1 sampling area (3.12 ± 1.32 cod per gill net hour in the nearshore and 1.27 ± 0.67 cod per gill net hour in the offshore) (Figure 4-4). Greenland cod catch rates by area ranged from 1.63 ± 1.66 to 2.19 ± 1.37 cod per gill net hour.

4.4.3 Stock Characteristics

Fulton's condition factor (K) was calculated for Greenland cod length-weight data. Data were divided into 25 mm length classes to provide a better indication of population range and "well-being". The length classes of captured Greenland cod ranged from 100 – 124 mm to 500 – 524 mm. The average (±SD) condition, an indicator of weight per length, was 0.99 ± 0.13 for all captured Greenland cod (Figure 4-5).

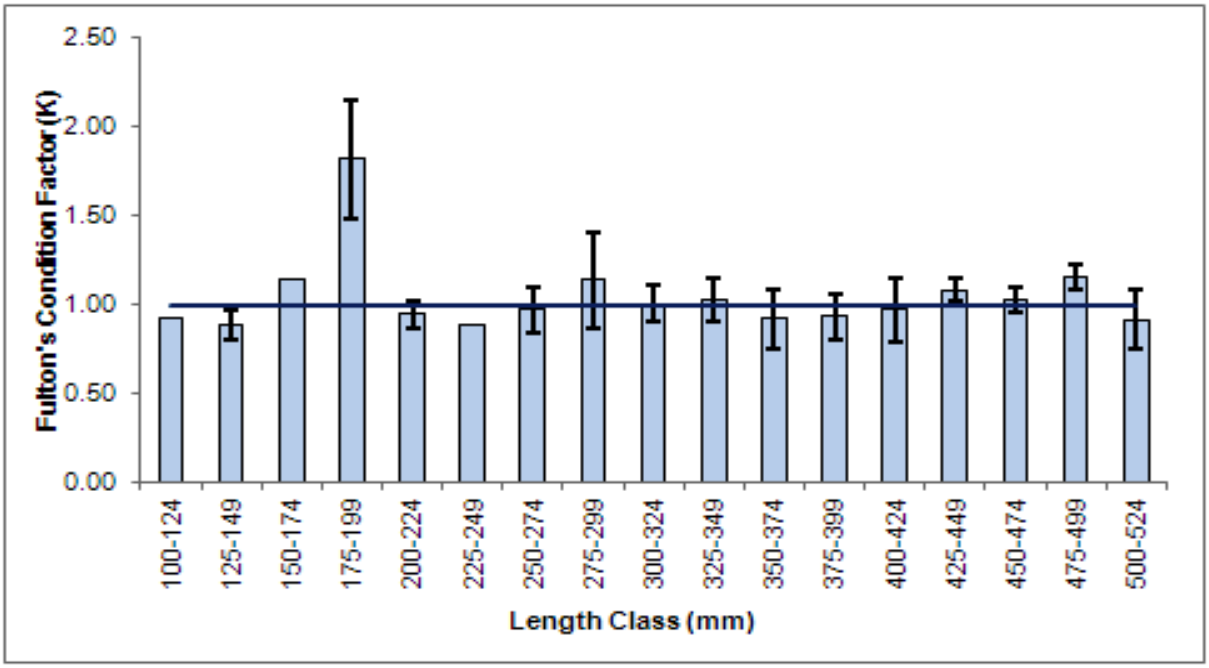

Figure 4-5: Mean (±SD) Fulton's Condition Factor (K) for Length Classes of Greenland Cod Captured in Melvin Bay (dark blue line indicates total mean condition factor)

A length class frequency figure shows generally three age classes (100 – 274; 275 – 424; 425 – 525) (Figure 4-6). The oldest age class is absent given the Greenland cod grows to approximately 80 cm.

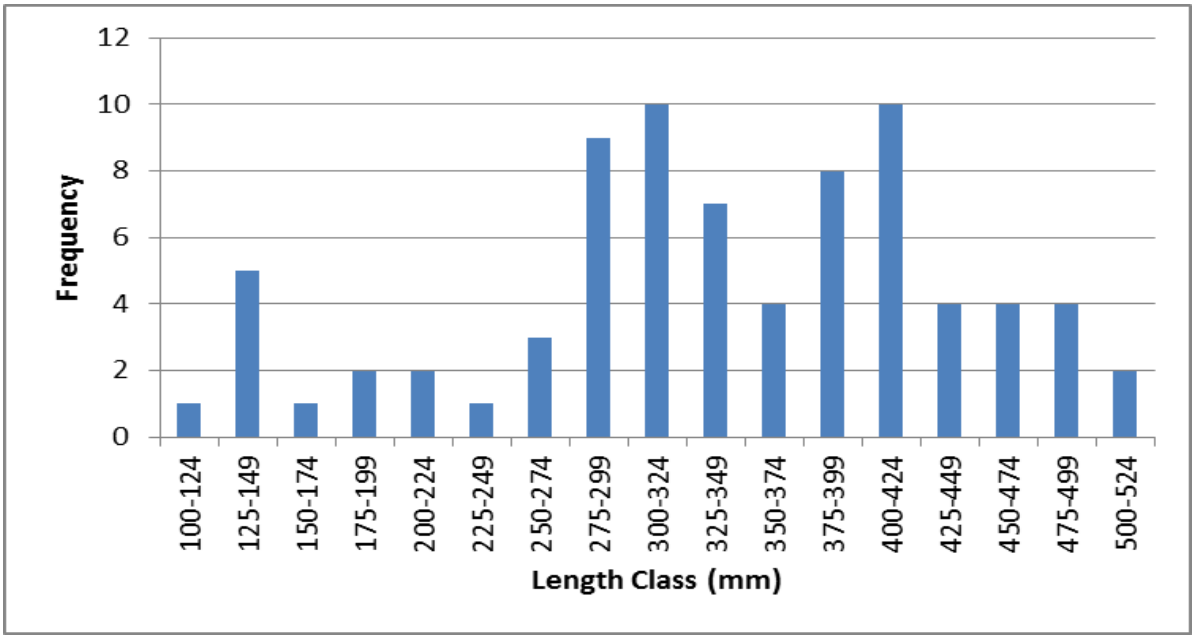

Figure 4-6: Frequency of Length Classes of Greenland Cod Captured in Melvin Bay

4.5 Marine Mammals and Birds

4.5.1 Observed Species

No marine mammals were observed during the baseline survey. A black guillemot and a pair of sandhill cranes were observed anecdotally.

4.5.2 Literature Review

4.5.2.1 Marine Mammals

Review of available information suggests that seven marine mammal species typically occur along the west coast of Hudson Bay. Detailed baseline information will focus on the beluga whale, ringed seal, and polar bear due to their importance to the community, regulators and their potential occurrence in the study area. Ringed seal and beluga whale are the most commonly harvested marine mammal species in Nunavut (Priest and Usher 2004).

Marine mammals can be divided into two distinct taxonomic groups: the cetaceans (toothed whales and baleen whales) and the pinnipeds (seals). Polar bears are included for consideration as a marine mammal because they depend on the marine environment for survival. The conservation status of the seven species that occur along the west coast of Hudson Bay is summarized in Table 4-5. Conservation status is summarized according to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status.

Table 4-8: Marine Mammal Occurrence and Conservation Status along the West Coast of Hudson Bay

Common Name	Species Name	COSEWIC Status
Beluga whale (Western Hudson Bay population)	*Delphinapterus leucas*	Special Concern
Ringed seal	*Phoca hispida*	Not at risk
Polar bear (Western Hudson Bay population)	*Ursus maritimus*	Special Concern
Bowhead whale (Eastern Canada population)	*Balaena mysticetus*	Special Concern
Bearded seal	*Erignathus barbatus*	Data Deficient
Harp seal	*Phoca groenlandica*	Not Listed
Walrus	*Odobenus rosmarus*	Special Concern
Narwhal	*Monodon monoceros*	Special Concern
Killer whale	*Orcinus orca*	Special Concern

NOTE:
Source: Government of Canada 2011

None of the species assessed by COSEWIC are listed under the Federal *Species at Risk Act* (SARA) either because they have not been assessed under SARA or it was reviewed and decided

not to list the species. The current status of review based on the Species at Risk Public Registry was last updated in June 2010 and is summarized below.

- **Beluga Whale**—The Western Hudson Bay population of beluga whale was submitted to the Minister of the Environment by COSEWIC in 2005. The decision in 2006 was to not list under SARA at that time due to the pending harmonization process between the Nunavut Land Claims Agreement and SARA and pending consultations with the Nunavik Marine Region Wildlife Board (Government of Canada 2006a).
- **Bowhead Whale**—COSEWIC designated the Eastern Canada-Western Greenland population of bowhead whales as Special Concern in 2009. Consultations on whether to list this population on Schedule 1 of SARA are ongoing between the Federal government and the governments of Quebec, Newfoundland and Labrador and Nunavut, the Nunavik Marine Region Wildlife Board and the Nunavut Wildlife Management Board, Aboriginal peoples, stakeholders, and the public (Government of Canada 2009).
- **Narwhal**—Extended consultations regarding listing the narwhal are ongoing since COSEWIC submitted its recommendation to the Minister of the Environment in 2005. Final determination is pending consultations between the Minister of Fisheries and Oceans and the governments of Quebec, Newfoundland and Labrador and Nunavut, the Nunavut Wildlife Management Board and the Hunting, Fishing and Trapping Coordinating Committee, Aboriginal peoples, stakeholders and the public (Government of Canada 2005).
- **Polar Bear**—The polar bear was re-submitted by COSEWIC to the Minister of the Environment in 2008. Consultations are ongoing with the governments of Manitoba, Ontario, Quebec, Newfoundland and Labrador, Yukon, Northwest Territories and Nunavut, the Yukon Fish and Wildlife Management Board, the Gwich'in Renewable Resources Board, the Wildlife Management Advisory Council-Northwest Territories, the Nunavut Wildlife Management Board, the Hunting, Fishing and Trapping Coordinating Committee, the Wildlife Management Advisory Council-North Slope and Torngat Wildlife and Plants Co-Management Board, Aboriginal peoples, stakeholders, and the public (Government of Canada 2008). No updated decision to list or not has been issued.
- **Atlantic Walrus**—The Atlantic walrus was submitted following extended consultations by COSEWIC to the Minister of the Environment in 2006. Final decision is pending consultations with the governments of Manitoba, Ontario, Quebec, Newfoundland and Labrador, New Brunswick, Nova Scotia, Prince Edward Island and Nunavut, Aboriginal peoples, stakeholders, and the public (Government of Canada 2006b).

Marine Mammal Focal Species Information

Beluga Whale

In Canada, the beluga whale is divided into seven populations based on summer distribution and genetic differences (COSEWIC 2004). The whales that occur in or near the study area belong to the Western Hudson Bay population. The most recent population estimate for the western Hudson Bay population of beluga whales was estimated at approximately 57,300 animals (Richard 2005).

Biological Information specific to the species' use of the Rankin Inlet area (and western Hudson Bay) by beluga whales is limited.

In the summer, western Hudson Bay belugas concentrate in the Churchill, Nelson and Seal River estuaries (Richard *et al*. 1990). Belugas initially arrive in these estuaries after spring ice breakup in mid- to late June and increase in abundance until late July. They tend to spend the summer in shallow coastal waters along western Hudson Bay (Martin *et al*. 2001). Migration is believed to begin northward along the coast of Hudson Bay during late August or early September (COSEWIC 2004). Satellite tag data suggest the population moves towards wintering habitat in Hudson Strait; however, the routes taken by belugas between summering and wintering habitats are not well known.

Beluga whales are an important cultural and ecological species in Nunavut and are hunted by many communities (20 out of 28) (DFO 2000; Priest and Usher 2004). Beluga are typically hunted along the western coast in the summer and are harvested up to 35 km offshore (Riewe 1992). Over the five-year period from 1996 to 2001, the total annual mean number of belugas taken through hunting was approximately 1,339 for all of Nunavut, while annual rates of belugas harvested from the community of Rankin Inlet ranged from 22 in 1998/99 to 116 in 1999/00 (Priest and Usher 2004). Inuit knowledge suggests that belugas are easier to hunt than other marine mammals because they are naive of humans and are often approached without fleeing (Richard 2001).

Polar Bear

In Canada, polar bears are divided into 13 sub-populations. One sub-population has the potential to occur in the study area; the Western Hudson Bay sub-population. The most recent estimate of the Western Hudson Bay sub-population indicates that overall abundance has declined from approximately 1,294 in 1987 to 935 in 2004, a decline of 22% (Regehr *et al*. 2007).

In contrast to COSEWIC's determination that the western Hudson Bay population of polar bears is declining, Inuit Qaujimajatuqangit (IQ) from Inuit elders concerning the population of polar bears suggests the numbers of bears are increasing (COSEWIC 2008). They report numerous polar bear dens and polar bears observed along the western coast. Results from a compilation of interviews along the western coast by the Nunavut Tunngavik Incorporated (NTI) indicate an increasing number of bears around Rankin Inlet since the 1980s (NTI 2005). Due to the discrepancy between scientific literature and IQ, the Government of Nunavut conducted a mark-recapture survey in 2007 on the bears that range from Churchill to Chesterfield Inlet (Peacock and Taylor 2007). Results of their survey do not conflict with the population estimate as determined by Regehr *et al*. (2007).

Distribution of polar bears is closely correlated with the distribution of ringed seal, which is their principal prey (Stirling and Øritsland 1995). The ringed seal, in turn, is strongly associated with ice distribution. The bears hunt the seals through their breathing holes in the ice, in birth lairs, or when they are hauled out on the ice (Smith 1980). Polar bears spend several months of the open-water season along the western coast of Hudson Bay from Southampton Island to Churchill (COSEWIC 2008). During this time, the Western Hudson Bay sub-population tends to congregate on coastal capes and headlands between Cape Churchill and Arviat (Stirling *et al*. 1999). In the fall, there is a gradual northward movement of the polar bears along the south coast of Hudson Bay, as they gather

to await the formation of new sea ice in November (Amstrup *et al*. 2007). Some bears tagged in the Churchill region moved northward along the Kivalliq Coast as far as Chesterfield Inlet (Stirling *et al*. 1999). The winter and summer concentration of polar bears is situated around Arviat, just under 200 km south of Rankin Inlet (Taylor *et al*. 2001; Van de Velde *et al*. 2003; Stephenson and Hartwig, 2010).

Primary limiting factors and threats to the polar bear that were identified by COSEWIC focus on starvation (from lack of accessibility to principal prey), human-caused mortality (hunting), and intraspecific predation. The number of polar bears hunted from Rankin Inlet from 1996 to 2001 ranged from 1 to 13 bears (Priest and Usher 2004). Several potential threats were identified including contamination, accumulation of environmental contaminants, increased vessel traffic, and climate change (COSEWIC 2008). Climate change is of particular concern to the western Hudson Bay population because they are land bound during the summer. Average sea-ice break-up has occurred earlier over the past 30 years (Stirling *et al*. 1999; Ferguson *et al*. 2005). Earlier sea-ice break-up is correlated with poor condition of adult females (Stirling *et al*. 1999).

Ringed Seal

The ringed seal is the most common and abundant species of seal in Hudson Bay, where it is resident year-round (Stewart and Lockhart 2005). Estimates of ringed seal populations are based mainly on aerial surveys conducted during the peak haulout and moulting period from late May to early July. Smith (1975) conducted an aerial survey of Hudson Bay between Churchill and Chesterfield Inlet, and estimated that there were 455,000 ringed seals in Hudson Bay. More recently, aerial systematic strip transect surveys extending from the Nelson River estuary to Rankin Inlet estimated 38,340 ringed seals in 1994 and 140,880 in 1995 (Lunn *et al*. 1997). These estimates are likely conservative because they are based on the number of seals hauled out on the ice and were not corrected for seals that were submerged. The total population of the area may be twice as large when submerged seals are taken into consideration (Stirling and Øritsland 1995).

In spring, breeding and non-breeding adults utilize distinct habitat. High densities of breeding adults occur on stable, landfast ice in areas with good snow cover, whereas non-breeders tend to be found at the floe edge or in the moving pack ice (Stewart and Lockhart 2005). Their ability to maintain breathing holes in ice enables them to occupy areas of Nunavut that are inaccessible to other marine mammals during the colder, ice-covered seasons.

The number of ringed seals hunted in Rankin Inlet varies widely, from 55 to 356 animals over a five year period (Priest and Usher 2004).

4.5.2.2 Marine Birds

Important Bird Areas (IBA) have been defined in Canada as an initiative between Bird Studies Canada, Nature Canada and BirdLife International to support the international conservation of discrete sites that support threatened birds, large groups of birds, and birds restricted by range or by habitat. The nearest IBA to Rankin Inlet is McConnell River IBA near Arviat, less than 200 km south along the coastline. The McConnell River Migratory Bird Sanctuary is one of five in Nunavut created to protect important habitats for bird species. Further to IBAs, the Canadian Wildlife Service (CWS)

has identified key migratory bird marine and terrestrial habitats which are essential to the welfare of various migratory bird species in Canada. The CWS established 16 bird sanctuaries in Canada to control and manage areas of importance for the protection of migratory birds, their nests and eggs. None of the identified key habitat or sanctuaries are in the vicinity of Rankin Inlet.

Interviews with the elders of Rankin Inlet noted a perceived decrease in guillemots, Arctic terns, and sand pipers (Kangiqliniq HTO 2011). The HTO also voiced concern regarding the birds on Panorama Island in Itivia Harbour; students have been studying the Peregrine falcon and rough-legged hawk there for the last 20 to 25 years (Kangiqliniq HTO 2011). Recorded birds harvested in Rankin Inlet include snow goose, Canada goose, ptarmigan, and the occasional eider duck (Priest and Usher 2004).

Most marine birds that occur in the vicinity of Rankin Inlet are summer residents; a few such as the black guillemot and snowy owl occur year-round (Sibley 2003). The summer migrants pass through the Kivalliq region for staging, moulting, nesting, and brooding (Canadian Circumpolar Institute 1992). A list of marine birds that occur in the vicinity of Rankin Inlet and their status is summarized in Table 4-9. No marine bird species that occur near Rankin Inlet are listed under the *Species at Risk Act*. Due to their presence, community concern, and conservation status, more detailed information on the black guillemot and Peregrine falcon are provided following the summary table.

Table 4-9: Marine Bird Occurrence and Conservation Status near Rankin Inlet

Common Name	Occurrence	COSEWIC Status
Black guillemot	Year-round	Not Assessed
Snowy owl	Year-round	Not at Risk
Loons: Pacific, Red-throated; Common	Summer	Not Assessed Not at Risk
Long-tailed duck	Summer	Not Assessed
Eiders: King and common	Summer	Not Assessed
Red-breasted merganser	Summer	Not Assessed
Sandhill crane	Summer	Not at Risk
Plovers: American golden and Semipalmated	Summer	Not Assessed
Dunlin	Summer	Not Assessed
Sandpipers: Semipalmated, Least, Pectoral	Summer	Not Assessed
Phalaropes: Red-necked, Red	Summer	Not Assessed
Jaegers: Parasitic, Long-tailed	Summer	Not Assessed
Herring gull	Summer	Not Assessed
Arctic tern	Summer	Not Assessed
Peregrine falcon	Summer	Special Concern
Brant	Migration	Not Assessed
Black scoter	Migration	Not Assessed

Common Name	Occurrence	COSEWIC Status
Black-bellied plover	Migration	Not Assessed
Sandpipers: White-rumped and Baird's	Migration	Not Assessed
Pomarine Jaeger	Migration	Not Assessed
Gulls: Sabine's, Thayer's and Glaucous	Migration	Not Assessed
Ruddy turnstone	Rare	Not Assessed
Sanderling	Rare	Not Assessed
Red knot, *rufa* subspecies *islandica* subspecies	Rare	Endangered Special Concern
Black-legged kittiwake	Rare	Not Assessed

NOTE:
Source: Sibley 2003; Government of Canada 2011

Marine Bird Focal Species Information

Black Guillemot

The Black guillemot occurs in Rankin Inlet year-round, never far from land (Sibley 2003). It has not been assessed by COSEWIC but the International Union for the Conservation of Nature (IUCN) has designated it as Least Concern globally. The reasons for the Least Concern designation are its large and apparently increasing population size, and extremely large range (BirdLife International 2009). They typically nest on cliffs of rocky shorelines or on the ground (Gauthier and Aubry 1996). Crustaceans are the primary prey followed by small fish which they capture by diving along the coast (DeGraff *et al*. 1985; Cairns 1992).

Peregrine Falcon

The Peregrine falcon (*Falco peregrinus tundris*) breeds near Rankin Inlet and has been studied by researchers from 1982 to 2009 (Franke *et al*. 2010). It breeds across northern Canada and winters south as far as northern Mexico (COSEWIC 2007). Its breeding habitat appears to be limited by sufficient food supply (White *et al*. 2002), but once a site is established the adults show a high degree of breeding site fidelity (COSEWIC 2007). If there is a stable food supply, the Peregrine falcon is extremely adaptable to different habitats and has increased their use of urban areas over the last few decades (Cade *et al*. 1996); they rarely experience enough disturbance from humans to cause breeding failure (COSEWIC 2007). It has been noted that birds in areas of Nunavut that are not accustomed to development could be more sensitive to human activity (Carrière *et al*. 2003).

Historically, pollutants have caused major population damage to the Peregrine falcon; DDT (dichloro-diphenyl-trichloroethane) in particular (Cade *et al*. 1998). Although the species has recovered over the last few decades, research on breeding population near Rankin Inlet has shown declining occupancy of breeding territories and number of young to reach banding age annually, despite the declining trends in pesticide loads (Franke *et al*. 2010). Population size for this species and sub-species is difficult to determine, however there are likely several thousand birds nationally (COSEWIC 2007).

5 CLOSURE

Nunami Stantec Ltd. has prepared this report for the sole benefit of Agnico-Eagle Mines Ltd (AEM) for the purpose of documenting marine baseline conditions at Itivia Harbour and Melvin Bay. The report may not be relied upon by any other person or entity, other than for its intended purposes, without the express written consent of Nunami and AEM. Any use of this report by a third party, or any reliance on decisions made based upon it, are the responsibility of such third parties.

The information provided in this report was compiled from existing documents and data provided by AEM, and field data compiled by Nunami. This report represents the best professional judgment of our personnel available at the time of its preparation. Nunami reserves the right to modify the contents of this report, in whole or in part, to reflect any new information that becomes available. If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

This report addressed marine aquatics and fisheries issues that are typically examined by regulators during environmental assessments under the Canadian *Environmental Assessment Act* and Article 12 of the Nunavut Land Claims Agreement, as well as issues specifically requested by regulatory agencies (e.g., Fisheries and Oceans Canada). Long term monitoring requirements were also considered during the design of this study so that an effective monitoring plan can be efficiently prepared for the proposed spud barge operation period.

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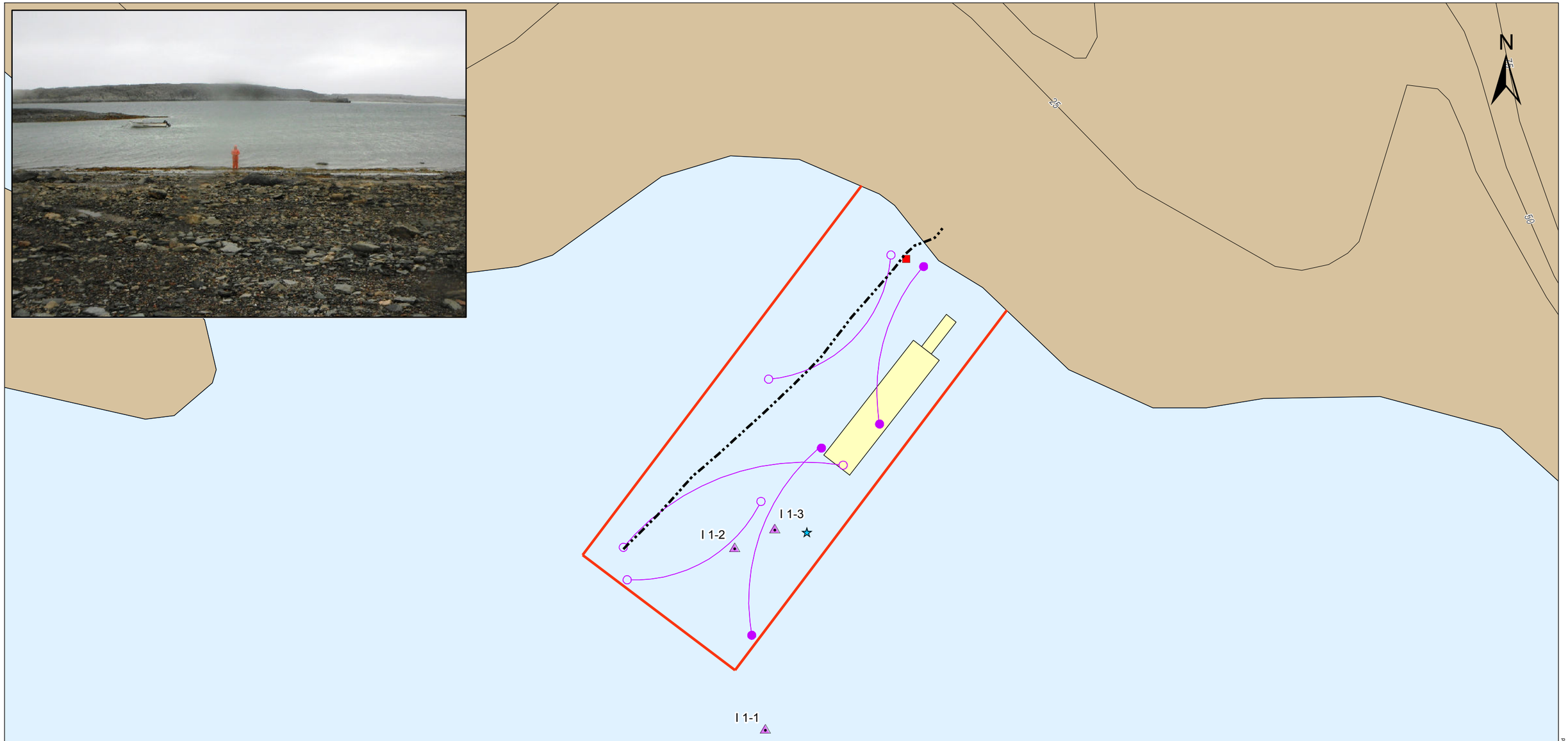
APPENDIX A

Sampling Site Locations



- Beach Seine Location
- Sediment Quality Sample Station
- Water Quality Sample Site
- Bathymetric Profile
- Gill Net Set
- Gill Net Set (approx. location)
- Elevation Contour
- Sampling Area
- Proposed Floating Wharf
- Waterbody
- Land

MARINE EFFECTS ASSESSMENT OF THE MELIADINE GOLD PROJECT - RANKIN INLET, NU

PROJECT FOOTPRINT (IMPACT AREA) SAMPLING AREA AND SAMPLING LOCATIONS

Sources:

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

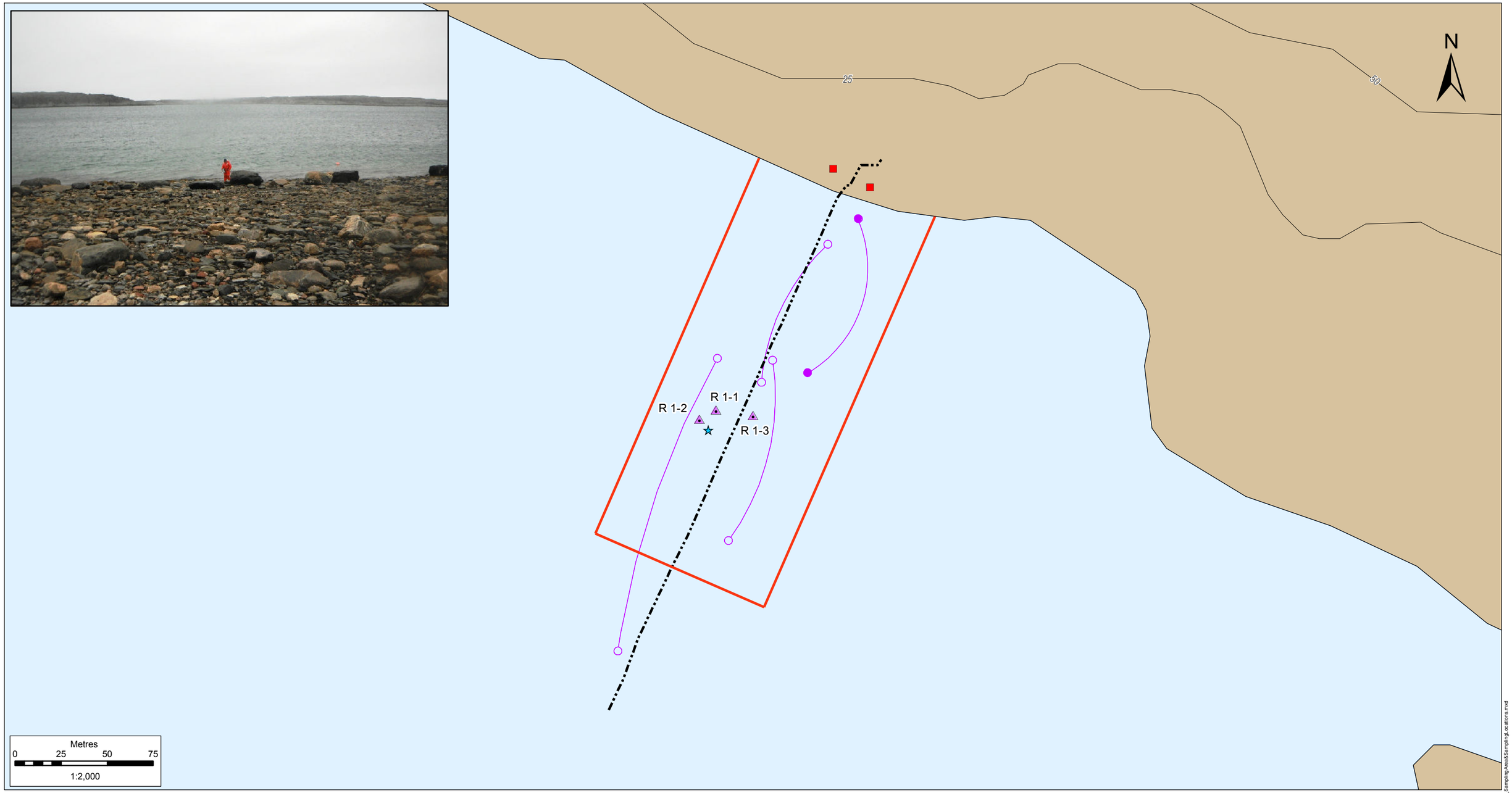
DATE: 16-NOV-11	PROJECTION: UTM 15	DRAWN BY: N. PUREWAL
FIGURE ID: 123510575	DATUM: NAD 83	CHECKED BY: C. SIBBALD

PREPARED BY:
NUNAMI STANTEC

PREPARED FOR:
AGNICO-EAGLE MINES LTD.

FIGURE NO:
A-1

Path: R:\2011\Stantec\123510575\gis\workingfiles\123510575_Fig A-1_ImpactArea_SamplingAreaSamplingLocations.mxd



Beach Seine Location
Sediment Quality Sample Station
Water Quality Sample Site
Bathymetric Profile
Gill Net Set
Gill Net Set (approx. location)
Elevation Contour
Sampling Area
Waterbody
Land

MARINE EFFECTS ASSESSMENT OF THE MELIADINE GOLD PROJECT - RANKIN INLET, NU

REFERENCE AREA 1 SAMPLING AREA AND SAMPLING LOCATIONS

Sources:

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

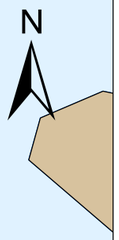
DATE: 16-NOV-11	PROJECTION: UTM 15	DRAWN BY: N. PUREWAL
FIGURE ID: 123510575	DATUM: NAD 83	CHECKED BY: C. SIBBALD

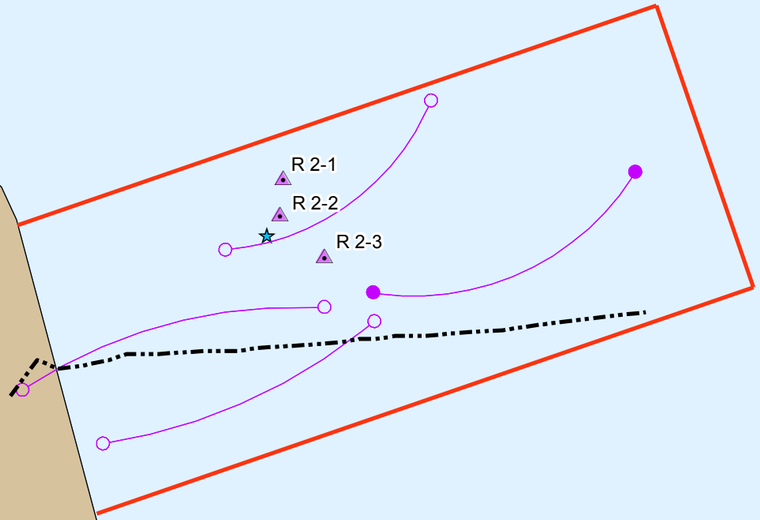
PREPARED BY:
NUNAMI STANTEC

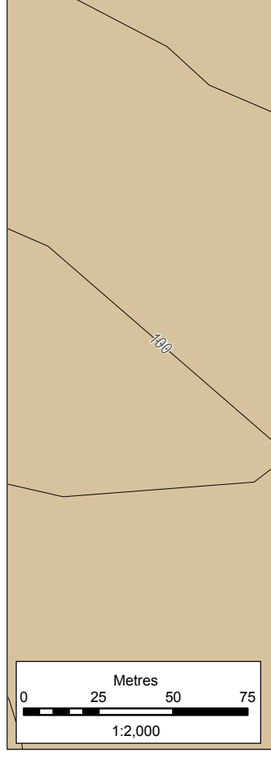
PREPARED FOR:
AGNICO-EAGLE MINES LTD.

FIGURE NO:
A-2

Path: R:\2011\Stantec\123510575\gis\working\123510575 Fig A-2_ReferenceArea1_SamplingAreas&SamplingLocations.mxd







Beach Seine Location
Sediment Quality Sample Station
Water Quality Sample Site
Bathymetric Profile
Gill Net Set
Gill Net Set (approx. location)
Elevation Contour
Sampling Area
Waterbody
Land

MARINE EFFECTS ASSESSMENT OF THE MELIADINE GOLD PROJECT - RANKIN INLET, NU

REFERENCE AREA 2 SAMPLING AREA AND SAMPLING LOCATIONS

Sources:

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

DATE: 16-NOV-11	PROJECTION: UTM 15	DRAWN BY: N. PUREWAL
FIGURE ID: 123510575	DATUM: NAD 83	CHECKED BY: C. SIBBALD

PREPARED BY:
NUNAMI STANTEC

PREPARED FOR:
AGNICO-EAGLE MINES LTD.

FIGURE NO:
A-3

Path: R:\2011\Stantec\123510575\gis\working\123510575 Fig A-3_ReferenceArea2_SamplingArea&SamplingLocations.mxd

NUNAMI STANTEC

APPENDIX B

Water and Sediment Chemistry Data

Table B1: Surface Water *In situ* Water Quality at Itivia Harbour (I1) and Reference Areas (R1 and R2)

Area	Date	Time	UTM (Zone 15V)		Tidal Current	Tide Level (m)	Total Depth (m)	Corrected Total Depth (m)	Depth (m)	Temperature (°C)	pH	Conductivity (µS/cm)	D.O. (%)	D.O. (mg/L)	ORP (mV)	Salinity (ppt)	Comments
			Easting	Northing													
I1	21-Aug-11	17:05	546209	6963411	Flood	1.53	4.75	3.22	1.0	8.63	8.10	45627	115.6	11.15	158.0	29.31	▪ Total depth with depth sounder was 5.2 m ▪ Tide was flooding (5:05 pm) ▪ Sampled WQ at 2.5 m ▪ Secchi depth was 3.75 m ▪ Zooplankton volume collected was 250 mL
									2.0	8.56	8.10	45647	115.6	11.17	157.6	29.31	
									3.0	8.52	8.10	45643	115.4	11.16	157.2	29.32	
									4.0	8.48	8.10	45669	115.4	11.18	157.0	29.33	
									4.5	8.47	8.10	45663	115.5	11.18	156.2	29.32	
R1	21-Aug-11	16:00	545284	6963806	Low Slack	1.30	13.3	12.00	1.0	8.50	8.08	45695	113.6	11.00	163.3	29.35	▪ Total depth with depth sounder was 13.4 m ▪ Tide was low slack (4:00 pm) ▪ Sampled WQ at 6.5 m ▪ Secchi depth was 4.5 m ▪ Zooplankton volume collected was 250 mL
									2.0	8.49	8.08	45664	114.4	11.07	162.7	29.32	
									3.0	8.49	8.08	45674	114.4	11.07	162.2	29.34	
									4.0	8.48	8.08	45685	114.5	11.07	161.9	29.34	
									5.0	8.49	8.08	45677	114.4	11.07	161.8	29.34	
									6.0	8.48	8.08	45671	114.3	11.06	161.5	29.33	
									7.0	8.43	8.08	45691	114.2	11.07	161.2	29.34	
									8.0	8.18	8.08	45742	114.0	11.11	161.4	29.36	
									9.0	8.13	8.08	45758	114.0	11.12	161.2	29.36	
									10.0	8.06	8.08	45763	113.9	11.13	161.1	29.36	
									11.0	7.99	8.07	45785	113.6	11.12	161.1	29.37	
									12.0	7.93	8.08	45796	113.5	11.12	161.1	29.37	
									13.0	7.93	8.07	45815	113.3	11.10	161.0	29.38	
R2	21-Aug-11	14:25	544709	6962663	Ebb	1.63	9.6	7.97	1.0	9.45	8.05	45521	114.3	10.84	191.3	29.29	▪ Total depth with depth sounder varied with waves between 8 to 11 m ▪ Tide was ebbing (2:25 pm) ▪ Sampled WQ at 5.0 m ▪ Secchi depth was 3.6 m ▪ Zooplankton volume collected was 300 mL
									2.0	9.44	8.06	45537	114.5	10.85	188.8	29.30	
									3.0	9.42	8.06	45532	114.3	10.84	187.0	29.30	
									4.0	9.43	8.05	45539	114.0	10.81	185.3	29.30	
									5.0	9.40	8.07	45545	113.8	10.79	184.0	29.30	
									6.0	9.39	8.07	45540	113.6	10.78	182.6	29.30	
									7.0	9.40	8.07	45541	113.5	10.77	181.8	29.30	
									8.0	9.31	8.07	45551	113.4	10.77	181.1	29.30	
									9.0	9.30	8.07	45545	113.7	10.83	179.8	29.30	
									10.0	9.07	8.07	45560	113.5	10.88	179.0	29.30	

Table B2: Baseline Marine Water Chemistry at Itivia Harbour and Reference Areas

Parameter	Units	D.L.[a]	CCME PMAL[b]	Itivia Harbour			Reference 1	Reference 2	Field Blank	Travel Blank
				I1	Replicate	RPD[c]	R1	R2		
Physicals										
Conductivity	µmhos/cm	20	-	>10,000	>10,000	-	>10,000	>10,000	<20	<20
Hardness (as $CaCO_3$)	mg/L	8.6	-	6590	6420	2.6	6360	6400	<0.50	<0.50
pH	pH units	0.10	7.00 - 8.70	7.35	7.57	2.9	7.48	7.56	5.75	5.74
Total Suspended Solids	mg/L	5.0	-	6.0	6.0	-	10.0	<5.0	<5.0	<5.0
Total Dissolved Solids	mg/L	5.0	-	34300	33600	2.1	34200	34300	<5.0	<5.0
Turbidity	NTU	0.10	-	0.27	0.21	-	0.11	0.13	0.11	<0.10
Anions										
Alkalinity, Total (as $CaCO_3$)	mg/L	20	-	142	144	1.4	143	143	<20	<20
Bicarbonate (HCO_3)	mg/L	24	-	174	175	0.6	175	175	<24	<24
Carbonate (CO_3)	mg/L	12	-	<12	<12	-	<12	<12	<12	<12
Chloride	mg/L	25	-	20000	16700	18.0	20100	20300	<0.50	<0.50
Fluoride	mg/L	1.0	-	<1.0	<1.0	-	1.2	<1.0	<0.020	<0.020
Hydroxide (OH)	mg/L	6.8	-	<6.8	<6.8	-	<6.8	<6.8	<6.8	<6.8
Sulfate	mg/L	25	-	2860	2360	19.2	2870	2890	<0.50	<0.50
Nutrients										
Ammonia, Total (as N)	mg/L	0.010	-	0.023	0.028	-	0.026	0.024	<0.010	<0.010
Nitrate-N	mg/L	2.5	3.6	<2.5	<2.5	-	<2.5	<2.5	<0.050	<0.050
Nitrite-N	mg/L	2.5	-	<2.5	<2.5	-	<2.5	<2.5	<0.050	<0.050
Total Kjeldahl Nitrogen	mg/L	0.20	-	<0.20	<2	-	<2	<2	<0.20	<0.20
Organic/Inorganic Carbon										
Total Organic Carbon	mg/L	1.0	-	4.8	3.3	-	3.6	3.3	<1.0	<1.0
Total Metals										
Aluminum (Al)-Total	mg/L	0.30	-	<0.30	<0.30	-	<0.30	<0.30	<0.0030	<0.0030
Antimony (Sb)-Total	mg/L	0.0010	-	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.000010	<0.000010
Arsenic (As)-Total	mg/L	0.0050	0.0125	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.000050	<0.000050
Barium (Ba)-Total	mg/L	0.010	-	<0.010	<0.010	-	<0.010	<0.010	<0.00010	<0.00010
Beryllium (Be)-Total	mg/L	0.00050	-	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.0000050	<0.0000050
Bismuth (Bi)-Total	mg/L	0.0050	-	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.000050	<0.000050
Boron (B)-Total	mg/L	0.50	-	4.49	4.88	8.3	4.79	4.66	0.0072	<0.0050
Cadmium (Cd)-Total	mg/L	0.00050	0.00012	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.0000050	<0.0000050
Calcium (Ca)-Total	mg/L	1.0	-	411	401	2.5	399	402	<0.050	<0.050
Cesium (Cs)-Total	mg/L	0.00050	-	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.0000050	<0.0000050
Chromium (Cr)-Total	mg/L	0.050	0.056	<0.050	<0.050	-	<0.050	<0.050	<0.00050	<0.00050

Parameter	Units	D.L.[a]	CCME PMAL[b]	Itivia Harbour			Reference 1	Reference 2	Field Blank	Travel Blank
				I1	Replicate	RPD[c]	R1	R2		
Cobalt (Co)-Total	mg/L	0.0050	-	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.000050	<0.000050
Copper (Cu)-Total	mg/L	0.050	-	<0.050	<0.050	-	<0.050	<0.050	<0.00050	<0.00050
Gallium (Ga)-Total	mg/L	0.0050	-	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.000050	<0.000050
Iron (Fe)-Total	mg/L	0.60	-	<0.60	<0.60	-	<0.60	<0.60	<0.030	<0.030
Lead (Pb)-Total	mg/L	0.0050	-	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.000050	<0.000050
Lithium (Li)-Total	mg/L	0.020	-	0.167	0.170	1.8	0.164	0.167	<0.00020	<0.00020
Magnesium (Mg)-Total	mg/L	2.0	-	1350	1310	3.0	1300	1310	<0.10	<0.10
Manganese (Mn)-Total	mg/L	0.020	-	<0.020	<0.020	-	<0.020	<0.020	<0.00020	<0.00020
Mercury (Hg)-Total	mg/L	0.000050	0.000016	*<0.000050*	*<0.000050*	-	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*
Molybdenum (Mo)-Total	mg/L	0.0050	-	0.0108	0.0108	-	0.0109	0.0112	<0.000050	<0.000050
Nickel (Ni)-Total	mg/L	0.020	-	<0.020	<0.020	-	<0.020	<0.020	<0.00020	<0.00020
Phosphorus (P)-Total	mg/L	6.0	-	<6.0	<6.0	-	<6.0	<6.0	<0.30	<0.30
Potassium (K)-Total	mg/L	40	-	398	393	1.3	388	394	<2.0	<2.0
Rhenium (Re)-Total	mg/L	0.00050	-	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.0000050	<0.0000050
Rubidium (Rb)-Total	mg/L	0.0020	-	0.112	0.115	2.6	0.113	0.110	<0.000020	<0.000020
Selenium (Se)-Total	mg/L	0.020	-	<0.020	<0.020	-	<0.020	<0.020	<0.00020	<0.00020
Silicon (Si)-Total	mg/L	1.0	-	<1.0	<1.0	-	<1.0	<1.0	<0.050	<0.050
Silver (Ag)-Total	mg/L	0.00050	-	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.0000050	0.0000103
Sodium (Na)-Total	mg/L	40	-	11000	10800	1.8	10800	10800	<2.0	<2.0
Strontium (Sr)-Total	mg/L	0.0050	-	7.29	7.17	1.7	7.27	7.06	<0.000050	<0.000050
Tellurium (Te)-Total	mg/L	0.0010	-	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.000010	<0.000010
Thallium (Tl)-Total	mg/L	0.00020	-	<0.00020	<0.00020	-	<0.00020	<0.00020	<0.0000020	<0.0000020
Thorium (Th)-Total	mg/L	0.00050	-	<0.00050	<0.00050	-	<0.00050	<0.00050	0.0000130	<0.0000050
Tin (Sn)-Total	mg/L	0.020	-	<0.020	<0.020	-	<0.020	<0.020	<0.00020	<0.00020
Titanium (Ti)-Total	mg/L	0.020	-	<0.020	<0.020	-	<0.020	<0.020	<0.00020	<0.00020
Tungsten (W)-Total	mg/L	0.0010	-	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.000010	<0.000010
Uranium (U)-Total	mg/L	0.00020	-	0.00319	0.00306	4.2	0.00311	0.00308	<0.0000020	<0.0000020
Vanadium (V)-Total	mg/L	0.0050	-	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.000050	<0.000050
Yttrium (Y)-Total	mg/L	0.00050	-	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.0000050	<0.0000050
Zinc (Zn)-Total	mg/L	0.30		<0.30	<0.30	-	<0.30	<0.30	0.0030	<0.0030
Zirconium (Zr)-Total	mg/L	0.0050	-	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.000050	<0.000050

NOTES:
[a] D.L. = Detection Limit
[b] CCME PMAL = Canadian Council of Ministers of the Environmental Guidelines for the Protection of Marine Aquatic Life (CCME 2007)
[c] RPD = relative percent difference, when results are greater than 5 times the detection limit
[d] ** = detection limit varied between samples
[e] **Bolded** result implies a guideline exceedance

Table B3: Baseline Marine Sediment Chemistry at Itivia Harbour and Reference Areas

Parameter	Units	D.L.[a]	CCME SQG[b]		Itivia Harbour (I1)						Reference 1 (R1)						Reference 2 (R2)					
					19-Aug-11						20-Aug-11						20-Aug-11					
			ISQG[c]	PEL[d]	Replicate 1	Replicate 2	Replicate 3	Mean	SD[e]	CV[f]	Replicate 1	Replicate 2	Replicate 3	Mean	SD[e]	CV[f]	Replicate 1	Replicate 2	Replicate 3	Mean	SD[e]	CV[f]
Organic and Inorganic Carbon																						
Inorganic Carbon	%	0.10	-	-	0.21	0.20	0.27	0.23	0.04	17	0.21	0.26	0.19	0.22	0.04	16	0.20	0.26	0.20	0.22	0.03	16
Total Organic Carbon	%	0.10	-	-	0.65	1.03	0.57	0.75	0.25	33	0.69	0.76	0.60	0.68	0.08	12	0.62	1.14	1.22	0.99	0.33	33
Total Carbon (by combustion)	%	0.1	-	-	0.9	1.2	0.8	1.0	0.21	22	0.9	1.0	0.8	0.9	0.10	11	0.8	1.4	1.4	1.2	0.35	29
$CaCO_3$ Equivalent	%	0.70	-	-	1.78	1.67	2.22	1.89	0.29	15	1.79	2.16	1.60	1.85	0.28	15	1.65	2.19	1.69	1.84	0.30	16
Nutrients																						
Total Kjeldahl Nitrogen	%	0.020	-	-	0.124	0.156	0.106	0.13	0.03	20	0.118	0.139	0.101	0.12	0.02	16	0.113	0.164	0.183	0.15	0.04	24
Total Phosphorus	mg/kg	50	-	-	745	778	801	775	28.15	4	823	892	835	850	36.86	4	768	840	787	798	37.31	5
Particle Size																						
% Sand (2.0 mm – 0.05 mm)	%	0.10	-	-	25.7	30.4	47.4	34.5	11.42	33	24.2	21.8	21.0	22.3	1.67	7	31.5	29.0	37.4	32.6	4.31	13
% Silt (0.05 mm – 2 µm)	%	0.10	-	-	69.4	64.3	49.1	60.9	10.56	17	71.2	72.6	74.5	72.8	1.66	2	64.2	64.8	57.0	62.0	4.34	7
% Clay (<2 µm)	%	0.10	-	-	4.98	5.28	3.54	4.60	0.93	20	4.59	5.57	4.5	4.89	0.59	12	4.28	6.17	5.63	5.36	0.97	18
Texture	%	-	-	-	Silt loam	Silt loam	Silt loam / Sandy loam	-	-	-	Silt loam	Silt loam	Silt loam	-	-	-	Silt loam	Silt loam	Silt loam	-	-	-
Metals																						
Aluminum (Al)	mg/kg	5.0	-	-	11600	13700	11900	12400	1135.78	9	12900	15200	11300	13133	1960.44	15	12500	15300	14300	14033	1418.92	10
Antimony (Sb)	mg/kg	0.10	-	-	0.12	0.13	0.10	0.12	0.02	13	0.14	0.18	0.12	0.15	0.03	21	0.13	0.19	0.18	0.17	0.03	19
Arsenic (As)	mg/kg	0.10	7.24	41.6	5.73	6.52	6.20	6.15	0.40	6	5.87	7.21	5.66	6.25	0.84	13	5.93	7.10	6.87	6.63	0.62	9
Barium (Ba)	mg/kg	0.50	-	-	68.7	70.5	64.4	67.9	3.13	5	64.1	75.5	57.8	65.8	8.97	14	57.6	75.4	74.3	69.1	9.97	14
Beryllium (Be)	mg/kg	0.10	-	-	0.33	0.3	0.29	0.31	0.02	7	0.21	0.4	0.17	0.26	0.12	47	0.2	0.32	0.41	0.31	0.11	34
Bismuth (Bi)	mg/kg	0.020	-	-	0.126	0.143	0.128	0.132	0.01	7	0.135	0.147	0.112	0.131	0.02	14	0.117	0.166	0.153	0.145	0.03	17
Boron (B)	mg/kg	1.0	-	-	23.8	29.6	22.9	25.4	3.64	14	25.4	29.7	22.4	25.8	3.67	14	23.5	36.7	36.9	32.4	7.68	24
Cadmium (Cd)	mg/kg	0.020	0.7	4.2	0.032	0.075	0.038	0.048	0.02	48	0.035	0.050	0.028	0.038	0.01	30	0.038	0.070	0.094	0.067	0.03	42
Calcium (Ca)	mg/kg	100	-	-	6680	6970	7520	7057	426.65	6	7270	8260	7120	7550	619.44	8	7100	8350	7250	7567	682.52	9
Cesium (Cs)	mg/kg	0.020	-	-	1.33	1.53	1.29	1.38	0.13	9	1.41	1.69	1.24	1.45	0.23	16	1.26	1.71	1.69	1.55	0.25	16
Chromium (Cr)	mg/kg	1.0	52.3	160	**52.4**	**62.6**	**52.4**	**55.8**	5.89	11	**55.6**	**66.9**	**52.5**	**58.3**	7.58	13	**53.2**	**64.3**	**63.2**	**60.2**	6.12	10
Cobalt (Co)	mg/kg	0.020	-	-	6.00	7.03	6.01	6.35	0.59	9	6.41	7.72	5.97	6.70	0.91	14	6.25	7.68	7.54	7.16	0.79	11
Copper (Cu)	mg/kg	1.0	18.7	108	15.8	**18.7**	17.9	17.5	1.50	9	14.5	17.4	12.7	14.9	2.37	16	13.4	17.0	17.1	15.8	2.11	13
Iron (Fe)	mg/kg	25	-	-	18400	20900	19000	19433	1305.12	7	20000	24200	18900	21033	2797.02	13	19300	23800	22700	21933	2345.92	11
Lead (Pb)	mg/kg	0.20	30.2	112	4.71	5.44	5.76	5.30	0.54	10	4.88	5.66	4.42	4.99	0.63	13	4.41	5.9	5.63	5.31	0.79	15
Magnesium (Mg)	mg/kg	10	-	-	9840	11200	9980	10340	748.06	7	11200	13000	10500	11567	1289.70	11	10300	12800	12600	11900	1389.24	12
Manganese (Mn)	mg/kg	0.50	-	-	201	229	209	213	14.42	7	216	257	206	226	27.02	12	212	253	248	238	22.37	9
Mercury (Hg)	mg/kg	0.050	0.13	0.70	<0.050	<0.050	<0.050	0.025	0.000	0	<0.050	<0.050	<0.050	0.025	0.000	0	<0.050	<0.050	<0.050	0.025	0.000	0
Molybdenum (Mo)	mg/kg	0.020	-	-	1.03	2.17	1.12	1.44	0.63	44	1.07	1.69	0.942	1.23	0.40	32	1.12	2.24	3.32	2.23	1.10	49
Nickel (Ni)	mg/kg	0.50	-	-	22.1	27.6	21.4	23.7	3.40	14	23.0	28.3	21.6	24.3	3.53	15	21.3	27.0	26.7	25.0	3.21	13
Phosphorus (P)	mg/kg	100	-	-	930	910	1000	947	47.26	5	980	1110	1000	1030	70.00	7	1000	990	970	987	15.28	2

Parameter	Units	D.L.[a]	CCME SQG[b]		Itivia Harbour (I1)						Reference 1 (R1)						Reference 2 (R2)					
					19-Aug-11						20-Aug-11						20-Aug-11					
			ISQG[c]	PEL[d]	Replicate 1	Replicate 2	Replicate 3	Mean	SD[e]	CV[f]	Replicate 1	Replicate 2	Replicate 3	Mean	SD[e]	CV[f]	Replicate 1	Replicate 2	Replicate 3	Mean	SD[e]	CV[f]
Phosphorus, Total	mg/kg	50	-	-	745	778	801	775	28.15	4	823	892	835	850	36.86	4	768	840	787	798	37.31	5
Potassium (K)	mg/kg	25	-	-	3180	3770	3140	3363	352.75	10	3400	4160	3060	3540	563.21	16	3180	4270	4290	3913	635.16	16
Rubidium (Rb)	mg/kg	0.020	-	-	19.4	23.5	18.7	20.5	2.59	13	20.9	25.5	18.0	21.5	3.78	18	19.5	26.7	26.0	24.1	3.97	16
Selenium (Se)	mg/kg	0.50	-	-	0.76	0.76	0.55	0.69	0.12	18	0.65	0.79	<0.50	0.56	0.28	50	0.67	0.9	0.97	0.85	0.16	19
Silver (Ag)	mg/kg	0.10	-	-	<0.10	0.10	<0.10	0.07	0.03	43	<0.10	<0.10	<0.10	0.05	0.00	0	<0.10	0.11	0.11	0.09	0.03	38
Sodium (Na)	mg/kg	10	-	-	8080	10500	7720	8767	1511.86	17	8770	10400	7980	9050	1234.06	14	8270	11100	11200	10190	1663.52	16
Strontium (Sr)	mg/kg	0.10	-	-	33.9	41.3	35.6	36.9	3.88	10	35.1	41.3	33.3	36.6	4.20	11	36.3	45.8	43.0	41.7	4.88	12
Tellurium (Te)	mg/kg	0.10	-	-	<0.10	<0.10	<0.10	0.05	0.00	0	<0.10	<0.10	<0.10	0.05	0.00	0	<0.10	<0.10	<0.10	0.05	0.00	0
Thallium (Tl)	mg/kg	0.10	-	-	0.11	0.14	0.12	0.12	0.02	12	0.11	0.13	0.1	0.11	0.02	13	0.12	0.15	0.15	0.14	0.02	12
Tin (Sn)	mg/kg	5.0	-	-	6.2	<5.0	<5.0	3.7	2.14	57	<5.0	<5.0	<5.0	2.5	0.00	0	<5.0	<5.0	<5.0	2.5	0.00	0
Titanium (Ti)	mg/kg	0.50	-	-	788	945	865	866	78.50	9	849	1060	851	920	121.25	13	919	1030	981	977	55.63	6
Tungsten (W)	mg/kg	0.050	-	-	0.132	0.256	0.167	0.185	0.06	35	0.220	0.153	0.163	0.179	0.04	20	0.143	0.193	0.165	0.167	0.03	15
Uranium (U)	mg/kg	0.020	-	-	0.988	1.390	0.991	1.123	0.23	21	1.050	1.380	0.977	1.136	0.21	19	1.060	1.540	1.740	1.447	0.35	24
Vanadium (V)	mg/kg	0.50	-	-	42.5	48.9	43.6	45.0	3.42	8	46.3	57.5	42.9	48.9	7.64	16	44.0	58.0	55.2	52.4	7.41	14
Zinc (Zn)	mg/kg	10	124	271	35	43	34	37	4.93	13	38	45	35	39	5.13	13	36	45	74	52	19.86	38
Zirconium (Zr)	mg/kg	0.10	-	-	6.85	8.18	6.84	7.29	0.77	11	6.18	7.96	6.40	6.85	0.97	14	6.82	8.09	7.67	7.53	0.65	9

NOTES:
[a] D.L. = Detection Limit
[b] CCME SQG = CCME Marine Sediment Quality Guidelines for the Protection of Aquatic Life (CCME 2002)
[c] ISQG = Interim Sediment Quality Guidelines
[d] PEL = Probable Effects Level
[e] SD = Standard Deviation
[f] CV = Coefficient of Variation
[g] **Bolded** result implies a ISQG exceedance
[h] Replicate results were precision threshold (CV >20%) was exceeded (when all results greater than five (5) times the detection limit)

Stantec Consulting Ltd (Burnaby)
ATTN: SANDRA WEBSTER
5th Floor,4370 Dominion Street
Bunaby BC V5G 4L7

Date Received: 19-MAR-12
Report Date: 27-MAR-12 15:52 (MT)
Version: FINAL

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L1125163

Project P.O. #: 123510575 - 205
Job Reference: 123510575 - 205
C of C Numbers:
Legal Site Desc:

Paul Nicolas
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1125163-1 SEA WATER 15-MAR-12 15:30 I1	L1125163-2 SEA WATER 15-MAR-12 16:00 R1	L1125163-3 SEA WATER 15-MAR-12 16:45 R2	L1125163-4 SEA WATER 15-MAR-12 15:30 I1 DUPLICATE	L1125163-5 SEA WATER 15-MAR-12 17:00 BLANK
WATER						
Physical Tests	Conductivity (umhos/cm)	>10,000	>10,000	>10,000	>10,000	<20
						<1.0
	Hardness (as CaCO3) (mg/L)	6590	6360	6400	6420	<0.50
	pH (pH units)	7.35	7.48	7.56	7.57	5.75
	Total Suspended Solids (mg/L)	6.0	10.0	<5.0	6.0	<5.0
	Total Dissolved Solids (mg/L)	34300	34200	34300	33600	<5.0
	Turbidity (NTU)	0.27	0.11	0.13	0.21	0.11
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	142	143	143	144	<20
						1.7
	Ammonia, Total (as N) (mg/L)	0.023	0.026	0.024	0.028	<0.010
	Bicarbonate (HCO3) (mg/L)	174	175	175	175	<24
						2.1
	Carbonate (CO3) (mg/L)	<12	<12	<12	<12	<12
						<0.60
	Chloride (mg/L)	20000	20100	20300	16700	<0.50
	Fluoride (mg/L)	<1.0	1.2	<1.0	<1.0	<0.020
	Hydroxide (OH) (mg/L)	<6.8	<6.8	<6.8	<6.8	<6.8
						<0.34
	Nitrate-N (mg/L)	<2.5	<2.5	<2.5	<2.5	<0.050
	Nitrite-N (mg/L)	<2.5	<2.5	<2.5	<2.5	<0.050
	Total Kjeldahl Nitrogen (mg/L)	<0.20	<2 DLM	<2 DLM	<2 DLM	<0.20
	Sulfate (mg/L)	2860	2870	2890	2360	<0.50
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	4.8	3.6	3.3	3.3	<1.0
Total Metals	Aluminum (Al)-Total (mg/L)	<0.30 DLA	<0.30 DLA	<0.30 DLA	<0.30 DLA	<0.0030
	Antimony (Sb)-Total (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.0010 DLA	<0.0010 DLA	<0.000010
	Arsenic (As)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.0050 DLA	<0.0050 DLA	<0.000050
	Barium (Ba)-Total (mg/L)	<0.010 DLA	<0.010 DLA	<0.010 DLA	<0.010 DLA	<0.00010
	Beryllium (Be)-Total (mg/L)	<0.00050 DLA	<0.00050 DLA	<0.00050 DLA	<0.00050 DLA	<0.0000050
	Bismuth (Bi)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.0050 DLA	<0.0050 DLA	<0.000050
	Boron (B)-Total (mg/L)	4.49	4.79	4.66	4.88	0.0072
	Cadmium (Cd)-Total (mg/L)	<0.00050 DLA	<0.00050 DLA	<0.00050 DLA	<0.00050 DLA	<0.0000050
	Calcium (Ca)-Total (mg/L)	411	399	402	401	<0.050
	Cesium (Cs)-Total (mg/L)	<0.00050 DLA	<0.00050 DLA	<0.00050 DLA	<0.00050 DLA	<0.0000050
	Chromium (Cr)-Total (mg/L)	<0.050 DLA	<0.050 DLA	<0.050 DLA	<0.050 DLA	<0.00050
	Cobalt (Co)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.0050 DLA	<0.0050 DLA	<0.000050
	Copper (Cu)-Total (mg/L)	<0.050 DLA	<0.050 DLA	<0.050 DLA	<0.050 DLA	<0.00050
	Gallium (Ga)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.0050 DLA	<0.0050 DLA	<0.000050

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1125163-6
	Description	SEA WATER
	Sampled Date	15-MAR-12
	Sampled Time	
	Client ID	TRAVEL BLANK
Grouping	**Analyte**	
WATER		
Physical Tests	Conductivity (umhos/cm)	<1.0
		<20
	Hardness (as CaCO3) (mg/L)	<0.50
	pH (pH units)	5.74
	Total Suspended Solids (mg/L)	<5.0
	Total Dissolved Solids (mg/L)	<5.0
	Turbidity (NTU)	<0.10
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	<20
		1.7
	Ammonia, Total (as N) (mg/L)	<0.010
	Bicarbonate (HCO3) (mg/L)	<24
		2.1
	Carbonate (CO3) (mg/L)	<0.60
		<12
	Chloride (mg/L)	<0.50
	Fluoride (mg/L)	<0.020
	Hydroxide (OH) (mg/L)	<6.8
		<0.34
	Nitrate-N (mg/L)	<0.050
	Nitrite-N (mg/L)	<0.050
	Total Kjeldahl Nitrogen (mg/L)	<0.20
	Sulfate (mg/L)	<0.50
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	<1.0
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030
	Antimony (Sb)-Total (mg/L)	<0.000010
	Arsenic (As)-Total (mg/L)	<0.000050
	Barium (Ba)-Total (mg/L)	<0.00010
	Beryllium (Be)-Total (mg/L)	<0.0000050
	Bismuth (Bi)-Total (mg/L)	<0.000050
	Boron (B)-Total (mg/L)	<0.0050
	Cadmium (Cd)-Total (mg/L)	<0.0000050
	Calcium (Ca)-Total (mg/L)	<0.050
	Cesium (Cs)-Total (mg/L)	<0.0000050
	Chromium (Cr)-Total (mg/L)	<0.00050
	Cobalt (Co)-Total (mg/L)	<0.000050
	Copper (Cu)-Total (mg/L)	<0.00050
	Gallium (Ga)-Total (mg/L)	<0.000050

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1125163-1 SEA WATER 15-MAR-12 15:30 I1	L1125163-2 SEA WATER 15-MAR-12 16:00 R1	L1125163-3 SEA WATER 15-MAR-12 16:45 R2	L1125163-4 SEA WATER 15-MAR-12 15:30 I1 DUPLICATE	L1125163-5 SEA WATER 15-MAR-12 17:00 BLANK
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	<0.60 DLA	<0.60 DLA	<0.60 DLA	<0.60 DLA	<0.030
	Lead (Pb)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.0050 DLA	<0.0050 DLA	<0.000050
	Lithium (Li)-Total (mg/L)	0.167	0.164	0.167	0.170	<0.00020
	Magnesium (Mg)-Total (mg/L)	1350	1300	1310	1310	<0.10
	Manganese (Mn)-Total (mg/L)	<0.020 DLA	<0.020 DLA	<0.020 DLA	<0.020 DLA	<0.00020
	Mercury (Hg)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Molybdenum (Mo)-Total (mg/L)	0.0108	0.0109	0.0112	0.0108	<0.000050
	Nickel (Ni)-Total (mg/L)	<0.020 DLA	<0.020 DLA	<0.020 DLA	<0.020 DLA	<0.00020
	Phosphorus (P)-Total (mg/L)	<6.0 DLA	<6.0 DLA	<6.0 DLA	<6.0 DLA	<0.30
	Potassium (K)-Total (mg/L)	398	388	394	393	<2.0
	Rhenium (Re)-Total (mg/L)	<0.00050 DLA	<0.00050 DLA	<0.00050 DLA	<0.00050 DLA	<0.0000050
	Rubidium (Rb)-Total (mg/L)	0.112	0.113	0.110	0.115	<0.000020
	Selenium (Se)-Total (mg/L)	<0.020 DLA	<0.020 DLA	<0.020 DLA	<0.020 DLA	<0.00020
	Silicon (Si)-Total (mg/L)	<1.0 DLA	<1.0 DLA	<1.0 DLA	<1.0 DLA	<0.050
	Silver (Ag)-Total (mg/L)	<0.00050 DLA	<0.00050 DLA	<0.00050 DLA	<0.00050 DLA	<0.0000050
	Sodium (Na)-Total (mg/L)	11000	10800	10800	10800	<2.0
	Strontium (Sr)-Total (mg/L)	7.29	7.27	7.06	7.17	<0.000050
	Tellurium (Te)-Total (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.0010 DLA	<0.0010 DLA	<0.000010
	Thallium (Tl)-Total (mg/L)	<0.00020 DLA	<0.00020 DLA	<0.00020 DLA	<0.00020 DLA	<0.0000020
	Thorium (Th)-Total (mg/L)	<0.00050 DLA	<0.00050 DLA	<0.00050 DLA	<0.00050 DLA	0.0000130
	Tin (Sn)-Total (mg/L)	<0.020 DLA	<0.020 DLA	<0.020 DLA	<0.020 DLA	<0.00020
	Titanium (Ti)-Total (mg/L)	<0.020 DLA	<0.020 DLA	<0.020 DLA	<0.020 DLA	<0.00020
	Tungsten (W)-Total (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.0010 DLA	<0.0010 DLA	<0.000010
	Uranium (U)-Total (mg/L)	0.00319	0.00311	0.00308	0.00306	<0.0000020
	Vanadium (V)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.0050 DLA	<0.0050 DLA	<0.000050
	Yttrium (Y)-Total (mg/L)	<0.00050 DLA	<0.00050 DLA	<0.00050 DLA	<0.00050 DLA	<0.0000050
	Zinc (Zn)-Total (mg/L)	<0.30 DLA	<0.30 DLA	<0.30 DLA	<0.30 DLA	0.0030
	Zirconium (Zr)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.0050 DLA	<0.0050 DLA	<0.000050

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1125163-6				
	Description	SEA WATER				
	Sampled Date	15-MAR-12				
	Sampled Time					
	Client ID	TRAVEL BLANK				
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	<0.030				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	<0.00020				
	Magnesium (Mg)-Total (mg/L)	<0.10				
	Manganese (Mn)-Total (mg/L)	<0.00020				
	Mercury (Hg)-Total (mg/L)	<0.000050				
	Molybdenum (Mo)-Total (mg/L)	<0.000050				
	Nickel (Ni)-Total (mg/L)	<0.00020				
	Phosphorus (P)-Total (mg/L)	<0.30				
	Potassium (K)-Total (mg/L)	<2.0				
	Rhenium (Re)-Total (mg/L)	<0.0000050				
	Rubidium (Rb)-Total (mg/L)	<0.000020				
	Selenium (Se)-Total (mg/L)	<0.00020				
	Silicon (Si)-Total (mg/L)	<0.050				
	Silver (Ag)-Total (mg/L)	0.0000103				
	Sodium (Na)-Total (mg/L)	<2.0				
	Strontium (Sr)-Total (mg/L)	<0.000050				
	Tellurium (Te)-Total (mg/L)	<0.000010				
	Thallium (Tl)-Total (mg/L)	<0.0000020				
	Thorium (Th)-Total (mg/L)	<0.0000050				
	Tin (Sn)-Total (mg/L)	<0.00020				
	Titanium (Ti)-Total (mg/L)	<0.00020				
	Tungsten (W)-Total (mg/L)	<0.000010				
	Uranium (U)-Total (mg/L)	<0.0000020				
	Vanadium (V)-Total (mg/L)	<0.000050				
	Yttrium (Y)-Total (mg/L)	<0.0000050				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.000050				

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

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments
L1125163-1	Water	Note: Conductivity is too high to provide an accurate result	
L1125163-2	Water	Note: Conductivity is too high to provide an accurate result	
L1125163-3	Water	Note: Conductivity is too high to provide an accurate result	
L1125163-4	Water	Note: Conductivity is too high to provide an accurate result	

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Ammonia, Total (as N)	DLA	L1125163-1, -2, -3, -4
Duplicate	Ammonia, Total (as N)	DLA	L1125163-5, -6
Duplicate	Ammonia, Total (as N)	DLA	L1125163-5, -6
Duplicate	Ammonia, Total (as N)	DLA	L1125163-5, -6
Method Blank	Thorium (Th)-Total	MB-LOR	L1125163-1, -2, -3, -4, -5
Matrix Spike	Total Kjeldahl Nitrogen	MS-B	L1125163-5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
MB-LOR	Method Blank exceeds ALS DQO. LORs adjusted for samples with positive hits below 5 times blank level. Please contact ALS if re-analysis is required.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-T-L-WP	Water	Alkalinity	APHA 2320B

Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. It is determined by titration with a standard solution of strong mineral acid to the successive HCO3- and H2CO3 endpoints indicated electrometrically.

ALK-TOT-WP	Water	Alkalinity	APHA 2320B

Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. It is determined by titration with a standard solution of strong mineral acid to the successive HCO3- and H2CO3 endpoints indicated electrometrically.

ANIONS5-IC-WP	Water	Anions scan (IC)	EPA 300.1 IC

Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.

C-TOT-ORG-WP	Water	Total Organic Carbon	APHA 5310 B-INSTRUMENTAL-WP

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

EC-L-WP	Water	Conductivity	APHA 2510B

Conductivity of an aqueous solution refers to its ability to carry an electric current. Conductance of a solution is measured between two spatially fixed and chemically inert electrodes.

EC-WP	Water	Conductivity	APHA 2510B

Conductivity of an aqueous solution refers to its ability to carry an electric current. Conductance of a solution is measured between two spatially fixed and chemically inert electrodes.

Reference Information

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-TOT-CVAFS-VA	Water	Total Mercury in Water by CVAFS	EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-T-L-HRMS-VA	Water	Total Metals in Water by HR-ICPMS	EPA 200.8

Trace metals in water are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The procedures may involve preliminary sample treatment by acid digestion modified from APHA Method 3030E.

MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

N-TOTKJ-WP	Water	Total Kjeldahl Nitrogen	Quickchem method 10-107-06-2-E Lachat

Samples are digested with a sulphuric acid solution, cooled, diluted with water, and analyzed for ammonia. Total Kjeldahl nitrogen is the sum of free-ammonia and organic nitrogen compounds which are converted to ammonium sulphate through this digestion process. Analysis is performed by Flow Injection
Analysis (FIA). The pH of the digested sample is raised to a known, basic pH by neutralization with a concentrated buffer solution. This neutralization converts the ammonium cation to ammonia. The ammonia produced is heated with saliclyate and hypochlorite to produce blue colour which is proportional to the ammonia concentration.

NH3-COL-WP	Water	Ammonia by colour	APHA 4500 NH3 F

Ammonia in water samples forms indophenol when reacted with hypochlorite and phenol. The intensity is amplified by the addition of sodium nitroprusside and measured colourmetrically.

PH-WP	Water	pH	APHA 4500H

The pH of a sample is the determination of the activity of the hydrogen ions by potentiometric measurement using a standard hydrogen electrode and a reference electrode.

SOLIDS-TDS-WP	Water	Total Dissolved Solids	APHA 2540C

The residue remaining in a prepared casserole after passing the sample through a 1.2 um Whatman GF/C glass microfibre filter and drying at 180 degrees C. Samples may be dried at 105 degrees C if the client specifically requests this drying temperature.

SOLIDS-TOTSUS-WP	Water	Total Suspended Solids	APHA 2540D

The residue retained by a prepared 1.5 um Whatman 934-AH glass microfibre filter dried at 105 degrees C.

TURBIDITY-WP	Water	Turbidity	APHA 2130B (modified)

Turbidity in aqueous matrices is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

L1125163-COFC

COC # 09 - 027785

L1125163

Page 1 of 1

Report To		Service Requested: (Rush subject to availability)
Company: Stantec Consulting Ltd	Standard: ✓ Other (specify):	✓ Regular (Standard Turnaround Times)
Contact: Sandra Webster	Select: PDF ✓ Excel ✓ Digital Fax	Priority, Date Req'd: (Surcharges apply)
Address: 4370 Dominion Street Burnaby, BC	Email 1: sandra.webster@stantec.com	Emergency (1 Business Day) - 100% Surcharge
Phone: 604-436-3014 Fax:	Email 2: carey.sibbald@stantec.com	For Emergency < 1 Day, ASAP or Weekend - Contact ALS

Invoice To	Client / Project Information
Same as Report ? (circle) Yes or No (if No, provide details)	Job #: 1235105575-205
Copy of Invoice with Report? (circle) Yes or No	PO / AFE: 1235105575-205
Company:	LSD:
Contact:	
Address:	Quote #:
Phone: Fax:	ALS Contact: Sampler: BT CP

Lab Work Order # (lab use only):

Analysis Request (Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH, EC, T-Alk, Hard.	TSS, TDS	Turbidity	TKN, NH3	NO3-N, NO2-N	TOC	Anion Scan	Met-T+DR+Hg-MS-VA	Hg-low-CVAFS-VA				Number of Containers
1	I1	03/15/12	15:30	Sea Water	X	X	X	X	X	X	X	X	X				5
2	R1	03/15/12	16:00	Sea Water	X	X	X	X	X	X	X	X	X				5
3	R2	03/15/12	16:45	Sea Water	X	X	X	X	X	X	X	X	X				5
4	I1 duplicate	03/15/12	15:30	Sea Water	X	X	X	X	X	X	X	X	X				5
5	Blank	03/15/12	17:00	Water	X	X	X	X	X	X	X	X	X				5
6	Travel Blank	03/15/12	-	TB	X	X	X	X	X	X	X	X	X				5

Special Instructions / Regulations / Hazardous Details

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.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
	03/16/12	10:00	ABM	17 Mar 12	06:25	4.8 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

APPENDIX C

Aquatic Biota Data

Table C1: Phytoplankton Taxonomy and Species Abundance

Phytoplankton	No. of Stations Taxa Identified	Project Footprint	Reference 1	Reference 2
		I1	R1	R2
		21-Aug-11	21-Aug-11	21-Aug-11
Phylum: Bacillariophycae (Diatoms)				
Order: Centrales				
Biddulphia sp. ?	2	<0.47		<0.47
Chaetoceros sp.	1		<0.47	
Coscinodiscus spp.	3	0.47	<0.47	<0.47
Thalassiosira sp.	1			0.94
UID[1]	3	<0.47	<0.47	0.47
Order: Pennales				
Achnanthes sp.	2	<0.47		<0.47
Amphora spp.	3	<0.47	<0.47	<0.47
Climacosphenia/Licmorpha sp.	3	<0.47	<0.47	<0.47
Cocconeis sp.	3	<0.47	<0.47	<0.47
Cymbella sp.	2	<0.47	<0.47	
Diatoma sp.?	2	<0.47		<0.47
Diploneis sp.	1			<0.47
Fragilaria sp.	2		<0.47	<0.47
Gyrosigma sp.	3	<0.47	<0.47	<0.47
Navicula spp.	3	0.94	<0.47	0.94
Nitzschia sp.	2	<0.47	<0.47	
Pleurosigma/Gyrosigma sp.	3	<0.47	<0.47	<0.47
Synedra spp.	3	<0.47	<0.47	<0.47
UID	3	0.94	<0.47	0.94
Phylum: Chlorophyta (Green Algae)				
Order: Chlorococcales				
Schroedera sp. ?	3	<0.47	0.94	<0.47
Order: Zygnematales				
Closterium sp. ?	3	<0.47	<0.47	<0.47
Mougeotia sp. ?	1	<0.47		

Phytoplankton	No. of Stations Taxa Identified	Project Footprint	Reference 1	Reference 2
		I1	R1	R2
		21-Aug-11	21-Aug-11	21-Aug-11
Phylum: Cryptophyta (Cryptophyte Algae)				
Order: Cryptomonadales				
Chroomonas acuta	1		<0.47	
Phylum: Cyanophyta (Blue-Green Algae)				
Order: Oscillatoriales				
Lyngbya sp.	2	<0.47		<0.47
Phylum: Pyrrhophyta (Dinoflagellates)				
Order: Dinokontae				
Dinophysis spp.	3	4.23	4.70	3.76
Diplopeltopsis minor ?	3	0.47	0.47	1.41
Gymnodinium spp.	3	2.35	1.88	1.41
Noctiluca spp.	3	1.88	<0.47	<0.47
Peridinium/Gonyaulax spp.	3	6.11	3.29	7.99
Prorocentrum sp. ?	3	1.88	1.88	0.94
UID	3	1.88	1.41	<0.47
Phylum: Ciliophora (Ciliates)				
Order: Tintinnida				
UID	3	0.47	1.88	1.88
Unidentified (UID)				
UID unicellular algae	2	<0.47	<0.47	
Total (cells/mL)	**-**	**24.68**	**20.68**	**25.62**

NOTES:
[1] UID = unidentified due to lack of size and/or missing morphological characters

Table C2: Zooplankton Taxonomy and Species Abundance

Zooplankton	Stage[1]	Project Footprint	Reference 1	Reference 2
		I1	R1	R2
		21-Aug-11	21-Aug-11	21-Aug-11
Phylum: Cnidaria				
Obelia sp.		2	3	
Cyanea caplillata			2	
Phylum: Rotifera				
Unidentified (Notommatidae?)		35,000	27,500	35,000
Trichocera sp.		20	20	10
Phylum: Annelida				
Class: Polychaeta	L	120	220	130
Family: Syllidae	juv	1		
Phylum: Arthropoda				
Class: Copepoda				
Order: Calanoida				
Unidentified Calanoida	nauplius	3,500	6,200	2,400
Family: Acartiidae				
Acartia clausi	M		1	1
Acartia clausi	F		1	
Acartia spp.	V	3		
Acartia spp.	IV	10	1	40
Acartia spp.	III	13	4	10
Acartia spp.	II	57	8	1
Acartia spp.	I	120	48	60
Family: Centropagidae				
Centropages abdominalis	M			2
Centropages abdominalis	F		2	
Centropages abdominalis	V	2	3	2
Centropages abdominalis	IV	6	19	6
Centropages abdominalis	III	9	47	30
Centropages abdominalis	II	26	90	70
Centropages abdominalis	I	50	140	90
Family: Pseudocalanidae				
Pseudocalanus minutus	M	1	2	
Pseudocalanus minutus	F	1	3	
Pseudocalanus minutus	V	8	9	2
Pseudocalanus minutus	IV	6	9	2
Pseudocalanus minutus	III	4	4	10

Zooplankton	Stage[1]	Project Footprint	Reference 1	Reference 2
		I1	R1	R2
		21-Aug-11	21-Aug-11	21-Aug-11
Pseudocalanus minutus	II	4	10	
Pseudocalanus minutus	I	3		
Family: Tortanidae				
Tortanus discaudatus	I	1		
Order: Harpacticoida				
Unidentified Harpacticoida	nauplius	1,100	400	40
Unidentified Harpacticoida	cop		20	
Family: Ectinosomidae				
Microsetella norvegica	F	24	37	9
Microsetella norvegica	cop	10	4	
Order: Cyclopoida				
Family: Oithonidae				
Oithona similis	M	8		
Oithona similis	F	27	1	3
Oithona similis	cop	280	110	110
Family: Oncaeidae				
Oncaea borealis	M	6	4	
Oncaea borealis	F		1	
Family: Ergasilidae	cop	3		
Order: Decapoda				
Infraorder: Brachyura	zoea		1	1
Phylum: Mollusa				
Class: Bivalvia	veliger	900	900	
Class: Gastropoda	veliger		10	
Phylum: Chaetognatha				
Sagitta elegans (accepted as *Parasagitta elegans*)		2		
Phylum: Chordata				
Class: Larvacea				
Fritillaria borealis		5		10
Total (organisms/L)	**-**	**165,328**	**143,336**	**126,797**

NOTES:

[1] Stage abbreviations: cop = copepodite (juvenile copepod)
F = female
M = male
juv = juvenile
L = larva (first juvenile of homometabolous insect

Table C3: Benthic Invertebrate Summary Statistics

Benthic Invertebrate[1]	No. Stations Reported at	Minimum Value	Maximum Value	Mean Value	Median	Standard Deviation	Standard Error
Phylum: Porifera	1	0.0	2.4	0.0	0.8	1.4	1.4
Phylum: Cnidaria							
Class: Hydrozoa							
Subclass: Hydroida Indeterminate (accepted as Hydroidolina)	1	0.0	4.0	0.0	1.3	2.3	2.3
Family: Bougainvilliidae	1	0.0	1.0	0.0	0.3	0.6	0.6
Family: Campanulariidae	2	0.0	7.4	4.0	3.8	3.7	2.6
Family: Tubulariidae	1	0.0	4.0	0.0	1.3	2.3	2.3
Phylum: Platyhelminthes	1	0.0	1.0	0.0	0.3	0.6	0.6
Phylum: Nemertea							
Phylum Nemertea Indeterminate	2	0.0	5.0	3.4	2.8	2.6	1.8
Subclass: Hoplonemertea	3	2.4	16.4	4.0	7.6	7.7	4.4
Family: Tetrastemmatidae	2	0.0	18.4	2.0	6.8	10.1	7.1
Phylum: Annelida							
Class: Polychaeta (Errantia)							
Family: Dorvilleidae	2	0.0	10.4	7.4	5.9	5.4	3.8
Family: Hesionidae	2	0.0	24.8	2.0	8.9	13.8	9.7
Family: Lumbrineridae	3	6.0	43.0	40.0	29.7	20.6	11.9
Family: Nephtyidae	3	298.0	884.0	314.4	498.8	333.7	192.7
Family: Pholoidae	3	71.0	403.2	264.6	246.3	166.9	96.3
Family: Phyllodocidae	3	21.0	55.4	33.6	36.7	17.4	10.1
Family: Polynoidae	2	0.0	4.0	1.0	1.7	2.1	1.5
Family: Syllidae	3	113.0	720.0	380.6	404.5	304.2	175.6
Family: Terebellidae	1	0.0	1.0	0.0	0.3	0.6	0.6
Class: Polychaeta (Sedentaria)							
Family: Ampharetidae	3	5.0	33.6	22.9	20.5	14.4	8.3
Family: Capitellidae	3	672.0	3656.0	3210.1	2512.7	1609.6	929.3
Family: Cirratulidae	3	186.4	401.0	262.1	283.2	108.8	62.8
Family: Cossuridae	3	70.0	95.4	88.0	84.5	13.1	7.5
Family: Maldanidae	3	14.4	38.0	18.9	23.8	12.5	7.2
Family: Orbiniidae	3	58.4	213.3	153.0	141.6	78.1	45.1
Family: Opheliidae	1	0.0	2.0	0.0	0.7	1.2	1.2
Family: Paraonidae	3	62.3	624.0	324.0	336.8	281.1	162.3

Benthic Invertebrate[1]	No. Stations Reported at	Minimum Value	Maximum Value	Mean Value	Median	Standard Deviation	Standard Error
Family: Pectinaridae	2	0.0	5.0	1.0	2.0	2.6	1.9
Family: Sabellidae	3	24.0	34.0	30.9	29.6	5.1	3.0
Family: Scalibregmatidae	3	7.4	27.0	16.8	17.1	9.8	5.7
Family: Serpulidae	1	0.0	4.0	0.0	1.3	2.3	2.3
Family: Spionidae	3	4.0	28.0	21.0	17.7	12.3	7.1
Family: Spirorbidae	2	0.0	6.4	3.4	3.3	3.2	2.3
Family: Terebellidae	3	52.0	75.0	73.4	66.8	12.8	7.4
Family: Trichobranchidae	1	0.0	4.0	0.0	1.3	2.3	2.3
Class: Clitatella							
Subclass: Oligochaeta							
Family: Enchytraeidae	2	0.0	24.0	17.0	13.7	12.3	8.7
Family: Naididae	2	0.0	66.4	4.0	23.5	37.2	26.3
Phylum: Mollusca							
Class: Gastropoda							
Family: Cylichnidae	1	0.0	4.0	0.0	1.3	2.3	2.3
Family: Melanodrymiidae	1	0.0	8.0	0.0	2.7	4.6	4.6
Family: Turbinidae	1	0.0	4.0	0.0	1.3	2.3	2.3
Class: Bivalvia							
Class Bivalvia Indeterminate	1	0.0	10.4	0.0	3.5	6.0	6.0
Family: Cardiidae	2	0.0	5.0	1.0	2.0	2.6	1.9
Family: Hiatellidae	1	0.0	42.4	0.0	14.1	24.5	24.5
Family: Myidae	3	9.0	31.4	21.4	20.6	11.2	6.5
Family: Mytilidae	1	0.0	82.4	0.0	27.5	47.6	47.6
Family: Nuculidae	1	0.0	17.0	0.0	5.7	9.8	9.8
Family: Tellinidae	3	9.0	35.2	12.0	18.7	14.3	8.3
Family: Thyasiridae	2	0.0	51.0	34.4	28.5	26.0	18.4
Phylum: Arthropoda							
Subphylum: Crustacea							
Class: Maxillopoda							
Subclass: Copepoda (parasitic)	-	-	-	-	-	-	-
Family: Chondracanthidae	1	0.0	8.0	0.0	2.7	4.6	4.6
Order: Siphonostomatoida	1	0.0	8.0	0.0	2.7	4.6	4.6

Benthic Invertebrate[1]	No. Stations Reported at	Minimum Value	Maximum Value	Mean Value	Median	Standard Deviation	Standard Error
Class: Malacostraca							
Order: Cumacea	2	0.0	4.0	1.0	1.7	2.1	1.5
Order: Isopoda	2	0.0	22.4	1.0	7.8	12.7	8.9
Order: Amphipoda	-	-	-	-	-	-	-
Family: Caprellidae	1	0.0	32.8	0.0	10.9	18.9	18.9
Family: Corophiidae	1	0.0	17.7	0.0	5.9	10.2	10.2
Family: Dexaminidae	1	0.0	48.8	0.0	16.3	28.2	28.2
Family: Eusiridae	1	0.0	31.2	0.0	10.4	18.0	18.0
Family: Ischyroceridae	3	1.0	22.3	12.0	11.8	10.6	6.1
Family: Lysianassidae	1	0.0	9.0	0.0	3.0	5.2	5.2
Family: Melitidae	1	0.0	4.0	0.0	1.3	2.3	2.3
Family: Oedicerotidae	3	32.0	94.4	51.0	59.1	32.0	18.5
Family: Photidae	2	0.0	37.0	8.8	15.3	19.3	13.7
Family: Stenthoidae	2	0.0	27.2	3.4	10.2	14.8	10.5
Family: Podoceridae	1	0.0	2.4	0.0	0.8	1.4	1.4
Family: Zopfiaceae	3	10.9	120.0	32.2	54.4	57.8	33.4
Suborder: Gammaridea	2	0.0	12.0	2.0	4.7	6.4	4.5
Order: Decapoda	1	0.0	1.0	0.0	0.3	0.6	0.6
Phylum: Bryozoa	2	0.0	43.2	3.4	15.5	24.0	17.0
Subphylum: Urochordata (accepted as Tunicata)	1	0.0	1.0	0.0	0.3	0.6	0.6

NOTES:

[1] Benthic invertebrate data has been combined to higher taxonomic levels (usually family); see Table C4 in Appendix C for all benthic data

Table C4: Benthic Invertebrate Taxonomy and Species Abundance

Benthic Invertebrate	Project Footprint (I1)										Reference 1 (R1)										Reference 2 (R2)									
	18-Aug-11										20-Aug-11										20-Aug-11									
	Replicate 1			Replicate 2			Replicate 3			Composite	Replicate 1			Replicate 2			Replicate 3			Composite	Replicate 1			Replicate 2			Replicate 3			Composite
	Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile		Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile		Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile	
Phylum: Porifera																														
Family: Cathrinidae																														
Cathrinidae Indeterminate																								2						2
Phylum: Cnidaria																														
Class: Hydrozoa																														
Subclass: Hydroida Indeterminate (accepted as Hydroidolina)							4			4																				
Family: Bougainvilliidae																														
Bougainvilliidae Indeterminate																	1			1										
Family: Campanulariidae																														
Obelia spp.				3			4			7																	4			4
Family: Tubulariidae																														
Tubulariidae Indeterminate														4						4										
Phylum: Platyhelminthes																														
Platyhelminthes Indeterminate																		1		1										
Phylum: Nemertea																														
Nemertea Indeterminate						3				3			4						1	5										
Subclass: Hoplonemertea																														
Hoplonemertea Indeterminate	1				3		4	4	4	16				4						4					2					2
Family: Tetrastemmatidae																														
Tetrastemma spp.																		2		2		12			2			4		18
Phylum: Annelida																														
Class: Polychaeta (Errantia)																														
Family: Dorvilleidae																														
Dorvilleidae sp. A																									2			4		6
Dorvilleidae Indeterminate						3			4	7													4							4
Family: Hesionidae																														
Hesionidae Indeterminate																					4									4
Microphthalmus sp.																	2			2	16			5						21
Family: Lumbrineridae																														
Lumbrineridae Indeterminate	2						8	4	4	18			4					1	5	10									4	4
Eranno sp.				8			17			25	12			9			5			26				1			1			2
Scoletoma sp.											4									4										
Family: Nephtyidae																														
Bipalponephtys cornuta	2			89	7		148	48	4	298	276	52		244	64		187	61		884	100	24		96	5		76			301
Nephtys spp.																					3			11						14

Benthic Invertebrate	Project Footprint (I1)										Reference 1 (R1)										Reference 2 (R2)									
	18-Aug-11										20-Aug-11										20-Aug-11									
	Replicate 1			Replicate 2			Replicate 3			Composite	Replicate 1			Replicate 2			Replicate 3			Composite	Replicate 1			Replicate 2			Replicate 3			Composite
	Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile		Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile		Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile	
Family: Pholoidae																														
Pholoe spp.				113	27		96	28		265	8	4		24	24		3	8		71	64	16	4	65	14		160	80		403
Family: Phyllodocidae																														
Eteone spp.				24	3		28			55	12			4			3	2		21	12			10			4			26
Phyllodoce sp.																						4					4			8
Family: Polynoidae																														
Harmothoe imbricata							1			1																	4			4
Family: Syllidae																														
Syllidae Indeterminate																					4									4
Eusyllis sp.							12			12														2			8			10
Exogone gemmifera				182	17		100	4		303	8			4			6	2	1	21	244	4		170	10		104			532
Pionosyllis sp.																					36						8			44
Sphaerosyllis sp.				34			24	4		62	36			32			24			92	32			12						44
Syllides sp.				3						3											44			29	2	2	8			86
Family: Terebellidae																														
Lysilla sp.																	1			1										
Class: Polychaeta (Sedentaria)																														
Family: Ampharetidae																														
Ampharetidae Indeterminate						3			4	7						4				4							4			4
Subfamily: Ampharetinae Indeterminate																									2					2
Ampharete sp.				3			12			15											16			7			4			27
Lysippe labiata																	1			1										0
Family: Capitellidae																														
Capitella capitata complex							4	4		8							2			2				2						2
Mediomastus ambiseta	1	2								3																				
Mediomastus sp.	2			1358	182	86	1232	340		3199	100	16		236	20		280	18		670	1132	152		871	84	2	1136	256	20	3654
Family: Cirratulidae																														
Cirratulidae Indeterminate							60	72	8	140	28	8	16	4			12	10	15	93	4	12	24	7	17	10	8	24		106
Aphelochaeta spp.																4			1	5						5				5
Chaetozone nr. setosa							4			4							24	1		25	8			7						15
Chaetozone spp.	1			14	55	21	20			110	56	8	24	40	28	32	53	18	19	278	16	4	4	14	2	5	4	4		54
Cirratulus sp.																								0		2				2
Tharyx sp.							8			8														5						5
Family: Cossuridae																														
Cossura pygodactylata				3			92			95	4			32			34			70	36			12			40			88
Family: Maldanidae																														
Euclymeninae Indeterminate							4		8	12			4						1	5										
Axiothella sp.				7						7	16			16			1			33	8			2			4			14

Benthic Invertebrate	Project Footprint (I1)										Reference 1 (R1)										Reference 2 (R2)									
	18-Aug-11										20-Aug-11										20-Aug-11									
	Replicate 1			Replicate 2			Replicate 3			Composite	Replicate 1			Replicate 2			Replicate 3			Composite	Replicate 1			Replicate 2			Replicate 3			Composite
	Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile		Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile		Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile	
Family: Orbiniidae																														
Orbiniidae Indeterminate						3		12	60	75									3	3									12	12
Leitoscoloplos pugettensis	1			3	3		8	68		84	4	28	8	4	4	8	19	35	39	149					2		4	20		26
Scoloplos armiger	2			24			28			54							1			1					0		20			20
Family: Opheliidae																														
Ophelina acuminata																	2			2										
Family: Paraonidae																														
Aricidea lopezi				7			32			39	52	28		24	28		44	11		187	16			26	5		76	8		131
Aricidea nr. minuta							12	8		20	8			24			22			54							4			4
Aricidea spp.					3					3	4	68	52	12	88	48	10	72	29	383	20	20	20	17	19	5	20	60		181
Paraonella sp.																											4	4		8
Family: Pectinaridae																														
Pectinaria sp.																	1			1							1	4		5
Family: Sabellidae																														
Chone spp.																						4								4
Euchone analis				3	3		12			19	4									4					5			4		9
Euchone incolor							12			12	8			16			6			30	4			2						6
Euchone spp.																									5					5
Family: Scalibregmatidae																														
Scalibregma nr. inflatum				3				4		7				4	12		4	6	1	27		4		2	2				8	17
Family: Serpulidae																														
Pileolaria quadrangularis																											4			4
Family: Spionidae																														
Dipolydora quadrilobata							4			4																				
Dipolydora sp.																								2			4			6
Prionospio (Prionospio) sp.											4			8			6	3		21	4									4
Pygospio elegans																					4			10						14
Spio sp.																											4			4
Family: Spirorbidae																														
Spirorbidae Indeterminate				3						3																				
Circeis spirillum																					4			2						6
Family: Terebellidae																														
Terebellidae Indeterminate																											4	4		8
Polycirrus spp.							1			1											4					2			4	10
Terebellides spp.	6			16			28	20	4	74	12	4		5	8	8	11	3	1	52	13			7	2	2	15		4	44
Subfamily: Amphitritinae Indeterminate (accepted as Terebellinae)																					4									4

Benthic Invertebrate	Project Footprint (I1)										Reference 1 (R1)										Reference 2 (R2)									
	18-Aug-11										20-Aug-11										20-Aug-11									
	Replicate 1			Replicate 2			Replicate 3			Composite	Replicate 1			Replicate 2			Replicate 3			Composite	Replicate 1			Replicate 2			Replicate 3			Composite
	Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile		Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile		Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile	
Lanassa venusta venusta																								5	2					7
Family: Trichobranchidae																														
Trichobranchidae Indeterminate																							4							4
Class: Clitatella																														
Subclass: Oligochaeta																														
Family: Enchytraeidae																														
Marionina sp.											4			12			1			17	20	4								24
Family: Naididae																														
Tubificoid Naididae Indeterminate															4					4		28		31	7					66
Phylum: Mollusca																														
Class: Gastropoda																														
Family: Cylichnidae																														
Cylichnidae Indeterminate																			4	4										
Family: Melanodrymiidae																														
Leptogyra alaskana																											8			8
Family: Turbinidae																														
Margarites sp.																						4								4
Class: Bivalvia																														
Bivalvia Indeterminate																							8			2				10
Family: Cardiidae																														
Clinocardium ciliatum	1									1																				
Clinocardium sp.													4							4										
Serripes groenlandicus															1					1										
Family: Hiatellidae																														
Hiatellidae Indeterminate																										2			4	6
Hiatella arctica																							8			12			16	36
Family: Myidae																														
Myidae Indeterminate						4			12	16																				
Mya sp.			1							1			4			4			1	9			24			2			5	31
Mya truncata							4			4																				
Family: Mytilidae																														
Mytilidae Indeterminate																							28			2			4	34
Crenella faba																					4	24		2	7	2		8		48
Family: Nuculidae																														
Ennucula tenuis											4	4					6	3		17										
Family: Tellinidae																														
Macoma calcarea	2	1			2			4		9				1	4		1	2		8	9	7		5	4		2	1		28

Benthic Invertebrate	Project Footprint (I1)										Reference 1 (R1)										Reference 2 (R2)									
	18-Aug-11										20-Aug-11										20-Aug-11									
	Replicate 1			Replicate 2			Replicate 3			Composite	Replicate 1			Replicate 2			Replicate 3			Composite	Replicate 1			Replicate 2			Replicate 3			Composite
	Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile		Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile		Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile	
Macoma carlottensis																					1			1						2
Macoma lama																									2					2
Macoma spp.															4					4						2				2
Family: Thyasiridae																														
Thyasiridae Indeterminate																	1	2		3										0
Axinopsida orbiculata																	1			1	4	4		5						13
Thyasira flexuosa												16			4			27		47		12		5	5					22
Phylum: Arthropoda																														
Subphylum: Crustacea																														
Class: Maxillopoda																														
Subclass: Copepoda (parasitic)																														
Family: Chondracanthidae																														
Chondracanthidae Indeterminate							8			8																				
Order: Siphonostomatoida																														
Siphonostomatoida Indeterminate																											8			8
Class: Malacostraca																														
Order: Cumacea																														
Cumacea Indeterminate							4			4																				
Diastylis sp.																	1			1										
Order: Isopoda																														
Munna frabricii																	1			1	8			2			12			22
Order: Amphipoda																														
Family: Caprellidae																														
Caprella ciliata																						28			5					33
Family: Corophiidae																														
Crassicorophium bonellii				14			4			18																				
Family: Dexaminidae																														
Guernea cf. nordenskioldi																					20	24		5						49
Family: Eusiridae																														
Rhachotropis sp.																						12			7			8	4	31
Family: Ischyroceridae																														
cf. *Parajassa* sp.					10		8	4		22								1		1		4						8		12
Family: Lysianassidae																														
Hippomedon sp.											4	4						1		9										
Family: Melitidae																														
Melita sp.							4			4																				
Family: Oedicerotidae																														

Benthic Invertebrate	Project Footprint (I1)										Reference 1 (R1)										Reference 2 (R2)									
	18-Aug-11										20-Aug-11										20-Aug-11									
	Replicate 1			Replicate 2			Replicate 3			Composite	Replicate 1			Replicate 2			Replicate 3			Composite	Replicate 1			Replicate 2			Replicate 3			Composite
	Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile		Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile		Adult	Int	Juvenile	Adult	Int	Juvenile	Adult	Int	Juvenile	
Oedicerotidae Indeterminate						24			8	32			8			4		1	3	16			56			24			4	84
Ameroculodes sp.														12			3			15		8			2					10
Bathymedon sp.											8				8			4		20										
Family: Photidae																														
Gammaropsis sp.											24		4				9			37		4			2	2				9
Family: Stenthoidae																														
Stenothoidae Indeterminate					3					3																				
Metopella carinata (accepted as *Hardametopa carinata*)																					12	4		7			4			27
Family: Podoceridae																														
Podoceridae Indeterminate																								2						2
Family: Zopfiaceae																														
Pontoporeia femorata					7			4		11	28	16	4	4	8		25	32	3	120	4				5	14	1	8		32
Suborder: Gammaridea																														
Gammaridea Indeterminate																		2		2	8		4							12
Order: Decapoda																														
Hyas coarctatus																						1								1
Phylum: Bryozoa																														
cf. Bowerbankia sp.																											4			4
Crisia spp.																					4									4
Reginella spp.																					4			2			8			14
Scrupocellaria spp.																					4			2			4			10
Tubulipora spp.				3						3											4			2			4			10
Subphylum: Urochordata (accepted as Tunicata)																														
Tethyum sp.							1			1																				
Total Number of Organisms by Stage	**21**	**3**	**1**	**1,920**	**328**	**148**	**2,052**	**632**	**120**	**-**	**728**	**256**	**136**	**779**	**309**	**112**	**814**	**329**	**127**	**-**	**1,958**	**424**	**188**	**1,479**	**235**	**103**	**1,796**	**509**	**89**	**-**
Total Number of Organisms	**25**			**2,396**			**2,804**			**5,225**	**1,120**			**1,200**			**1,270**			**3,590**	**2,570**			**1,817**			**2,394**			**6,781**
Total organisms per m^2	**1,082**			**103,711**			**121,364**			**226,157**	**48,476**			**51,939**			**54,969**			**155,384**	**111,236**			**78,644**			**103,618**			**293,499**

APPENDIX D

Fish Catch Data

Table D1: Fish Catch Data from Itivia Harbour and Reference Areas

Area	Distance	UTM (Zone 15V)		Gear[1]	Date	Set Time	Retrieval Time	Set Duration (h)	Tide Level at Set (m)[2]	Tide Level at Retrieval (m)[3]	Offshore Depth at Set (m)	Tidal Current	Fish Catch[4]							Species Richness	Catch per Unit Effort (CPUE)						
		Easting	Northing										ASC	FHS	GLC	SEB	SHS	SSP	Total		ASC	FHS	GLC	SEB	SHS	SSP	Total
I1	Nearshore	– [c]	– [c]	GN-F	16-Aug-11	9:11	11:30	2.32	3.15	1.20	1.7	Ebb	–	12	1	–	–	–	13	2	0.00	5.18	0.43	0.00	0.00	0.00	5.61
R1	Nearshore	– [c]	– [c]	GN-S	16-Aug-11	9:43	12:00	2.28	2.73	0.80	12.7	Ebb	–	–	5	5	–	1	11	3	0.00	0.00	2.19	2.19	0.00	0.44	4.82
R2	Offshore	– [c]	– [c]	GN-S	16-Aug-11	12:45	16:00	3.25	0.58	2.20	10.5	Flood	–	–	7	3	–	–	10	2	0.00	0.00	2.15	0.92	0.00	0.00	3.08
I1	Offshore	– [c]	– [c]	GN-S	16-Aug-11	13:00	16:30	3.50	0.50	2.65	7.5	Flood	1	–	14	2	–	–-	17	3	0.29	0.00	4.00	0.57	0.00	0.00	4.86
R1	Nearshore	545349	6963907	GN-S	17-Aug-11	14:42	17:10	2.47	0.87	2.73	11.6	Flood	–	–	10	3	–	–-	13	2	0.00	0.00	4.05	1.22	0.00	0.00	5.27
R2	Nearshore	544654	6962593	GN-S	17-Aug-11	15:15	17:40	2.42	1.20	3.13	8.3	Flood	–	–	4	–	–	1	5	2	0.00	0.00	1.66	0.00	0.00	0.41	2.07
I1	Nearshore	546261	6963554	BS	17-Aug-11	16:00	–	–	1.80	–	1.5	Flood	–	–	–	–	–	–	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R1	Nearshore	545352	6963948	BS	17-Aug-11	16:35	–	–	2.27	–	1.5	Flood	–	–	–	–	–	–	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
I1	Nearshore	546253	6963556	GN-F	19-Aug-11	10:30	14:55	4.42	3.20	0.91	4.2	Ebb	–	8	3	–	–	1	12	3	0.00	1.81	0.68	0.00	0.00	0.23	2.72
R1	Offshore	545289	6963845	GN-S	19-Aug-11	10:45	15:55	5.17	3.05	1.18	15.2	Ebb	–	–	9	2	1	1	13	4	0.00	0.00	1.74	0.39	0.19	0.19	2.52
I1	Offshore	546185	6963427	GN-S	19-Aug-11	15:20	19:42	4.37	1.00	3.58	8.2	Flood	–	–	12	5	–	–	17	2	0.00	0.00	2.75	1.15	0.00	0.00	3.89
R2	Offshore	544695	6962658	GN-S	19-Aug-11	16:20	20:15	3.92	1.43	3.73	7.6	Flood	1	–	8	6	1	–	16	4	0.26	0.00	2.04	1.53	0.26	0.00	4.09
R1	Offshore	545319	6963844	GN-S	20-Aug-11	8:50	12:37	3.78	3.57	2.17	15.7	Ebb	–	2	3	3	–	–	8	3	0.00	0.53	0.79	0.79	0.00	0.00	2.11
R2	Nearshore	544627	6962611	GN-S	20-Aug-11	9:20	12:13	2.88	3.57	2.45	12.7	Ebb	–	2	4	–	1	–	7	3	0.00	0.69	1.39	0.00	0.35	0.00	2.43
I1	Offshore	546228	6963446	GN-F	20-Aug-11	16:18	20:00	3.70	1.32	3.40	7.7	Flood	–	–	1	13	–	–	14	2	0.00	0.00	0.27	3.51	0.00	0.00	3.78

NOTES:

[1] Gear: BS = Beach seine
GN-F = Floating gillnet
GN-S = Sinking gillnet

[2] Tide level at set and retrieval referenced to chart datum

[3] Locations on Figures A-1 to A-3 (Appendix A) approximate

[4] Fish Species: ASC = Arctic sculpin
FHS = fourhorn sculpin
GLC = Greenland cod
SEB = slender eelblenny
SHS = staghorn sculpin
SSP = unidentified sculpin (juvenile)

APPENDIX E

Individual Fish Data

Table E1: Individual Fish Data from Itivia Harbour and Reference Areas

Date	Area	Distance	Set No.	Gear[1]	Species	Retrieval Time	Length (mm)	Weight (g)	Fulton's Condition (K)[2]	External Condition	Depth	Comments
16-Aug-11	I1	Nearshore	1	GN-F	FSC	11:30	220	110.8	–	–	Lead line	
16-Aug-11	I1	Nearshore	1	GN-F	FSC	11:30	225	97.4	–	–	Lead line	
16-Aug-11	I1	Nearshore	1	GN-F	FSC	11:30	295	249.5	–	–	Lead line	
16-Aug-11	I1	Nearshore	1	GN-F	FSC	11:30	315	261.7	–	–	Lead line	
16-Aug-11	I1	Nearshore	1	GN-F	FSC	11:30	235	126.2	–	–	Lead line	
16-Aug-11	I1	Nearshore	1	GN-F	FSC	11:30	240	140.5	–	–	Lead line	
16-Aug-11	I1	Nearshore	1	GN-F	FSC	11:30	285	247.7	–	–	Lead line	
16-Aug-11	I1	Nearshore	1	GN-F	FSC	11:30	230	105.2	–	–	Lead line	
16-Aug-11	I1	Nearshore	1	GN-F	FSC	11:30	260	186.5	–	–	Lead line	
16-Aug-11	I1	Nearshore	1	GN-F	FSC	11:30	205	83.7	–	–	Lead line	
16-Aug-11	I1	Nearshore	1	GN-F	FSC	11:30	245	150.7	–	–	Lead line	
16-Aug-11	I1	Nearshore	1	GN-F	FSC	11:30	245	134.6	–	–	Lead line	
16-Aug-11	I1	Nearshore	1	GN-F	GLC	11:30	300	-	–	–	Lead line	Fell off net before in boat
16-Aug-11	R1	Nearshore	1	GN-S	GLC	12:00	495	1400	1.15	–	Lead line	2 sculpins in stomach
16-Aug-11	R1	Nearshore	1	GN-S	GLC	12:00	370	400	0.79	–	Lead line	
16-Aug-11	R1	Nearshore	1	GN-S	GLC	12:00	285	233.5	1.01	–	Lead line	
16-Aug-11	R1	Nearshore	1	GN-S	GLC	12:00	300	273.3	1.01	–	Lead line	
16-Aug-11	R1	Nearshore	1	GN-S	GLC	12:00	220	94.6	0.89	–	Lead line	
16-Aug-11	R1	Nearshore	1	GN-S	SEB	12:00	235	38	–	–	Lead line	
16-Aug-11	R1	Nearshore	1	GN-S	SEB	12:00	195	21.5	–	–	Lead line	Dead
16-Aug-11	R1	Nearshore	1	GN-S	SEB	12:00	270	34.5	–	–	Lead line	
16-Aug-11	R1	Nearshore	1	GN-S	SEB	12:00	-	-	–	–	–	Fell off net before in boat
16-Aug-11	R1	Nearshore	1	GN-S	SEB	12:00	310	47.5	–	–	Lead line	
16-Aug-11	R1	Nearshore	1	GN-S	SSP	12:00	120	10.5	–	–	Lead line	
16-Aug-11	R2	Offshore	1	GN-S	GLC	16:00	300	24.5	0.09	–	Lead line	
16-Aug-11	R2	Offshore	1	GN-S	GLC	16:00	320	336.3	1.03	–	Lead line	
16-Aug-11	R2	Offshore	1	GN-S	GLC	16:00	315	344.8	1.10	–	Lead line	
16-Aug-11	R2	Offshore	1	GN-S	GLC	16:00	405	600	0.90	–	Lead line	
16-Aug-11	R2	Offshore	1	GN-S	GLC	16:00	440	900	1.06	–	Lead line	
16-Aug-11	R2	Offshore	1	GN-S	GLC	16:00	450	950	1.04	–	Lead line	
16-Aug-11	R2	Offshore	1	GN-S	GLC	16:00	500	1000	0.80	–	Lead line	
16-Aug-11	R2	Offshore	1	GN-S	SEB	16:00	240	39.5	–	–	Lead line	

Date	Area	Distance	Set No.	Gear[1]	Species	Retrieval Time	Length (mm)	Weight (g)	Fulton's Condition (K)[2]	External Condition	Depth	Comments
16-Aug-11	R2	Offshore	1	GN-S	SEB	16:00	245	36.5	–	–	Lead line	
16-Aug-11	R2	Offshore	1	GN-S	SEB	16:00	230	30.6	–	–	Lead line	
16-Aug-11	I1	Offshore	1	GN-S	GLC	16:30	240	123.2	0.89	–	Lead line	
16-Aug-11	I1	Offshore	1	GN-S	GLC	16:30	295	250.8	0.98	–	Lead line	
16-Aug-11	I1	Offshore	1	GN-S	GLC	16:30	340	371.9	0.95	–	Lead line	
16-Aug-11	I1	Offshore	1	GN-S	GLC	16:30	215	99.5	1.00	–	Lead line	
16-Aug-11	I1	Offshore	1	GN-S	GLC	16:30	280	221	1.01	–	Lead line	
16-Aug-11	I1	Offshore	1	GN-S	GLC	16:30	295	465	1.81	–	Lead line	
16-Aug-11	I1	Offshore	1	GN-S	GLC	16:30	335	400	1.06	–	Lead line	
16-Aug-11	I1	Offshore	1	GN-S	GLC	16:30	370	500	0.99	–	Lead line	
16-Aug-11	I1	Offshore	1	GN-S	GLC	16:30	355	350	0.78	–	Lead line	
16-Aug-11	I1	Offshore	1	GN-S	GLC	16:30	380	550	1.00	–	Lead line	
16-Aug-11	I1	Offshore	1	GN-S	GLC	16:30	400	700	1.09	–	Lead line	
16-Aug-11	I1	Offshore	1	GN-S	GLC	16:30	415	900	1.26	–	Lead line	
16-Aug-11	I1	Offshore	1	GN-S	GLC	16:30	450	950	1.04	–	Lead line	
16-Aug-11	I1	Offshore	1	GN-S	GLC	16:30	400	600	0.94	–	Lead line	
16-Aug-11	I1	Offshore	1	GN-S	ASC	16:30	270	215.5	–	–	Lead line	
16-Aug-11	I1	Offshore	1	GN-S	SEB	16:30	245	35	–	–	Lead line	
16-Aug-11	I1	Offshore	1	GN-S	SEB	16:30	265	47	–	–	Lead line	
17-Aug-11	R1	Nearshore	2	GN-S	GLC	17:10	320	300	0.92	–	Lead line	
17-Aug-11	R1	Nearshore	2	GN-S	GLC	17:10	375	450	0.85	–	Lead line	
17-Aug-11	R1	Nearshore	2	GN-S	GLC	17:10	380	450	0.82	–	Lead line	
17-Aug-11	R1	Nearshore	2	GN-S	GLC	17:10	395	450	0.73	–	Lead line	
17-Aug-11	R1	Nearshore	2	GN-S	GLC	17:10	405	700	1.05	–	Lead line	
17-Aug-11	R1	Nearshore	2	GN-S	GLC	17:10	485	1200	1.05	–	Lead line	
17-Aug-11	R1	Nearshore	2	GN-S	GLC	17:10	185	130	2.05	–	Lead line	
17-Aug-11	R1	Nearshore	2	GN-S	GLC	17:10	185	100	1.58	–	Lead line	
17-Aug-11	R1	Nearshore	2	GN-S	GLC	17:10	-	-	–	–	–	Fell off net before in boat
17-Aug-11	R1	Nearshore	2	GN-S	GLC	17:10	-	-	–	–	–	Fell off net before in boat
17-Aug-11	R1	Nearshore	2	GN-S	SEB	17:10	180	50	–	–	Lead line	
17-Aug-11	R1	Nearshore	2	GN-S	SEB	17:10	200	100	–	–	Lead line	
17-Aug-11	R1	Nearshore	2	GN-S	SEB	17:10	260	200	–	–	Lead line	
17-Aug-11	R2	Nearshore	1	GN-S	GLC	17:40	340	450	1.14	–	Lead line	

Date	Area	Distance	Set No.	Gear[1]	Species	Retrieval Time	Length (mm)	Weight (g)	Fulton's Condition (K)[2]	External Condition	Depth	Comments
17-Aug-11	R2	Nearshore	1	GN-S	GLC	17:40	345	500	1.22	–	Lead line	
17-Aug-11	R2	Nearshore	1	GN-S	GLC	17:40	355	500	1.12	–	Lead line	
17-Aug-11	R2	Nearshore	1	GN-S	GLC	17:40	450	850	0.93	–	Lead line	
17-Aug-11	R2	Nearshore	1	GN-S	SSP	17:40	110	9	–	–	Lead line	Appears eggs released
19-Aug-11	I1	Nearshore	2	GN-F	Crab spp.	14:55	90 x 70	169.7	–	–	Lead line	Length = carapace measurement; barnacles, kelp & 1 ascidian on carapace; photos 145-151
19-Aug-11	I1	Nearshore	2	GN-F	GLC	14:55	305	314.9	1.11	–	Lead line	Dead
19-Aug-11	I1	Nearshore	2	GN-F	GLC	14:55	-	-	–	–	Lead line	Fell off net before in boat
19-Aug-11	I1	Nearshore	2	GN-F	GLC	14:55	-	-	–	–	Lead line	Fell off net before in boat
19-Aug-11	I1	Nearshore	2	GN-F	FSC	14:55	298	273.7	–	–	Lead line	
19-Aug-11	I1	Nearshore	2	GN-F	FSC	14:55	300	263.4	–	–	Lead line	
19-Aug-11	I1	Nearshore	2	GN-F	FSC	14:55	285	216.2	–	BSP	Lead line	
19-Aug-11	I1	Nearshore	2	GN-F	FSC	14:55	260	174.5	–	–	Lead line	
19-Aug-11	I1	Nearshore	2	GN-F	FSC	14:55	265	178.5	–	BSP	Lead line	
19-Aug-11	I1	Nearshore	2	GN-F	FSC	14:55	268	199	–	BSP	Lead line	
19-Aug-11	I1	Nearshore	2	GN-F	FSC	14:55	275	205.1	–	BSP	Lead line	
19-Aug-11	I1	Nearshore	2	GN-F	FSC	14:55	270	187.8	–	–	Lead line	
19-Aug-11	I1	Nearshore	2	GN-F	SSP	14:55	118	19.3	–	–	Lead line	Appears immature/juvenile
19-Aug-11	R1	Offshore	1	GN-S	GLC	15:55	430	900	1.13	–	Lead line	
19-Aug-11	R1	Offshore	1	GN-S	GLC	15:55	250	144.9	0.93	–	Lead line	
19-Aug-11	R1	Offshore	1	GN-S	GLC	15:55	403	500	0.76	–	Lead line	
19-Aug-11	R1	Offshore	1	GN-S	GLC	15:55	385	550	0.96	–	Lead line	
19-Aug-11	R1	Offshore	1	GN-S	GLC	15:55	423	600	0.79	–	Lead line	
19-Aug-11	R1	Offshore	1	GN-S	GLC	15:55	250	136.2	0.87	–	Lead line	
19-Aug-11	R1	Offshore	1	GN-S	GLC	15:55	300	301.9	1.12	–	Lead line	
19-Aug-11	R1	Offshore	1	GN-S	GLC	15:55	318	263.2	0.82	–	Lead line	
19-Aug-11	R1	Offshore	1	GN-S	GLC	15:55	130	19.9	0.91	–	Lead line	
19-Aug-11	R1	Offshore	1	GN-S	SHS	15:55	210	111.9	–	–	Lead line	
19-Aug-11	R1	Offshore	1	GN-S	SSP	15:55	120	15.4	–	–	Lead line	Appears immature/juvenile
19-Aug-11	R1	Offshore	1	GN-S	SEB	15:55	235	40.3	–	–	Lead line	
19-Aug-11	R1	Offshore	1	GN-S	SEB	15:55	230	44.3	–	–	Lead line	
19-Aug-11	I1	Offshore	2	GN-S	GLC	19:42	450	100	0.11	–	Lead line	
19-Aug-11	I1	Offshore	2	GN-S	GLC	19:42	480	135	0.12	–	Lead line	Dead
19-Aug-11	I1	Offshore	2	GN-S	GLC	19:42	485	135	0.12	–	Lead line	

Date	Area	Distance	Set No.	Gear[1]	Species	Retrieval Time	Length (mm)	Weight (g)	Fulton's Condition (K)[2]	External Condition	Depth	Comments
19-Aug-11	I1	Offshore	2	GN-S	GLC	19:42	330	350	0.97	–	Lead line	
19-Aug-11	I1	Offshore	2	GN-S	GLC	19:42	345	350	0.85	–	Lead line	
19-Aug-11	I1	Offshore	2	GN-S	GLC	19:42	420	900	1.21	–	Lead line	
19-Aug-11	I1	Offshore	2	GN-S	GLC	19:42	380	600	1.09	–	Lead line	
19-Aug-11	I1	Offshore	2	GN-S	GLC	19:42	430	800	1.01	–	Lead line	
19-Aug-11	I1	Offshore	2	GN-S	GLC	19:42	300	271	1.00	–	Lead line	
19-Aug-11	I1	Offshore	2	GN-S	GLC	19:42	295	248	0.97	–	Lead line	
19-Aug-11	I1	Offshore	2	GN-S	GLC	19:42	270	219	1.11	–	Lead line	
19-Aug-11	I1	Offshore	2	GN-S	GLC	19:42	170	56	1.14	–	Lead line	
19-Aug-11	I1	Offshore	2	GN-S	SEB	19:42	305	35	–	–	Lead line	
19-Aug-11	I1	Offshore	2	GN-S	SEB	19:42	245	37	–	–	Lead line	
19-Aug-11	I1	Offshore	2	GN-S	SEB	19:42	255	45	–	–	Lead line	
19-Aug-11	I1	Offshore	2	GN-S	SEB	19:42	222	28	–	–	Lead line	
19-Aug-11	I1	Offshore	2	GN-S	SEB	19:42	235	35	–	–	Lead line	
19-Aug-11	R2	Offshore	2	GN-S	GLC	20:15	520	1450	1.03	–	Lead line	
19-Aug-11	R2	Offshore	2	GN-S	GLC	20:15	380	600	1.09	–	Lead line	
19-Aug-11	R2	Offshore	2	GN-S	GLC	20:15	325	350	1.02	–	Lead line	
19-Aug-11	R2	Offshore	2	GN-S	GLC	20:15	396	550	0.89	–	Lead line	Missing top corner of caudal fin
19-Aug-11	R2	Offshore	2	GN-S	GLC	20:15	130	18.3	0.83	–	Lead line	
19-Aug-11	R2	Offshore	2	GN-S	GLC	20:15	118	15.1	0.92	–	Lead line	
19-Aug-11	R2	Offshore	2	GN-S	GLC	20:15	127	17.8	0.87	–	Lead line	
19-Aug-11	R2	Offshore	2	GN-S	GLC	20:15	130	22.4	1.02	–	Lead line	
19-Aug-11	R2	Offshore	2	GN-S	ASC	20:15	370	700	–	–	Lead line	
19-Aug-11	R2	Offshore	2	GN-S	SHS	20:15	215	121.5	–	–	Lead line	
19-Aug-11	R2	Offshore	2	GN-S	SEB	20:15	245	49.3	–	–	Lead line	
19-Aug-11	R2	Offshore	2	GN-S	SEB	20:15	225	36.3	–	–	Lead line	
19-Aug-11	R2	Offshore	2	GN-S	SEB	20:15	287	61.3	–	–	Lead line	
19-Aug-11	R2	Offshore	2	GN-S	SEB	20:15	260	60.8	–	–	Lead line	
19-Aug-11	R2	Offshore	2	GN-S	SEB	20:15	255	47.3	–	–	Lead line	
19-Aug-11	R2	Offshore	2	GN-S	SEB	20:15	290	61.2	–	–	Lead line	
19-Aug-11	R2	Offshore	2	GN-S	Crab spp.	20:15	–	–	–	–	Lead line	Fell off net before in boat; appeared to be different spp than previous one caught at I1-N, no decorations on carapace; looked similar to king crab but smaller; ~ 5" carapace & long thin legs and claws
19-Aug-11	R2	Offshore	2	GN-S	Crab spp.	20:15	–	–	–	–	Lead line	Fell off net before in boat; appeared to be different spp than previous one caught at I1-N, no decorations on carapace; looked similar to king crab but smaller; ~ 5" carapace & long thin legs and claws

Date	Area	Distance	Set No.	Gear[1]	Species	Retrieval Time	Length (mm)	Weight (g)	Fulton's Condition (K)[2]	External Condition	Depth	Comments
20-Aug-11	R2	Nearshore	2	GN-S	GLC	12:13	290	298	1.22	–	Lead line	
20-Aug-11	R2	Nearshore	2	GN-S	GLC	12:13	290	294	1.21	–	Lead line	
20-Aug-11	R2	Nearshore	2	GN-S	GLC	12:13	410	650	0.94	–	Lead line	
20-Aug-11	R2	Nearshore	2	GN-S	GLC	12:13	420	550	0.74	–	Lead line	Appears to have been net caught before
20-Aug-11	R2	Nearshore	2	GN-S	FSC	12:13	240	129.6	–	–	Lead line	
20-Aug-11	R2	Nearshore	2	GN-S	FSC	12:13	255	114.7	–	–	Lead line	
20-Aug-11	R2	Nearshore	2	GN-S	SHS	12:13	145	33.7	–	–	Lead line	
20-Aug-11	R1	Offshore	2	GN-S	GLC	12:37	295	276.3	1.08	–	Lead line	
20-Aug-11	R1	Offshore	2	GN-S	GLC	12:37	430	900	1.13	–	Lead line	
20-Aug-11	R1	Offshore	2	GN-S	GLC	12:37	125	15.6	0.80	–	Lead line	
20-Aug-11	R1	Offshore	2	GN-S	ASC	12:37	315	348	–	–	Lead line	
20-Aug-11	R1	Offshore	2	GN-S	ASC	12:37	242	149.3	–	–	Lead line	
20-Aug-11	R1	Offshore	2	GN-S	SEB	12:37	290	43	–	–	Lead line	
20-Aug-11	R1	Offshore	2	GN-S	SEB	12:37	305	52	–	–	Lead line	
20-Aug-11	R1	Offshore	2	GN-S	SEB	12:37	228	35.1	–	–	Lead line	Dead - head bitten
20-Aug-11	I1	Offshore	3	GN-F	GLC	20:00	280	214.1	0.98	–	Lead line	Dead
20-Aug-11	I1	Offshore	3	GN-F	SEB	20:00	235	40.8	–	–	Lead and Middle	All SEB caught on last panel of net (near/on a reef); this panel
20-Aug-11	I1	Offshore	3	GN-F	SEB	20:00	260	54.5	–	–	Lead and Middle	Straddled the shallow water column (from surface to bottom)
20-Aug-11	I1	Offshore	3	GN-F	SEB	20:00	240	41.4	–	–	Lead and Middle	
20-Aug-11	I1	Offshore	3	GN-F	SEB	20:00	210	28.3	–	–	Lead and Middle	
20-Aug-11	I1	Offshore	3	GN-F	SEB	20:00	235	36.6	–	–	Lead and Middle	
20-Aug-11	I1	Offshore	3	GN-F	SEB	20:00	265	37.6	–	–	Lead and Middle	
20-Aug-11	I1	Offshore	3	GN-F	SEB	20:00	250	37.9	–	–	Lead and Middle	
20-Aug-11	I1	Offshore	3	GN-F	SEB	20:00	235	38.4	–	–	Lead and Middle	
20-Aug-11	I1	Offshore	3	GN-F	SEB	20:00	235	43.5	–	–	Lead and Middle	
20-Aug-11	I1	Offshore	3	GN-F	SEB	20:00	220	31.9	–	–	Lead and Middle	
20-Aug-11	I1	Offshore	3	GN-F	SEB	20:00	220	33.2	–	–	Lead and Middle	
20-Aug-11	I1	Offshore	3	GN-F	SEB	20:00	215	36.7	–	–	Lead and Middle	
20-Aug-11	I1	Offshore	3	GN-F	SEB	20:00	270	37.9	–	–	Lead and Middle	

NOTES:
[1] Gear: GN-F = Floating gillnet
GN-s = Sinking Gillnet
[2] Fulton's Condition Factor (K) = $(W / L^3) \times 10^5$ where W = weight (g) and L = length (mm)

APPENDIX F

Laboratory Methods

SAMPLE METHODS

Field Collection and Preservation

Once the samples are collected they are washed from the grab and placed in a large container labeled with the station and replicate number. The samples are then delivered to personnel for screening. The samples should be screened into the sample fractions required in the field (ie. 1.0mm, 0.5mm). The wash water is filtered with a 250 μm or smaller screen fitted on the intake hose to prevent planktonic organisms or other debris from entering the sample. Samples are washed in portions to minimize the time organisms are in contact with the screen. Any visible fragile organisms are removed and preserved separately during the washing process to prevent damage. Also, if there is any large debris such as rocks or wood debris they are removed and preserved in a separate container to prevent damage to the organisms.

Once the portion on the screen has been washed thoroughly the sediment was washed off the screen down into a corner of the pan for easy transfer into the sample jar. The washed sample fractions were then placed into an appropriately labeled container. After the entire sample was washed buffered formalin was added until a final concentration of 10% was achieved. The preservative was mixed in by gently rolling the sample jars. Calcium carbonate chips were added along with the collection labels. Adhesive waterproof labels were also placed on the exterior of the sample containers. Any samples taking up more than one container were labeled in series (ex “1 of 3”, “2 of 3”, etc.).

Laboratory Washing

Upon arrival at the laboratory, samples are inventoried and checked against chain-of-custody forms. Sample numbers and other information are entered into our record journal and samples are assigned Biologica reference numbers to facilitate labelling and record-keeping. Original field labels will be kept with the samples throughout the sample processing procedures and are retained with the debris.

After the samples are received they are transferred from formalin to alcohol. The sample material is gently washed on a geological screen to remove the formalin and any residual fine sediment. A screen size of at least half that of the field collection screen size (*i.e.* 0.500 mm) is used to retain soft-bodied organisms or fragments that may have shrunk during preservation. Larger samples are washed in portions to maximize washing efficiency and prevent loss of material. All material retained on the sieve is returned to the originally labelled plastic jar and preserved in 70% (v/v) ethanol. All original internal and external labels remain with re-screened sample material. Formalin is collected for disposal in an appropriate manner.

Splitting Technique

Caton Tray

The design of the tray is from a model created by Larry Caton, a biologist with the US government in Oregon. His idea was to split the sample as it is being sorted. The trays vary in size and are chosen depending on how much sediment is being sorted (6 quadrat, 12 quadrat and 24 quadrat or greater). Each size of tray also varies in mesh opening (0.250 mm or 0.500 mm) depending on the opening in the field screens. Initially, the sample is spread over the top screen by placing the Caton tray over a pan of water so that the debris is floated. When the sample is evenly spread out, the tray is drained and the sorter collects debris from a randomly selected quadrat (labelled with a letter and a number) and sorts that debris. The selection of additional quadrats is repeated until the target number of 300-500 organisms has been reached. For example: If a 6 quadrat Caton tray is used and in the sorting of one quadrat the required critter-number is reached, then the sample is completed with the 1/6th portion. The 1/6th fraction will then be used to extrapolate for the whole sample.

Sorting Technique

A standard biological stain (Rose Bengal) is added to the samples to facilitate the sorting process. Rose Bengal targets protein, turning organisms pink or red and making them easier to separate from the sediment matrix of the sample.

Samples are sorted by trained technicians. Small fractions of a sample are placed in a dish and sorted with a dissecting microscope at 10x to 60x magnification. The dish is scanned systematically and all animals are removed using fine forceps. Each dish is sorted until no further organisms are recovered (each dish is sorted at least twice, regardless of number of organisms recovered). Organisms representing major taxonomic groups (Polychaeta, Crustacea, Mollusca, Echinodermata and Other Taxa) are sorted into individually, labelled vials containing 70% ethanol.

Benthic Invertebrate Identification

Identifications are performed by qualified taxonomists using stereo dissecting microscopes and high-power compound microscopes. All organisms found in the samples are enumerated and identified to the lowest practical taxonomic level. If organism fragments are present, only anterior portions are counted. Identifications are checked for consistency by the principal taxonomist.

Identified organisms are stored in 70% ethanol in glass storage vials, with labels indicating sample number, taxonomist and date.

Internal QA/QC

25% of each sorters sorted samples are examined by a qualified sorter as a quality control measure. If the project requires QA re-sorts then each jar of sorted debris from each sample is examined. A portion of the sample from each jar is spread in a 9" x 13" white pan and examined under a dissecting microscope at 10x magnification. If more than three identifiable organisms are removed per 500 mL the sample is re-sorted.

Identifications of any new or unusual specimens are checked by the principal taxonomist.

Data Entry

The benthic data is entered into a Microsoft Excel table and checked against the taxonomist's bench sheets to ensure that no typographical errors were made. The raw data is forwarded to the lead contractor for analysis.

Total taxa per sample (species richness) is calculated in the following manner. Each species is counted as one taxon. Organisms which are identified to broader levels than species are counted if no organisms of the same type have been more precisely defined in the sample.

FRASER ENVIRONMENTAL SERVICES

METHODS MANUAL
JANUARY 1994

Revised July 2011

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FRASER ENVIRONMENTAL SERVICES

METHODS MANUAL

Details of the analytical methods used by Fraser Environmental Services are described here. Our firm employs similar standard techniques to ensure consistency over time. The QA/QC procedures employed can be found in the QA/QC Manual.

Phytoplankton Identification and Enumeration

Scope :

This method describes the identification and enumeration of phytoplankton.

Summary :

The sample is settled overnight and the slide is examined. Using the appropriate keys and procedures, phytoplankton can then be identified and subsequently enumerated.

Apparatus :

1. Utermohl-type settling chambers
2. Inverted microscope
3. Compound microscope
4. Appropriate taxonomic keys

Reagents :

1. Lugol's Solution : prepared as outlined in **Standard Methods for the Examination of Water and Wastewater.**

Procedure :

1. Calibrate the microscope using stage and ocular micrometers (see Section 1, page 8 for procedure).
2. Confirm that the sample is appropriately preserved.
3. Settle out an appropriate sample volume randomly removed depending on the density of organisms (usually 100 mL) for approximately 24 hours. Use smaller or diluted volumes for densely populated samples or concentrate sparsely populated samples by centrifugation or by sedimentation.
4. Scan the entire slide at increasing powers of magnification to determine which species/genera are present. Identify the organisms observed to the requested level if possible.
5. Once the identifications are made, do the counts. Count at least 20 random fields, continue counting until you get a total count of at least 100 for the dominant species if possible. Statistical tests for randomness have been performed.

6. Enumerate the data by a total cell count (cells/mL). Calculate the per mL total for each species or genera by multiplying the actual count by the factor F as defined below :

$$F = \frac{A / r^2 \pi N}{V}$$

where A= the area of the settling chamber
r= the radius of the field
N= the number of fields counted
V= the volume settled

Taxonomic Keys :

1. Bourrelly, P. (1966)
2. Cleve-Euler, A. (1951)
3. Cleve-Euler, A. (1968)
4. Contant, H. (1978)
5. Dodd, J. (1947)
6. Germain, H. (1981)
7. Hustedt, F. (1930)
8. Hustedt, F. (1985)
9. Komarek, J. and K. Anagnostidis. (1999)
10. Patrick, R. (1966)
11. Patrick, R. (1975)
12. Pennak, R. (1953)
13. Prescott, G. (1978)
14. Prescott, G. (1982)
15. Stein, J. (1975)
16. Ward, H.B. (1959)
17. Webber, C. (1966)

Note : Other taxonomic keys may be used.

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Wetzel, R.G. 1983. **Limnology: Second edition**.

Periphyton Identification and Enumeration

Scope :

This method describes the identification and enumeration of periphyton.

Summary :

The sample is settled for at least two hours and the slide is examined. The minimum settling time is dependent on the volume of the chamber used. Using the appropriate keys and procedures, periphyton can then be identified and subsequently enumerated.

Apparatus :

1. Utermohl-type settling chambers
2. Inverted microscope
3. Compound microscope
4. Appropriate taxonomic keys

Reagents :

1. Lugol's Solution : prepared as outlined in **Standard Methods for the Examination of Water and Wastewater.**
2. Hyrax mounting medium (or other medium with similar optical properties).

Procedure :

1. Calibrate the microscope using stage and ocular micrometers (see Section 1, page 8 for procedure).
2. Confirm that the sample is appropriately preserved. Measure and record the total volume of the sample.
3. Settle out an appropriate sample volume randomly removed, depending on the density of organisms for approximately 4 hours. Use smaller or diluted volumes for densely populated samples or concentrate sparsely populated samples by centrifugation or by sedimentation.
4. Scan the entire chamber at increasing powers of magnification to determine which species/genera are present. Identify the organisms observed to the requested level if possible.
5. If required prepare three diatom slides using either pyrolysis or acid digestion to clear the frustules. See Standard Methods for the Examination of Water and Wastewater for further details of these procedures.
6. Once the identifications are made, do the counts. From the settling chambers, count at least 10 random fields (at 1000X and/or 400X) continue counting until you get a count of at least 100 for the dominant species. Count at least one transect at 400X and two transects at 200X for more accurate counts of the less dominant species (optional).

7. Enumerate the data by a total cell count (cells/mL). Calculate the per mL total for

each species or genera by multiplying the actual count by the factor F as defined below :

$$F = \frac{A / r^2 \pi N}{V}$$

where A= the area of the settling chamber
r= the radius of the field
N= the number of fields counted
V= the volume settled

The cells per total sample can then be determined by multiplying by the total sample volume. Then divide by the area sampled to get cells per cm^2. In other words the count can be multiplied by factor P as defined below to get cells per cm^2 :

$$P = \frac{FD\ V_t}{A_s}$$

where F = the factor defined previously
D = the dilution
V_t = the total sample volume
A_s = the area sampled (cm^2)

Taxonomic keys:

1. Bourrelly, P. (1966, 1968 & 1970)
1. Cleve-Euler, A. (1951)
2. Cleve-Euler, A. (1968)
3. Contant, H. (1978)
4. Dodd, J. (1947)
5. Geitler, L. (1932)
6. Germain, H. (1981)
7. Huber-Pestalozzi, G. (1938, 1941, 1961,1955, 1972 & 1983)
8. Hustedt, F. (1930)
9. Hustedt, F. (1985)
10. Komarek, J. and K. Anagnostidis. (1999)
11. Krammer K. and H. Lange-Bertalot. (1986, 1988, 1991 & 2000)
12. Patrick, R. (1966)
13. Patrick, R. (1975)
14. Pennak, R. (1953)
15. Prescott, G. (1978)
16. Prescott, G. (1982)
17. Stein, J. (1975)
18. Ward, H.B and C. G. Whipple. (1959)
19. Webber, C. (1966)

Note : Other taxonomic keys may be used.

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Zooplankton Identification and Enumeration

Scope :

This method describes the identification and enumeration of zooplankton.

Summary :

The sample is settled and the slide is examined. Using the appropriate keys and procedures, zooplankton can then be identified and subsequently enumerated.

Apparatus :

1. Sedgwick-Rafters
2. Inverted microscope
3. Compound microscope
4. Stereoscopic microscope
5. Appropriate taxonomic keys

Reagents :

1. Preservative such as 70% ethanol or 10% buffered formalin
2. 0.04% rose bengal stain

Procedure :

1. Confirm that the sample is appropriately preserved. Measure and record the total volume of the sample.
2. Examine an appropriate sample volume depending on the density of organisms (usually 50 mL) in a petri dish. Use smaller or diluted volumes for densely populated samples or concentrate sparsely populated samples by centrifugation or by sedimentation.
3. Scan the entire sample at increasing powers of magnification to determine which species/genera are present. Identify the organisms observed to the requested level if possible.
4. Once the identifications are made, do the counts. Settle out a 1mL aliquot of a well mixed subsample in a Sedgwick-Rafter (concentrate sample if required), allow to settle for at least 15 minutes.
   Count the entire cell using a strip counting method. Count at least 3 of the 1mL aliquots, continue counting until you get a total count of at least 100 zooplankton organisms if possible.
5. Enumerate the data by calculating the total number of organisms per sample for each species or genera. Take an average count for each species or genera from all the aliquots counted. This gives you an organisms per mL count. Now the volume can then be multiplied in to give you a count of organisms per total sample.

Alternative Procedure :

Each sample is rinsed and sieved with water through a 64 micron Nitex sieve to remove the preservative. Each sample is made up to 100mL and a Hensen-Stemple pipette is used to remove 10 mL into another beaker (1/10 sub-sample), and that is made up to 100 mL and 10 mL removed for examination (1/100 sub-sample). The contents of the smallest sub-sample are identified to the lowest taxon and life-stage, and enumerated. Those species that occur in numbers fewer than about 10 (unless extremely small) are then looked for in the larger sub-samples. Thus, the largest and rarest organisms will be counted in their entirety, whereas the numbers of the smallest and commonest will be extrapolated.

Taxonomic Keys :

1. Balcer, M.D. et. al (1984)
2. Brandlova, J. et. al (1972)
3. Brooks, J.L. (1957)
4. Comita, G.W. et. al (1976)
5. Deevey, E.S. et. al (1971)
6. Edmondson, W.T. et. al (1959)
7. Edmondson, W.T. et. al (1982)
8. Fulton, J. (1968)
10. Green, G.D. et. al (draft)
11. Green, G.D. et. al (1982)
12. Green, G.D. et. al (1996)
13. Pennak, R.W. (1953)
14. Pennak, R.W. (1989)
15. Pinel-Alloul, B. et. al (1988)
16. Pontin, R.M. (1978)
17. Ruttner-Kolisko, A. (1974)
18. Sandercock, G. A. & G.G.E. Scudder. (1994)
19. Smith, D.L. (1977)
20. Ward, H.B. et. al (1959)

Note : Other taxonomic keys may be used.

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APPENDIX G

Meeting Minutes with Kangiqliniq Hunters and Trappers Organization

MEETING WITH KANGIQLINIQ HUNTERS AND TRAPPERS ORGANIZATION

July 15, 2011 at 12:00 pm

Turaarvik Inns North Boardroom

Attendees: Carey Sibbald (Nunami Stantec)

Norman Ford (HTO Secretary Manager)

John Tatty (HTO Board of Director)

Titaaq Komaksiutiksak (HTO Secretary Treasurer)

Jack Kabvitok (HTO President)

Aline Kabvitok (HTO President's spouse)

HTO members were reviewing maps and Nunami's project description before lunch. At the start of meeting, HTO members brought up concerns with Agnico-Eagle Mines Ltd's (AEM's) plans for infrastructure in Itivia Harbour. Community members use Itivia Harbour all the time for launching boats, right where AEM plans to construct their floating wharf. It is the only place that is accessible during low tide; the other harbour (with the dock/breakwater) is not accessible during low tide. They are concerned that the AEM use of Itivia Harbour will take away the boat launch for the community. Then what? Community will need to be compensated with another spot, fixed up for launching boats.

1) Introduced myself and Nunami Stantec; explained we're hired by AEM to conduct baseline study of marine fish and mammals in area of proposed floating wharf. Concerns will be communicated to AEM by Nunami however HTO should discuss concerns about infrastructure directly with AEM.
    - HTO understands and agreed
2) Inquired what type of fish people in Rankin Inlet catch? Where do they typically catch them and where do they come from?
    - People catch Arctic char, sculpin and cod
    - Catch char right at Itivia Harbour; there are cabins on either side of the harbour where people spend the summer; catch char there
    - Char usually come from the Diane River and Char River
    - Sculpins are caught everywhere; now only Elders eat them once in awhile, people used to eat them more often
    - People also collect a lot of mussels and clams all along the north shore of Melvin Bay during low tide

- John noted that he supports Nunami's study but notes the area is very important to locals; feels the owners of the cabins along Itivia Harbour have been or will be ignored; feels they should be compensated; would like to have more discussion with AEM regarding their plans
- HTO members noted the Itivia Harbour route is very important in the winter for skidoo travel in and out of the community
- HTO members also noted that the Itivia Harbour areas is very important because when barges (fuel, etc) come in, they block the entrance to the dock/breakwater harbour (in Johnston Cove); this forces boaters to go around the barges which is dangerous because it is very shallow; many people run aground. They boaters currently have Itivia Harbour though and they can use that when the barges come in.
- HTO President also noted they've noticed an impact in Itivia since there has been more traffic – less fish come in than they used to. Itivia used to be a really good fishing spot in 1960s and 1970s for Arctic char, sculpin and cod. Seal harvesting used to be good there too but now there's hardly any.

3) When is the best time to fish around Rankin Inlet? When do the char come?
    - August is usually the best time around the community but now don't catch as much as they used to
4) Does anyone in Rankin Inlet participate in commercial fishing?
    - Yes, people do do some commercial fishing, usually travel 25 to 30 miles out and catch a lot of char. Used to be catch closer to shore but now have to travel further away
5) Have mentioned people catch fish, mammals and mussels and clams, does anyone harvest seaweed?
    - No, no seaweed harvesting
    - HTO noted that people used to catch baby sculpin and mussels from along the shore during low tide, eat them raw; now with fuel and oil spills they don't eat them anymore
    - Department of Health told them mussels near the community are not good to eat anymore so have to go further away to catch them
6) Have mentioned people hunt seals, where do people usually hunt them and what types?
    - Used to catch seals near the community but now have to go further away
    - Usually catch Ring, Harbour and Bearded seals, also catch beluga; people also travel north to Repulse Bay to catch narwhal
    - At the dock/breakwater harbour, there used to be a lot of marine wildlife/mammals coming in, now not anymore

7) When does freeze up and break up usually happen?

    - Freeze up usually happens in mid to late October or early November; has changed in the last 10 years, used to freeze in mid-October
    - Also now it breaks up faster, usually in early to mid July
    - Have noticed the ice free period has gotten longer

8) Have mentioned you've noticed impacts in Itivia Harbour due to more traffic, do you think the additional traffic due to the proposed plans will further affect marine life?

    - Yes, think so; more traffic will have an effect. Definitely for marine mammals; noted people have seen it in Chesterfield Inlet – there are less seals and whales that come into the Inlet due to the increase in traffic going to Baker Lake

9) Do you know what Arctic char eat when they are in the ocean?

    - They eat little shrimp and small, shiny minnow-like fish, not sure what they are, maybe baby capelin; seals hunt and eat the small fish too
    - There are large schools of the small fish on the north side of the Peninsula

10) HTO noted several additional items:

    - Have noticed a decrease in Arctic terns and guillemots; there was a ban on egg collecting in 2007 for five years, just finished this year; AEM's proposed plans may affect birds too, not just marine mammals and fish. There are less terns and guillemots around, have also noticed it for sandpiper birds along the shore and birds like sandpipers but larger (maybe yellowlegs or plovers?). Think the birds are moving further north with the cooler weather.
    - HTO is concerned about how much room hunters will have with the proposed floating barge and crane at Itivia Harbour; want full access to the area all of the time, and not having to "come back when we're (AEM) is less busy"
    - People also use the reef that is at the end of the floating barge to anchor and shelter their boats
    - Students have been doing studies on peregrine falcon and rough-legged hawk around the area and on Panorama Island for the last 20 to 25 years; they will have concerns about the Itivia Harbour infrastructure and traffic too; noted falcons or hawks will dive in the water (ocean) if they see a fish swimming on the surface

11) Confirmed tides in Rankin Inlet

    - Itivia area is always accessible during low tide
    - Tides range from 10 to 20 feet depending on the moon and day

12) If any of the char Nunami catches dies, what would the HTO like us to do with it?

    - Give the fish to the HTO, we will distribute it around

13) Have mentioned that the Itivia Harbour area is very busy with local people and their boats; what's the best way for Nunami to put our nets in? Just have two buoys on either end?

    - Yes, just have two big buoys in either end; make it visible and obvious that it's a net and it will be fine

14) HTO asked Nunami several questions:

    - Wondered if we knew why the char flesh is turning more white than it used to, used to be more red; is it because of more chemicals in the water? What causes that? – Noted we've heard it before in other communities, might be due to a change in the fishes diets, eating different things than they used to, or maybe because of chemicals if there are any, or different water temperatures; we'd would have to test the fish flesh to start to figure it out; we (Nunami) are not testing the fish flesh
    - Wondered how we'll be catching fish, what kind of nets and what we're going to do with the fish – Noted we'll be catching fish with nets of different mesh sizes (six panels of all different sizes, from very small to large), set the nets perpendicular to shore; will also be using a seine net, with small mesh size, that we'll drive out from shore and then sweep back around to shore
    - Wondered what we'd do if we catch a seal – noted Nunami really hopes not to catch a seal, we'll be setting the nets for 2 to 4 hours or less, and will be watching the nets; however if we do catch a seal we would give it to the HTO to give to people in the community
    - Wondered if we caught a walrus, could we check it for trichinosis – noted that we couldn't check for trichinosis; would need to take a sample of the meat and look at it under a microscope; won't have a microscope
    - HTO noted there will be ducklings swimming around when we're doing our study (around August 9th); how visible will our nets be to ducklings? – Noted we will try to make our nets as visible as possible to ducklings, do not want to catch any ducks
    - HTO noted they would like a copy of our report on what we found – Noted we (Nunami) are producing two reports for AEM, which will become publicly available. Can probably develop a plain language summary of our report

Meeting adjourned at 1:30 pm

APPENDIX C • CLASSIFICATION PROJECT TERMS AND CONDITIONS FROM NPC APPLICATION

Project Certificate Conditions Applicable to the Meliadine Project Modification for Ocean Discharge

No.	Category	Term or Condition
1	Air Quality	Prior to commencing construction activities, the Proponent shall update its Air Quality Monitoring Plan, and shall consider installing two real-time air monitoring stations in advance of mining operations. The updated plan shall include, but is not limited to, details regarding the following: a. Description of real-time air monitoring stations including proposed timing of installation, location, and any factors considered with regards to planning for the installation; b. Plans for the collection of total suspended dust samples year round, including sampling for metals content relevant to the Project; c. Description of snowpack surveys and dustfall collectors; d. Description of lichen surveys; e. Identification of near field, far field and reference sites that are located with consideration of ambient wind conditions; f. Baseline data collected prior to significant construction activity; and g. A description of the proposed annual reporting mechanism and response framework.
3	Air Quality	Prior to commencing construction activities the Proponent shall update its dust management and monitoring plan to address and/or include the following additional items: a. Align plan requirements with commitments made in the FEIS and during the Final Hearing to monitor dust along the all-weather access road and associated roads and trails. b. Verify commitments to the utilization of dust suppressants along the all-weather access road including and associated roads and trails, including a description of the type of suppressant to be utilized, the frequency and timing of applications to be made throughout the various seasons of road use. c. Outline the specific adaptive management measures to be considered should monitoring indicate that dust deposition is higher than predicted, specifically where traffic along the all-weather access road is greater than initially predicted.
7	Climate and Meteorology, Climate Change - GHG	The Proponent shall provide within its annual report to the NIRB, calculations of greenhouse gas emissions generated by activities at the Itivia port and other Project sources including mine-related road traffic and aircraft associated with the Project. Calculations shall take into consideration, fuel consumption as measured by the Proponent's purchase and use as well as the fuel use of its contractors and sub-contractors.
8	Climate and Meteorology, Climate Change - GHG	To actively engage Inuit in initiatives related to climate change, where it is feasible, the Proponent shall endeavour to include the participation of Inuit from affected communities when undertaking climate-change related studies and research.
10	Noise and Vibration	The Proponent shall further develop and implement its noise abatement plan to protect people and wildlife from mine activity noise, including, blasting, drilling, equipment, vehicles and aircraft. The noise abatement plan will be developed in consultation the Government of Nunavut, Environment Canada and Health Canada as appropriate, and at a minimum is to include: a. Restrictions on blasting and drilling when migrating caribou, birds or local carnivores may be affected; b. The establishment of strict standards for noise levels; use of equipment and vehicles with the best noise attenuation devices; c. When practical, the use of fences or berms around noisy machinery or sites; d. Flight corridor restrictions over sensitive areas with known concentrations of wildlife and birds whenever possible; e. Requiring with the exception of take off and approach for landing, a minimum flight altitude of 300 metres above ground level when flights to and from the mine site are passing near sensitive wildlife and bird areas; and, f. The incorporation of the use of sound metres to monitor sound levels at locations in and around the mine site and local study area. The location and design of the sound metres shall be selected in consultation with EC and set up immediately upon issuance of the Project Certificate for the purpose of obtaining baseline data, and shall be maintained for data collection during and after operations.
17	Terrestrial Environment-Permafrost Integrity	The Proponent shall monitor the effects of the Project on permafrost conditions relative to Project infrastructure, including along the all-weather access road and associated roads, waste rock stockpile, trails and quarries. Through its monitoring the Proponent must demonstrate that permafrost integrity is maintained with implementation of appropriate preventative measures should permafrost degradation be observed.
18	Terrestrial Environment - As-built drawings and final design plans	The Proponent shall provide the NIRB with copies of as-built drawings and final design plans for Project infrastructure as they are developed/finalized to assist with the Board's ongoing monitoring efforts.

No.	Category	Term or Condition
24	Hydrogeology and Groundwater - Hydraulic data	The Proponent shall, reflecting any direction from the Nunavut Water Board during water licensing, collect new hydraulic data (e.g., from new monitoring wells) in key areas during the pre-development, construction and operation phases to better define vertical and horizontal ground flow in the project development area.
25	Hydrogeology and Groundwater - Saline Water Management Plan	The Proponent shall provide to the NIRB, a saline water management plan which includes, but is not limited to, 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.
26	Hydrogeology and Groundwater - Pit refill rates	The Proponent shall carry out continued analyses over time to confirm and update, accordingly, the approximate fill time for the mine pits as identified in the FEIS.
27	Hydrology and Sediment Quality - AEMP	The Proponent shall update its Aquatic Effects Monitoring Plan (AEMP) to include, at a minimum: a. Details regarding the monitoring of non-point sources of discharge, selection of appropriate reference sites, measures to ensure the collection of adequate baseline data at Meliadine Lake prior to and during construction activities, including information on chemical loading in the snowpack, and the mechanisms proposed to monitor for and treat runoff and sediment; b. A description of measures to be undertaken as relate to dustfall monitoring, designed in accordance with the following: i. To establish Phase 1 all-weather access road baseline data and a description of plans for data collection during Project operations for comparison; ii. To facilitate comparison with existing guidelines; iii. To assess the seasonal deposition (rates, quantities) and chemical composition of dust entering aquatic systems along representative distance transects of the all-weather access road and Rankin Inlet by-pass road; c. A description of water quality monitoring to be conducted at Little Meliadine Lake; and d. Details regarding comparisons of results to be run against predicted values and the analysis of data to be undertaken on an annual basis, or as may be required.
28	Hydrology and Sediment Quality -Sediment and Erosion Control Plan	The Proponent shall develop and implement a sediment and erosion management plan to prevent or minimize the effects of destabilization and erosion that may occur due to Project activities. The plan should also detail sediment control plans to prevent and/or mitigate sediment loading into surface water within the Project area.
29	Hydrology and Sediment Quality -water infrastructure monitoring	The Proponent shall develop and implement adequate monitoring and maintenance procedures to ensure that the culverts and other conduits that may be prone to blockage do not significantly hinder or alter the natural flow of water from areas associated with the proposed mine. In addition, the Proponent shall monitor, document and report the withdrawal rates for water removed and utilized for all domestic and industrial purposes.
32	Freshwater Aquatic Environment- Site Drainage and Silt Control Plan	Prior to the commencement of construction, the Proponent shall submit to the NIRB, a Site Drainage and Silt Control Plan.
35	Vegetation-Site footprint	The Proponent shall ensure that Project components and activities are planned and conducted in such a way as to minimize the Project footprint; this should include input from potentially affected communities where applicable.
36	Vegetation-Invasive species	The Proponent shall ensure that equipment and supplies brought to Project sites are clean and free of soils that could contain plant seeds not naturally occurring in the area. Vehicle tires and treads in particular must be inspected, and cleaned if required, prior to transport into Nunavut for use in Project areas.
37	Vegetation- monitoring for Invasive species	The Proponent shall incorporate protocols for monitoring for the potential introduction of invasive vegetation species (e.g. surveys of plant populations in previously disturbed areas) into its Terrestrial Environment and Monitoring Plan. Any introductions of non-indigenous plant species must be promptly reported to the Government of Nunavut Department of Environment.
43	Terrestrial Wildlife and Wildlife Habitat- General	The Proponent shall continue to develop and implement Project-specific monitoring for the terrestrial environment through its Terrestrial Environment Management and Monitoring Plan (TEMMP), and will demonstrate appropriate refinements to design, incorporation of analytical methods and elaboration of methodologies. The TEMMP shall contain clear thresholds to allow for the assessment of long-term trends and cumulative effects where project interactions are

No.	Category	Term or Condition
		identified. Coordination and cooperation will be required where data collection, analysis and interpretation, or responsibility for mitigation and management requires the efforts of multiple parties (e.g., government, Kivalliq Inuit Association, communities).
44	Terrestrial Wildlife and Wildlife Habitat- Caribou monitoring	In consultation with the Government of Nunavut (GN) and other relevant parties, the Proponent shall further develop its Terrestrial Environment Management and Monitoring Plan (TEMMP) to include increased caribou monitoring across the regional study area and additional details on the scope and design of monitoring programs. The Proponent shall also demonstrate consideration for contributing to existing and planned regional monitoring initiatives associated with terrestrial wildlife and wildlife habitat as appropriate. Monitoring should be adequate to test impact predictions, monitor impact thresholds and trends over time, and to support implementation of mitigation measures as proposed in the Final Environmental Impact Statement.
45	Terrestrial Wildlife and Wildlife Habitat- general monitoring	The Proponent shall demonstrate consideration for cooperating with existing and planned regional and/or community-based monitoring initiatives associated with terrestrial wildlife and wildlife habitat that produce information pertinent to mitigating project-induced impacts. The Proponent shall give special consideration for supporting regional studies of population health and harvest programs for Qamanirjuaq caribou which help address areas of uncertainty for Project impact predictions.
46	Terrestrial Wildlife and Wildlife Habitat-harvest study	The Proponent shall update its Terrestrial Environment Management and Monitoring Plan (TEMMP) for the Project to include a detailed harvest study prepared in consultation with the Government of Nunavut (GN) and other affected parties. The design of the harvest study should demonstrate consideration for the following: a. Hiring of a dedicated local survey coordinator through local Hunters and Trappers Organizations (HTOs) and provision of adequate resources for the HTOs to run the program; b. The potential effects on caribou populations and on caribou behaviour resulting from increased human access caused by the all-weather access road and associated roads and trails; and, c. Increasing local knowledge of the project development areas, including establishing baseline harvesting levels prior to unrestricted public access on the all-weather access road.
47	Terrestrial Wildlife and Wildlife Habitat monitoring	The Proponent shall share information with the Government of Nunavut (GN) relating to the migration of caribou and include the GN as a party respecting caribou monitoring and movement through Project development areas, including the all-weather access road and associated roads and trails.
48	Terrestrial Wildlife and Wildlife Habitat monitoring	In consultation with the Government of Nunavut, the Kivalliq Inuit Association, the Kivalliq Wildlife Board and local Hunters and Trappers Organizations, the Proponent shall develop appropriate monitoring and mitigation measures relating to the harvesting of caribou and improved harvesting access granted by the all-weather access road. These measures shall be included within a Road Access Management Agreement that must be in place prior to construction of phase 2 of the all-weather access road. The Road Management Agreement shall include the following specific measures: • During periods when large aggregations of caribou (greater than 50 individuals) are detected within 1 km of the all-weather access road (AWAR), the road will be closed to public access via car and truck by means of a barrier at the southern gate. Public access using all-terrain vehicles (ATVs) will be allowed. • During periods when large aggregations of caribou (greater than 50 individuals) are observed within 1 km of the AWAR, the road will be closed to public access via barriers at bridges on the AWAR to prevent all vehicle access, including ATVs. This will allow ATVs to enter areas previously accessible along existing trails while not facilitating access via bridges constructed specifically for the Project. • Following consultation with the Nunavut Wildlife Management Board, as required under the Nunavut Wildlife Act, it is recommended that a no-shooting zone (1 km wide) on either side of the road should be established as a condition of public access to the AWAR and compliance with this Agnico Eagle policy should be monitored and reported by the Proponent. • Dedicated 'road monitors' should patrol the road to ensure compliance with the provisions of the Road Management Plan (SD 2-9) relating to public safety and wildlife. Monitoring should be increased during periods of road closure when large aggregations of caribou are present. • All incidents of hunting involving shooting along or across the AWAR should be reported by the Proponent to the GN. • During periods when large aggregations of caribou are detected near the Project, harvest monitoring intensity should be increased to ensure that levels of caribou harvesting are properly documented.
49	Terrestrial Wildlife and Wildlife Habitat- research licensing	The Proponent is encouraged to consult with the Nunavut Research Institute (NRI) on the research permitting process as it relates to the Nunavut Scientists Act. The Proponent is encouraged to share monitoring and research study design with the NRI four (4) months prior to the anticipated commencement of research activities to facilitate licensing review.

No.	Category	Term or Condition
55	Terrestrial Wildlife and Wildlife Habitat- wildlife mortality	In consultation with the Government of Nunavut (GN) and other affected parties, the Proponent shall set thresholds for direct mortality of wolf, grizzly bear, polar bear, wolverine, and fox to ensure monitoring and mitigation for the Project is responsive to undesirable rates of mortality. The Proponent shall reach an agreement with the appropriate Designated Inuit Organization regarding compensation or any direct mortality of wildlife resulting from the Project.
56	Terrestrial wildlife and Wildlife Habitat- reporting	The Proponent shall report annually to the NIRB regarding its terrestrial environment monitoring efforts, with inclusion of the following information: a. Description of all updates to terrestrial ecosystem baseline data; b. A description of the involvement of Inuit in its monitoring programs; c. A detailed presentation and analysis of the distribution relative to Project infrastructure and activities for caribou and other terrestrial mammals observed during surveys and incidental sightings; d. Results of the annual monitoring program, including field methodologies and statistical approaches used to support conclusions drawn; and e. An assessment and presentation of annual environmental conditions including timing of snowmelt, green-up, as well as standard weather summaries.
57	Terrestrial Wildlife and Wildlife Habitat- reporting	Within its annual report to the NIRB, the Proponent shall incorporate a review section which includes: a. An examination for trends in the measured natural variability of Valued Ecosystem Components in the region relative to the baseline reporting; b. A detailed analysis of wildlife responses to operations with emphasis on wildlife behaviour, mortalities and displacements (if any), and responses to operations of the all-weather access road and associated access roads/trails; c. A demonstration and description of how the monitoring results, including the all-weather access road and associated access roads/trails contribute to cumulative effects of the project; and d. Any proposed changes to the monitoring survey methodologies, statistical approaches or proposed adaptive management stemming from the results of the monitoring program.
61	Birds and Bird Habitat- construction/clearing activities	Prior to bird breeding season, the Proponent shall either conduct clearing activities or identify and install nesting deterrents (e.g., flagging) to discourage birds from nesting in areas likely to be disturbed by construction/clearing activities. If clearing is to take place during the nesting season, a nest survey should take place to identify nests and any identified nests must remain undisturbed until the young have fledged or left the nest. Any nests identified shall be included as part of the annual reporting for the Terrestrial Environmental Mitigation and Monitoring Plan (TEMMP).
62	Birds and Bird Habitat- construction/clearing activities	The Proponent shall protect any nests found (or indicated nests) with a buffer zone determined by the setback distances outlined in its Terrestrial Environment Mitigation and Monitoring Plan (TEMMP), until the young have fledged. If it is determined that observance of these setbacks is not feasible, the Proponent will develop nest-specific guidelines and procedures to ensure bird's nests and their young are protected.
72	Birds and Bird Habitat- monitoring	The Proponent shall continue to develop and update relevant monitoring and management plans for migratory birds under the Proponent's Environmental Protection Plan and Terrestrial Environment Mitigation and Monitoring Plan (TEMMP) prior to construction. The key indicators for follow up monitoring under this plan will include upland birds (including migratory birds), waterbirds, raptors, and seabirds including migration and wintering.
74	Birds and Bird Habitat	The Proponent's Terrestrial Management and Monitoring Plan (TEMMP) shall include mitigation measures implemented to prevent the use of water attenuation ponds by waterfowl and waterbirds and monitoring that assesses whether the mitigation measures are working or revised or further deterrent measures are required.
76	Marine Environment - General	The Proponent shall update all relevant plans including, but not limited to: the Shipping Management Plan, Wildlife Mitigation and Monitoring Plan, and Adaptive Management Plan, in order to address concerns and identify potential impacts of the Project and proposed mitigation measures designed to protect the integrity of the marine environment. The Shipping Management Plan shall also incorporate updates for all Project-related shipping.
77	Marine Environment - Spill prevention	The Proponent shall ensure that it maintains the necessary equipment and trained personnel to respond to all sizes of potential spills associated with the Project in a self-sufficient manner.
79	Marine Wildlife- update baseline	Prior to any Project-related shipping, the Proponent will update its marine baseline information to ensure that it includes the most recent information on marine wildlife abundance and distribution, carefully considers seasonal distribution patterns of marine wildlife, and incorporates western scientific and Inuit Qaujimajatuqangit knowledge sources. The updated marine baseline should be made available to appropriate authorities for feedback, then incorporated into the Proponent's Shipping Management Plan (SMP), with continued updates on a regular basis as new information becomes available.
80	Marine wildlife- marine baseline	The Proponent shall assess its available baseline information for Melvin Bay and for the area surrounding the fuel transhipment anchorage to ensure that both are adequate for the detection of Project-related impacts, particularly related to contaminants.

No.	Category	Term or Condition
86	Marine Wildlife-cumulative effects	The Proponent is encouraged to liaise with relevant stakeholders, regulatory agencies and/or forums (e.g. the Marine Environmental Working Group associated with the Mary River Project), that might allow for participation in relevant research and management initiatives and increasing understanding and mitigation of potential cumulative effects associated with the Project's shipping activities through the Hudson Strait.
87	Economic development, contracting and business opportunities	The Proponent is strongly encouraged to participate in the work of the Kivalliq Socio-Economic Monitoring Committee along with other agencies and the communities of the Kivalliq region, and to identify areas of mutual interest and priority for inclusion into a collaborative monitoring framework that includes socio-economic priorities related to the Project, communities, and the Kivalliq region as a whole.
88	Economic development, contracting and business opportunities	The Proponent is encouraged to work in collaboration with other socio-economic stakeholders including for example, the KIA, GN, AANDC, and communities of the Kivalliq region, to establish a socio-economic working group for the Project to develop and oversee the Meliadine Socio-economic Monitoring Program. The working group should develop a Terms of Reference which outlines each member's roles and responsibilities with regards to, where applicable, project-specific socio-economic monitoring throughout the life of the Project. The Terms of Reference are to be provided to the NIRB upon completion, and within one year of issuance of the Project Certificate.
89	Economic development, contracting and business opportunities	The Proponent shall develop the Meliadine Socio-economic Monitoring Program to monitor the predicted impacts outlined in the FEIS as well as regional concerns identified by the Kivalliq Socio-economic Monitoring Committee (SEMC). Where possible, the Proponent is encouraged to work in collaboration with all other socio-economic stakeholders such as the KIA, GN, AANDC and the communities of the Kivalliq region in developing this program, which should include a process for adaptive management and mitigation in the event unanticipated impacts are identified. Details of the Meliadine Socio-economic Monitoring Program are to be provided to the NIRB upon finalization, and within one year of issuance of the Project Certificate.
95	Education and training	The Proponent is encouraged to work with training organizations and/or government departments offering mine-related or other training in order to provide additional opportunities for residents and employees to gain meaningful and transferable skills and certifications.
101	Population demographics-employee origin	The Proponent shall include with its annual reporting to the NIRB a summary of employee origin information as follows: a. The number of Inuit and non-Inuit employees hired from each of the Kivalliq communities, specifying the number from each; b. The number of Inuit and non-Inuit employees hired from each of the Kitikmeot and Qikiqtani regions, specifying the number from each; c. The number of Inuit and non-Inuit employees hired from a southern location or other province/territory outside of Nunavut, specifying the locations and the number from each; and d. The number of non-Canadian foreign employees hired, specifying the locations and number from each foreign point of hire.
103	Traditional activity and knowledge	The Proponent is encouraged to consult with the Kangiqliniq Hunters and Trappers Organization and the Kivalliq Socio-Economic Monitoring Committee and to make all reasonable efforts to engage Elders and community members of the Kivalliq communities in order to have community level input into updates to its monitoring plans, programs and mitigative measures. This type of engagement will ensure that these programs and measures have been informed by traditional activities, cultural resources, and land use as such may be implicated or impacted by ongoing Project activities. All plans are to include a feedback mechanism for consulting with residents of the Kivalliq, including the provision of results from the Proponent's wildlife monitoring programs to each community. The Proponent shall submit updated plans to the NIRB within 30 days' of their revision and/or finalization.
104	Non-traditional land use and resource use	The Proponent is encouraged to consult with outfitting and guiding businesses that operate in the LSA and RSA regarding use of the area, specifically as it relates to hunting, fishing and guiding within proximity of the AWAR. Results of this consultation should be incorporated into updated plans where applicable.
118	Accidents and Malfunctions- all-weather access road	The Proponent shall include in an updated Terrestrial Wildlife Management and Monitoring Plan (TEMMP), plans for increased caribou monitoring efforts including weekly winter track surveying and summer and fall surveys undertaken on foot twice per month. These results shall be reported to the NIRB with the Proponent's annual reporting requirements.
119	Accidents and Malfunctions- all-weather access road	The Proponent shall include within its updated Terrestrial Wildlife Management and Monitoring Plan, a commitment to establishing deterrents along the AWAR at any areas where it is observed that caribou are attracted to the AWAR and their presence may present a risk of collisions with traffic along the AWAR (such as areas where caribou are utilizing the AWAR to facilitate movement, areas where caribou may be licking minerals/road salt from the road, areas where caribou are gathering to avoid insects, etc.).
124	Accidents and Malfunctions- spill	Prior to construction, the Proponent shall update its Spill Contingency Plan specific to a major spill event occurring on the bypass road and within proximity to (and including potential spills into) Nipissar Lake.

No.	Category	Term or Condition
	preparedness	
125	Accidents and Malfunctions- all-weather access road	The Proponent shall implement all such measures necessary to protect public and mine traffic on all Project roads. The measures undertaken shall include, but are not limited to: a. Prior to expansion of the AWAR, the Proponent shall update its Roads Management Plan to include a detailed consultation plan specifying the methods the Proponent will use to provide the Kivalliq Inuit Association, members of the Hunters and Trappers Organizations in the area, residents of Rankin Inlet and the Hamlet of Rankin Inlet with information regarding the safety requirements of AWAR use. The updated Plan is to be submitted to the Nunavut Impact Review Board, Kivalliq Inuit Association, Kangiqliniq Hunters and Trappers Organization, and the Government of Nunavut; b. Prior to the opening of the AWAR to the public, and annually thereafter, advertise and hold at least one community meeting in the Hamlet of Rankin Inlet and Chesterfield Inlet to explain to the community the rules for use of the road; c. Prior to the opening of the AWAR to the public, the Proponent shall address enforcement of health and safety rules for the operation of the road (i.e., no shooting zone) and implement necessary communications with the public (i.e., signage and public meetings), which includes, but is not limited to: i. Maintaining manned and unmanned gates as proposed along the all-weather access road; ii. The posting of signs in English and Inuktitut along the road at appropriate intervals (i.e., 10 km and bridge crossings); and iii. Place notices at least quarterly on the radio and television to explain to the community the rules for use of the road; d. Once the AWAR expansion is completed and the road is opened to the public, the Proponent shall conduct a vehicle survey four times annually (once during the weekdays during the winter season, once during the week end days during the winter season, once during the weekdays during the summer season and once during the week end days during the summer season) to record the number and types of mine vehicles and the number and type of public vehicles using the AWAR over a 12 hour period (8:00 am to 8:00 pm). The vehicle survey data shall be collated as indicated above and provided in the Proponent's Annual Report; e. Prior to the development of the Discovery deposit, the Proponent shall update its Road Management Plan for the planned operation of the twinned road which could include additional rules, Project infrastructure, or other measures designed to maintain safety for employees and the public; and f. Report all accidents or other safety incidents on the road, to the Government of Nunavut, Kivalliq Inuit Association, the Hamlet of Rankin Inlet and the NIRB immediately.

APPENDIX D • MELIADINE GOLD MINE - GROUNDWATER MANAGEMENT PLAN, JUNE 2018

AGNICO EAGLE

MELIADINE GOLD MINE

Groundwater Management Plan

JUNE 2018
VERSION 2

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 12.1 million tonnes (Mt) of ore, 31.8 Mt of waste rock, 7.4 Mt of overburden waste, and 12.1 Mt of tailings (Agnico Eagle 2017). 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).

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.

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

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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
MMER	Metal Mining Effluent Regulations
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 Certificate (No. 006) issued 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 discharge of saline groundwater in compliance with the Type A Water Licence 2AM-MEL1631 (Licence). Overall water management for the life of the Mine and post-closure is described in the Agnico Eagle Meliadine Gold Mine Water Management Plan, dated March 2017 (6513-MPS-11) (WMP). The WMP provides descriptions of the Mine water control structures and associated design criteria. The WMP will be updated in March 2018 to reflect 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.

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 management strategies (Section 3); and
- A description of the groundwater monitoring program (Section 4).

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 2 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 south west 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 12.1 million tonnes (Mt) of ore, 31.8 Mt of waste rock, 7.4 Mt of overburden waste, and 12.1 Mt of tailings (Agnico Eagle 2017). The following phased approach is proposed for the development of the Tiriganiaq gold deposit:

- Phase 1: 4 years for Mine Construction. Construction began in 2015 and is estimated to be complete in 2019;
- Phase 2: 8 years for Mine Operations, beginning in 2017 and ending in 2027;
- Phase 3: 3 years Mine Closure, from 2028 to 2030; and
- Phase 4: Post-closure (2031 forwards).

Mine facilities on surface include a plant site and accommodation buildings, three 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, and a final Effluent Water Treatment Plant (EWTP). The general location and site layout of the Mine are shown in Figure 1 of Appendix A.

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 field work 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, in combination with the updated Mine geologic model, 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 and updated predictions of groundwater inflow using the developed numerical (Golder 2017), are provided in Table 1.

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 2017).

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, 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.

3.2 Existing Groundwater Management Control Structures

Contact water in the Underground Mine is contained within underground sumps. A proportion of the underground water will be recirculated as make-up water for underground drilling. The drilling water will report to the underground sumps for recirculation; however, the need for up to 3% treated water make-up has been assumed to compensate for losses of drilling water due to evaporation or capture within the mined waste rock that is transferred to surface. Calcium chloride is currently not added to the underground water but has been used in the past and potentially again in the future to increase salinity and reduce water freezing during drilling.

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, Collection Pond 5 (CP5) or actively evaporated during the open water season (Agnico Eagle 2017). Details of the underground dewatering system are provided in the Mine Plan (Agnico Eagle 2015a) and details of the pond are provided in the WMP (Agnico Eagle 2017).

The pond capacities and maximum water elevation for storage of the saline water are presented in Table 2. The locations of the ponds are shown on Figure 1 of Appendix A. The estimated volume of groundwater inputs to surface storage for management are expected to range from approximately a minimum of 0.11 million cubic metre(s) per year (Mm^3/year) to a maximum of 0.18 Mm^3/year, dependent on year of Mine life (Agnico Eagle 2017).

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)
CP5	46,674	66.0
Saline Pond	32,686	62.9
P1	20,781	68.5
P2	6,828	66.5
P3	18,432	67.0

Source: Agnico Eagle (2017).

3.3 Groundwater Quality

Groundwater investigations undertaken indicate that total dissolved solids (TDS) concentrations are relatively consistent below the permafrost at approximately 64,000 mg/L (Golder 2016). Recent groundwater quality data from the Underground Mine collected by Agnico Eagle in 2016 and 2017 from diamond drillholes (DDHs), indicates mostly stable concentrations for several parameters

(Table 3) and suggest that TDS concentrations may be less at approximately 50,000 to 55,000 mg/L, on average, and the assumption of TDS at 64,000 mg/L may represent a more conservative estimate. 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 ammonium nitrate, fuel oil [ANFO] and emulsion explosives).

Table 3: Average Underground Saline Water Quality

Representative Months (average per month)		Aug 2016	Sep 2016	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017
Parameters (total metal)	**Units**														
pH	pH	7.09	7.09	7.34	7.99	7.17	7.08	6.87	7.11	7.32	7.38	7.27	8.27	7.45	7.33
Alkalinity	mg/L	65	69	56	72.6	64	57	61.7	51	64.5	68	68	75	68.2	64
Conductivity	µmhos/cm	53320	70323	77750	79800	56000	77000	76500	77000	79000	79000	76308	74385	72200	72667
Total Hardness (as $CaCO_3$)	mg/L	14923	14644	13125	13260	13700	13200	18267	12700	18400	12433	12623	12500	12583	11700
Turbidity	NTU	82.85	93.00	56.25	27.56	74.00	123.75	69.00	88.00	90.00	51.00	75.00	61.00	47.02	104.33
Total Dissolved Solids (TDS)	mg/L	39663	50765	58600	60600	55000	54350	66433	54900	57500	57300	55123	57815	57520	54567
Total Suspended Solids (TSS)	mg/L	41	68.5	61	108.6	29	45	75.7	63	248.5	102.7	102.2	156	86	102
Aluminum (Al)	mg/L	0.56	8.72	0.075	0.32	0.06	0.21	0.10	6.02	1.29	0.51	1.45	0.73	0.97	1.75
Ammonia Nitrogen (NH_3-NH_4)	mg/L	4.66	4.20	5.93	5.98	3.50	4.13	105.3	4.50	4.95	5.20	5.51	11.1	4.87	4.43
Arsenic (As)	mg/L	0.0012	0.32	0.005	0.005	0.002	0.003	0.005	0.01	0.008	0.004	0.016	0.016	0.102	0.013
Barium (Ba)	mg/L	0.05	0.19	0.09	0.10	0.05	0.06	0.61	0.10	0.27	0.07	0.09	0.25	0.10	0.07
Beryllium (Be)	mg/L	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.01	0.002	0.002	0.005	0.008	0.01	0.01
Boron (B)	mg/L	1.4	1.7	1.5	1.5	1.8	1.6	4.98	5.0	4.9	1.5	2.7	3.97	5.0	2.5
Total Organic Carbon (TOC)	mg/L	4.95	2.65	3.68	4.28	2.00	2.23	11.67	2.10	2.95	2.63	3.20	5.30	2.57	2.50
Dissolved Organic Carbon	mg/L	2.60	2.35	3.45	3.74	1.90	1.90	10.17	1.70	2.30	2.37	2.70	4.90	2.32	2.10
Calcium (Ca)	mg/L	1899	1955	1965	1816	1800	1710	3777	1650	3737	1593	1608	1771	1610	1565
Cadmium (Cd)	mg/L	0.00002	0.0002	0.0002	0.0013	0.0002	0.0003	0.0002	0.001	0.0003	0.0002	0.0005	0.001	0.001	0.002
Chloride (Cl - dissolved)	mg/L	—	33500	31000	32800	34000	31250	38000	31000	31500	32000	31385	31538	32800	29333
Chromium (Cr)	mg/L	0.01	0.015	0.018	0.014	0.02	0.025	0.017	0.01	0.02	0.017	0.05	0.075	0.1	0.88
Copper (Cu)	mg/L	0.26	0.44	0.009	0.009	0.01	0.01	0.008	0.05	0.01	0.01	0.02	0.04	0.05	0.03
Cyanide (CN)	mg/L	0.005	0.006	0.008	0.017	0.005	0.005	0.19	0.005	0.028	0.005	0.006	0.01	0.005	0.008
Iron (Fe)	mg/L	9.68	40.28	6.48	5.23	4.31	4.76	8.96	3.60	8.78	6.19	9.81	6.33	8.24	4.10
Lead (Pb)	mg/L	0.002	0.002	0.004	0.005	0.004	0.005	0.005	0.02	0.004	0.003	0.009	0.015	0.02	0.018
Magnesium (Mg)	mg/L	2475	2170	2053	2118	2230	2168	2150	2080	2200	2050	2092	1962	2105	1975
Mercury (Hg)	mg/L	0.0002	0.01	0.00001	0.00002	0.00001	0.00001	0.00001	0.00001	0.000001	0.00001	0.00001	0.00001	0.00001	0.00001
Molybdenum (Mo)	mg/L	0.01	0.015	0.04	0.013	0.02	0.025	0.055	0.01	0.25	0.026	0.047	0.075	0.1	0.17
Nickel (Ni)	mg/L	0.05	0.04	0.02	0.01	0.02	0.025	0.04	0.1	0.07	0.017	0.05	0.08	0.1	0.35
Nitrate (NO_3) as N	mg/L	0.15	0.168	0.88	0.57	0.1	0.5	116.39	0.1	2.58	0.23	0.89	4.35	0.17	0.34
Nitrite (NO_2) as N	mg/L	0.02	0.04	0.089	0.072	0.05	0.05	8.01	0.1	0.125	0.086	0.14	0.391	0.042	0.027
Total Kjeldahl Nitrogen (TKN)	mg/L	4.49	3.65	6.95	7.58	5.90	3.78	112.47	4.60	5.20	7.83	7.40	12.0	72.02	4.50
Phosphorous (P)	mg/L	0.05	0.14	0.05	0.05	0.04	0.07	0.14	0.04	0.13	0.12	0.08	0.09	0.1	—
Potassium (K)	mg/L	512	504.5	460.5	493.6	454	496	595	407	609	433	463	518	488	763
Radium-226 (Ra 226)	mg/L	—	—	—	1.9	1.7	0.49	0.33	0.3	1.2	1.95	1.8	1.9	2.2	0.29
Selenium (Se)	mg/L	0.23	0.006	0.0018	0.0033	0.002	0.003	0.002	0.01	0.002	0.002	0.005	0.0075	0.01	0.007
Silver (Ag)	mg/L	0.002	0.003	0.0004	0.0005	0.0004	0.001	0.0003	0.002	0.0009	0.0004	0.0012	0.0018	0.0002	0.018
Sodium (Na)	mg/L	16379	16000	14100	14600	15100	14625	14700	13400	15400	13900	14369	14654	14417	9433
Strontium (Sr)	mg/L	39.8	39.4	44.7	40.9	40.1	43.1	171	38.4	136	40	39	43.5	36.5	23.6
Sulphate (SO_4 – dissolved)	mg/L	—	3350	3125	3260	3200	3125	2700	3100	3100	3233	3169	2969	3120	3067
Thallium (Tl)	mg/L	0.0009	0.0008	0.0009	0.0006	0.001	0.001	0.001	0.001	0.0002	0.0002	0.0005	0.001	0.001	0.002
Uranium (U)	mg/L	0.002	0.003	0.002	0.002	0.002	0.003	0.002	0.01	0.006	0.002	0.005	0.008	0.01	0.09
Vanadium (V)	mg/L	0.05	0.08	0.09	0.06	0.1	0.13	0.08	0.5	0.1	0.08	0.23	0.38	0.5	0.33
Zinc (Zn)	mg/L	0.06	0.08	0.36	0.1	0.1	0.125	0.1	0.5	0.12	0.08	0.23	0.38	0.5	0.34

Source: Groundwater quality data from DDH sample location (Agnico Eagle, October 2017)

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."*

Groundwater management alternatives were considered for the Mine based on the potential range of groundwater flows and quality that could be generated (refer to Appendix F of the WMP; Agnico Eagle 2015a). The option selection has been driven by the expected quality and quantity of the water.

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 in combination with treated surface contact water (Section 3.4.2)
- Potential Future Long-term Strategy: ocean disposal (see Section 3.4.3)

The short and long-term groundwater management strategies are described below. At this time, Agnico Eagle is requesting approval from the NWB for the short-term strategy and the current long-term strategy to discharge to Meliadine Lake. The potential future long-term strategy of ocean disposal is still under assessment and provided for information purposes.

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 being 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 2017), a total of nine water containment ponds are planned on-site at the Mine surface (CP1, CP3, CP4, CP5 and CP6, the P-Area [P1, P2, and P3], and the Saline Pond), and associated water retention dykes, water diversion berms, channels, and culverts, to manage surface water and underground water (Figure 1).

Evaporators have been in-use on site since mid-2017 at P1 to reduce groundwater volumes stored in surface water ponds. A single evaporator is estimated to remove approximately 500 m^3/day when operated for 24 hours with ideal wind and relative humidity conditions. While evaporators have

been used with some success, the combined volumes of groundwater 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.

These short-term storage and treatment options are being implemented at the Mine pending regulatory approvals for the long-term groundwater management option.

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

Effluent discharge to Meliadine Lake was assessed as part of the FEIS and modelled as part of the Water Licence Application (Agnico Eagle 2014, 2015a) and discharge criteria have been defined in the Licence. Provided the discharge criteria can be met following commissioning of the treatment system, this option represents the immediate long-term management strategy to be implemented at the Site in 2018. Approval of this plan will be required, prior to discharge, as per the Term and Condition Part E, No. 14 of the Licence. Total discharge to Meliadine Lake, including the treated groundwater, will remain within the permitted daily volume and meet the discharge criteria defined in the Licence.

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 also undertaken a pilot test of a SaltMaker combined with a Chemical-RO post-treatment system and based on the results of this testing decided to proceed with this technology.

The groundwater will flow through a Saltwater Treatment Plant (SWTP), comprised of a set of SaltMakers, and will be treated to remove excessive total suspended solids (TSS), calcium chloride ($CaCl_2$), sodium chloride (NaCl), metals, phosphorous (P), and nitrogen compounds. The salt generated by the water treatment unit will be stored at the Mine, where it will be re-used for underground operations and/or disposed of at an appropriate disposal location. Given the predicted groundwater volumes, a maximum of three SaltMakers are proposed to be built at the Mine, forming the SWTP, to treat the groundwater for discharge to the environment. Two SaltMaker's have been procured and are anticipated to be in operation between Q3 2018 and Q1 2019. Additional SaltMakers could be built at the Mine to meet the discharge volumes required. This need will be evaluated based on the effectiveness of the short-term management strategies and observed operational capacities of the SaltMakers, which are anticipated to be 120 m^3/day. The saline effluent temperature from the SWTP is expected to be approximately 35 °C, with an approximate pH of 7.5 (Saltworks 2017). The SWTP effluent largely meets the required Water Quality Output requirements defined in Agnico Eagle's Desalination Water Treatment Plan Design Criteria and passes completed toxicity tests (Saltworks 2017). Treated effluent quality (of the groundwater) through the SWTP indicates that TDS concentrations would be approximately 158 mg/L (condensed water after treatment; Saltworks 2017).

Post-treatment options, such as the RO post-treatment system, are being considered if required, to meet applicable effluent quality criteria for Meliadine Lake. The permeate resultant from the Chemical-RO post-treatment system meets all the required Site-Specific Water Quality Objectives (SSWQO) and passes completed toxicity tests. Saline effluent quality after secondary treatment through the SWTP indicates that TDS concentration would be considerably reduced, at approximately 55 mg/L after RO post-treatment (Saltworks 2017). Pilot testing of the SaltMaker condensed water and RO permeate quality results are presented in the SaltMaker Pilot Final Report document (Saltworks 2017). The results indicate that values will meet SSWQO for water management, which also comply with MMER.

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

Based on the potential volumes of groundwater, it is anticipated that a second discharge location will be required for long-term groundwater management. Agnico Eagle is proposing to treat groundwater 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. Ocean discharge is currently not permitted and requires appropriate regulatory licenses and approvals, which are currently being assessed and applications prepared. An updated GWMP will be submitted if appropriate licenses and approvals are obtained prior to discharge.

For the ocean discharge option, the saline effluent would be trucked from the Mine and discharged in Melvin Bay at Itivia Harbour. The discharge facility will include an unheated saline water storage tank at the Itivia Fuel Storage Facility and a pipeline extending to an engineered diffuser located in Melvin Bay during the open water season from 2019 to 2035. The saline effluent will be discharged in a controlled manner through the diffuser in compliance with the required discharge criteria to allow for maximum dilution and minimum environmental impact to the marine environment. Saline effluent quality will be required to meet the Canadian federal end-of-pipe discharge criteria (Metal Mining Effluent Regulations – or MMER), including the amended MMER (GC 2017; anticipated to come into effect in 2018), and Canadian Surface Water Quality Guidelines (Canadian Council of Ministers of the Environment Guidelines for the Protection of Aquatic Life [CCME 2003]) or Site-Specific Water Quality Objectives at the edge of the mixing zone for the diffuser discharge into Melvin Bay. It is recognized that further discussions are required with relevant stakeholders to confirm that this approach meets the amended MMER (GC 2017).

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 2017 WMP, which will be updated in March 2018.

Table 4: High Level Mine Schedule

Activity	Timeline	Notes
On-site water storage	Ongoing	—
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)	Q3-2018 to Q1-2019	—
Earliest first Discharge of treated saline groundwater to Meliadine Lake	Q3-2018	
Commissioning of additional SaltMaker unit(s) if required	2019	—
Active Discharge to Meliadine lake	Annually May thru October to 2032	—
Operation of Salt Water Treatment Plant	24 hr. a day / 7 days a week, May thru Oct	In-service as required
Inactive Discharge	Annually November thru April to 2032	Water will be stored underground and in surface containment ponds during the winter
Final Saline Effluent Discharge to Meliadine Lake	End of Mine life 2032	—

Source: Agnico Eagle (2017).

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 will be used at the Mine. The WMP is described in the Environment Management and Protection Plan (EMPP) (Agnico Eagle 2015b). It presents 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, which will be further defined as the Mine advances and will be conducted in agreement with the WMP for the Mine (Agnico Eagle 2017). Required monitoring and frequency for pre- and post- treatment (i.e., monitoring above ground) is presented in the WMP (Agnico Eagle 2017).

4.2 Water Quantity

The volume of groundwater inflow being collected and transferred to surface water management systems will be measured using a flow meter installed at the Portal Water Sump Stope L75. This data will be supplemented by monthly seepage surveys which will record visually observed groundwater inflows in the Underground Mine.

Measured groundwater inflow rates will be compared to model predictions 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.

Identification of a potential long-term effect associated with the groundwater flow will 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.

4.3 Water Quality

To understand and plan for treatment requirements at surface, water accumulating in sumps underground will also be sampled on a monthly basis at Sump 125, which is the main collection sump prior to recirculation for underground use. Sump water samples will be 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 will also be 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 pilot holes drilled in advance of mining to support grouting. These DDHs will be sampled if there is sufficient flow to flush the borehole prior to initiation of grouting (approximately 1 hr from completion). Samples are anticipated to be collected quarterly but actual sampling frequency may vary depending on rate of progress and observed trends in groundwater quality with time.

Water samples will be analyzed for the following parameters: conductivity, TDS, pH, temperature, major anions, radium 226, dissolved and total metals and toxicity testing.

Water quality results are compared to MMER and SSWQO guidelines and will be compliant prior to discharging to Meliadine Lake.

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.

4.4 Groundwater Monitoring Plan

Table 5 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-water treatment as outlined in the WMP.

Table 5: 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

Source: Agnico Eagle (2017).

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 will be 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 will be 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 that 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.

5.1.3 Office Operations

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 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 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.

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

- Sample bottles will be kept in a clean environment, capped at all times, and stored in clean shipping containers. Samplers will 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 will be cleaned appropriately between locations.
- Temperature, pH, and specific conductivity will be measured in the field using hand held meters.
- Samples will be cooled to between 4 °C and 10˚C as soon as possible after collection. Care will be taken in 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 will be treated with preservatives to minimize physical, chemical, biological processes that may alter the chemistry of the sample between sample collection and analysis.
- Samples will be 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 will be completed by field sampling staff and will be submitted with the samples to the laboratory.
- Only staff with the appropriate training in the applicable sampling techniques will conduct water sampling.

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. These are defined as follows:

- Field Blank: A sample will be prepared in the field using laboratory-provided deionized water to fill a set of sample containers, which will then be submitted to the laboratory for the same analysis as the field water samples. Field blanks will be used to detect potential sample contamination during collection, shipping and analysis.

- Travel Blank: A sample will be prepared and preserved at the analytical laboratory prior to the sampling trip using laboratory-provided deionized water. The sample will remain unopened throughout the duration of the sampling trip. Travel blanks will be used to detect potential sample contamination during transport and storage.
- Duplicate Sample: Two samples will be collected from a sampling location using identical sampling procedures. They will be labelled, preserved individually and submitted for identical analyses. Duplicate samples will be used to assess variability in water quality at the sampling site. Duplicate will be 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.

Additional QA/QC procedures that will be applied to the seepage survey component of the Groundwater Monitoring Program will include:

- Location – Universal Transverse Mercator (UTM) coordinates of seepage will be defined through the use of a hand-held Global Positioning System (GPS) unit.
- Sample Labels – appropriate sample nomenclature will be assigned to the sample labels that will define sample locations, sample type, year, and designation (numerical from 01 sequentially upwards) (e.g., SEEP-13-01 for seepage; 5034PIT-13-02 for pit sump).

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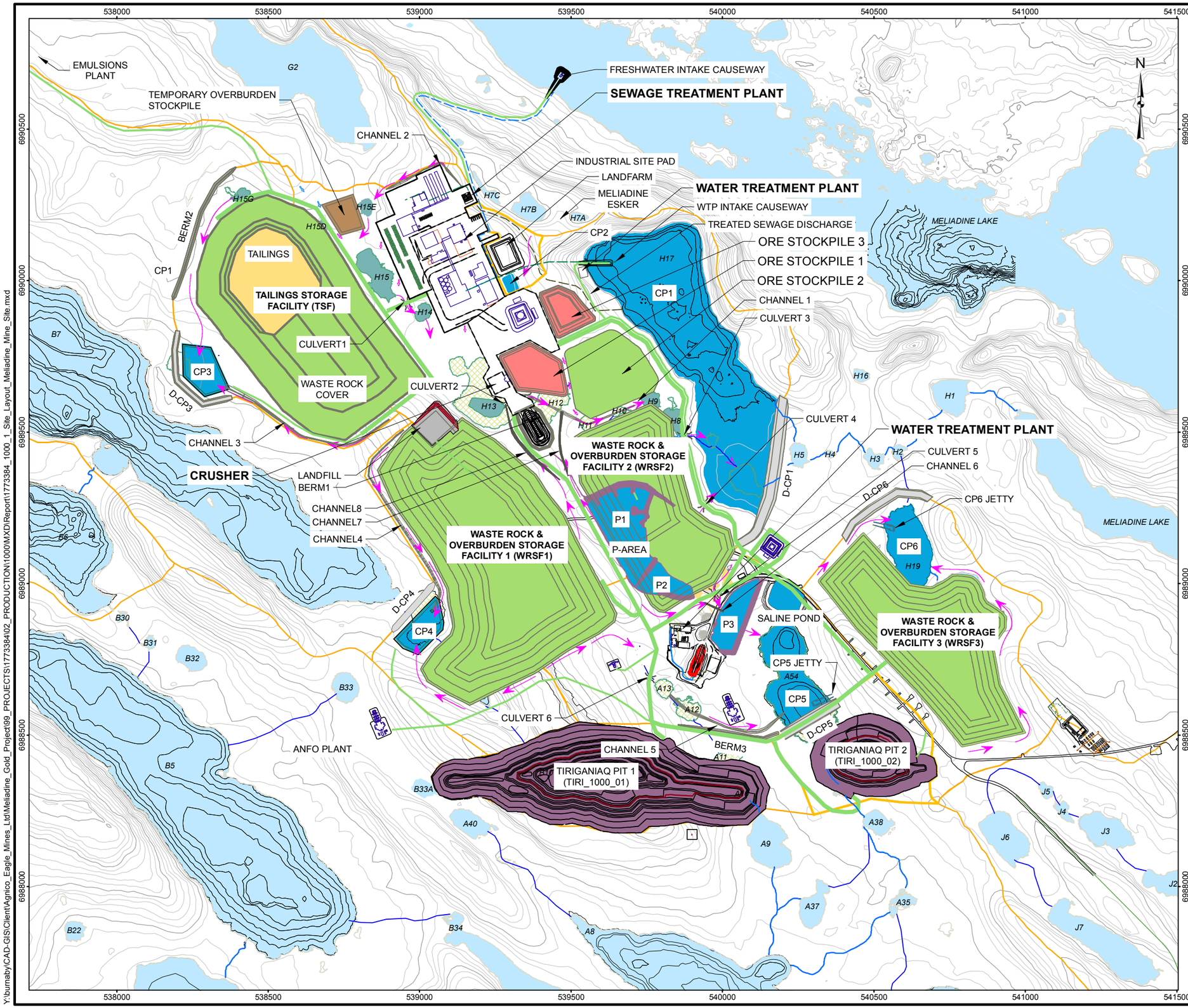
APPENDIX A • FIGURES

Figure 1 General Mine Site Location Plan



LEGEND

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

REFERENCE

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

250 0 250
METRES

PROJECT
AGNICO EAGLE MINES LIMITED
MELIADINE GOLD PROJECT
NUNAVUT

TITLE
SITE LAYOUT
MELIADINE MINE SITE

Golder Associates

PROJECT NO.		1773384	FILE No.	
DESIGN	CLT	8 Dec. 2017	SCALE AS SHOWN	REV. 0
GIS	CDB	8 Dec. 2017		
CHECK	JR	8 Dec. 2017		
REVIEW	LY	8 Dec. 2017		

FIGURE: 1

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APPENDIX E • 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.

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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

545500
546000
546500
6964000
6963500
6963000

End- of- pipe Monitoring

116
FUEL TANK FARM

Approximate Discharge Pipe Centerline

Approximate Diffuser Location

A

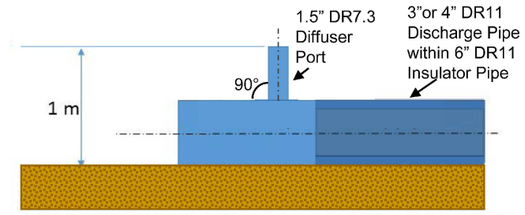
A'

Rankin Inlet

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)



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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 MINES LIMITED
AGNICO EAGLE

PROJECT
MELIADINE MINE
NUNAVUT

TITLE
CONCEPTUAL MARINE MONITORING PLAN
PROPOSED SAMPLING STATIONS

CONSULTANT
GOLDER

YYYY-MM-DD	2018-05-24
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APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
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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.

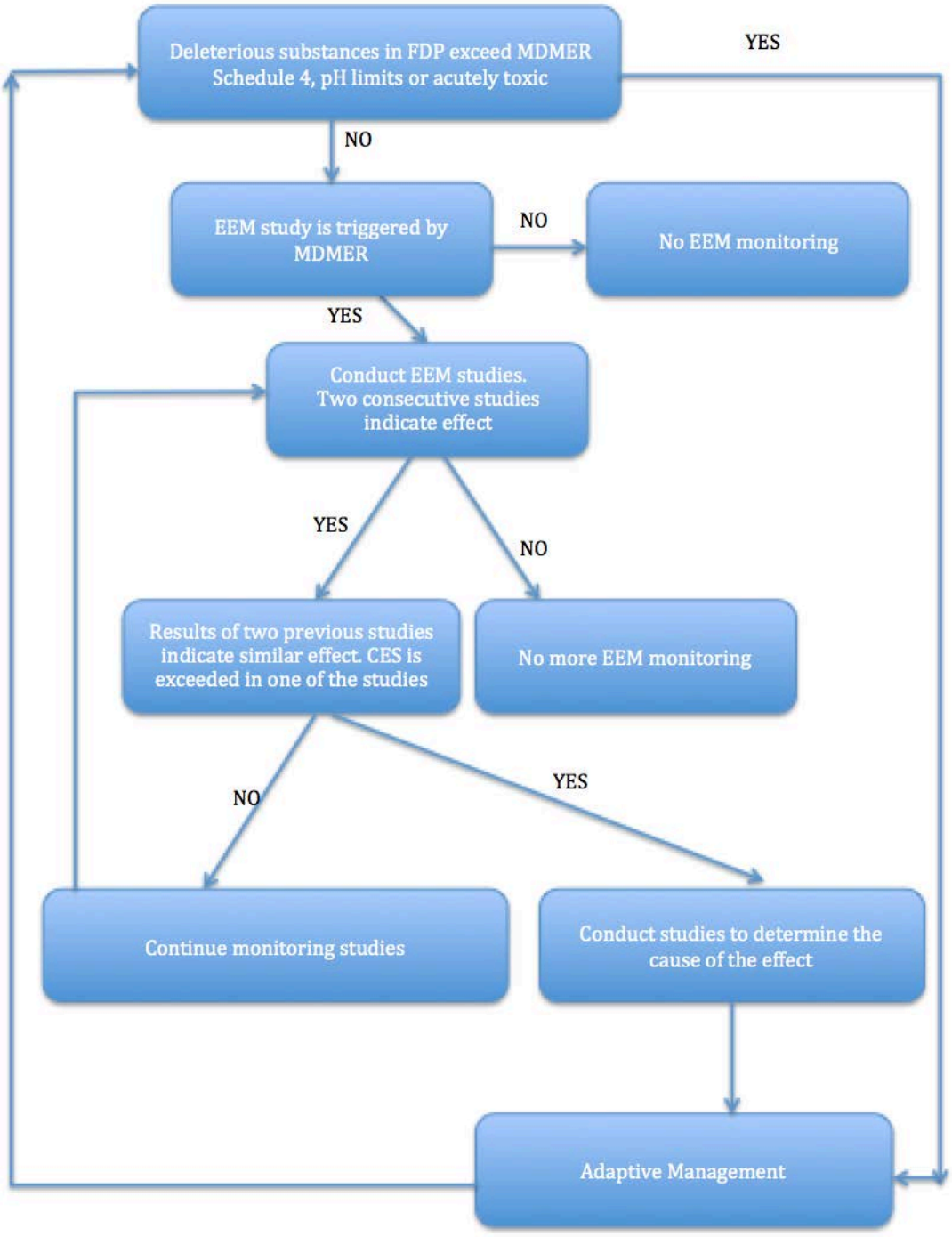

Figure 2: Ocean Discharge Monitoring Plan Decision Tree

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).

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APPENDIX F • PRELIMINARY DIFFUSER MODELLING ASSESSMENT OF THE PROPOSED GROUNDWATER DISCHARGE INTO THE MARINE ENVIRONMENT, RANKIN INLET

F.1 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by Agnico Eagle Mines Limited (Agnico Eagle) to undertake a preliminary modelling assessment of proposed groundwater discharge into the marine environment near Rankin Inlet. Agnico Eagle is considering the potential discharge of treated groundwater inflows from the Meliadine Mine underground workings into the marine environment at Melvin Bay, as part of the adaptive management strategy for long-term groundwater management. Based on groundwater quality it is anticipated that direct discharge to the ocean will not meet discharge criteria; therefore, the option of marine disposal at Melvin Bay for treated groundwater is proposed.

The modelling assessment consisted of nearshore oceanographic modelling of the proposed discharge. The study did not include geotechnical, structural or hydraulic engineering assessments of the proposed outfall or water quality analysis of the proposed discharge.

F.2 TASK BACKGROUND

Mine development will reach the unfrozen ground below the permafrost in Year 1 of mining. Groundwater is expected to flow into the underground mine workings from this time until mine closure. It has been estimated that the potential underground inflows below the permafrost will range up to approximately 420 m^3/d (cubic meters per day; Golder 2016). These underground inflows are predicted to be saline and contain naturally elevated levels of chloride, sodium, and calcium in the form of dissolved salts, making up a large bulk of the total dissolved solids (TDS). The groundwater will be collected in sumps located within the underground workings, as such, the groundwater may come into contact with blasting materials and with residue from equipment spills. Groundwater quality will not be suitable for direct discharge to the receiving environment. While a portion of the groundwater will be used for drilling, and for freeze control, where appropriate. Excess groundwater from underground inflows will not be managed underground and will be pumped for discharge following treatment and/or storage on the surface in containment ponds at the Mine. Groundwater inputs to surface storage for management are expected to range approximately from a minimum of 0.11 Mm^3/year to a maximum of 0.18 Mm^3/year, dependent on the year of Mine life (Agnico Eagle 2018b). Groundwater pumped from underground can result in a total of approximately 800 m^3/d for discharge to Melvin Bay based on groundwater inflow rates and groundwater stored at the Mine.

Groundwater inflows that have accumulated to date have not been discharged to the environment and are being stored in the Saline Pond and P-Area containment ponds, or actively evaporated during the open water season per the existing Water Management Plan (Agnico Eagle 2017). The short-term (treat and store/use groundwater on-site) and long-term (discharge treated groundwater to Meliadine Lake per the Type A Water Licence [NWB 2016]) management strategies for groundwater are outlined in the Groundwater Management Plan (Agnico Eagle 2018a). Based on the potential volumes of groundwater, it is anticipated that a second discharge location will be required for long-term groundwater management. The option for discharging treated groundwater to Melvin Bay is also outlined in the Groundwater Management Plan (Agnico Eagle 2018a) and in Section 3.4 of the Final Environmental Impact Statement (FEIS) Addendum. The excess groundwater will be treated prior to discharge to meet the required discharge criteria, as described under the Environmental Guidelines presented in section F.2.3, or background concentrations. Treatment options are currently being investigated for the groundwater, including the potential use of a SaltMaker plant in combination with the water management ponds at the Mine site for discharge of treated water.

Treated groundwater effluent, will be trucked from the Meliadine Mine to a receiving storage tank at the Itivia Fuel Storage Facility. This modelling study analyzes the mixing of a treated groundwater effluent plume to evaluate the option of ocean discharge at a regular rate through an engineered marine outfall installed in a suitable location in Melvin Bay, with an assumed discharge quality after treatment to comply with the required discharge criteria.

F.2.1 Scope of Work

The objective of this work is to assess the near field mixing of the proposed 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.

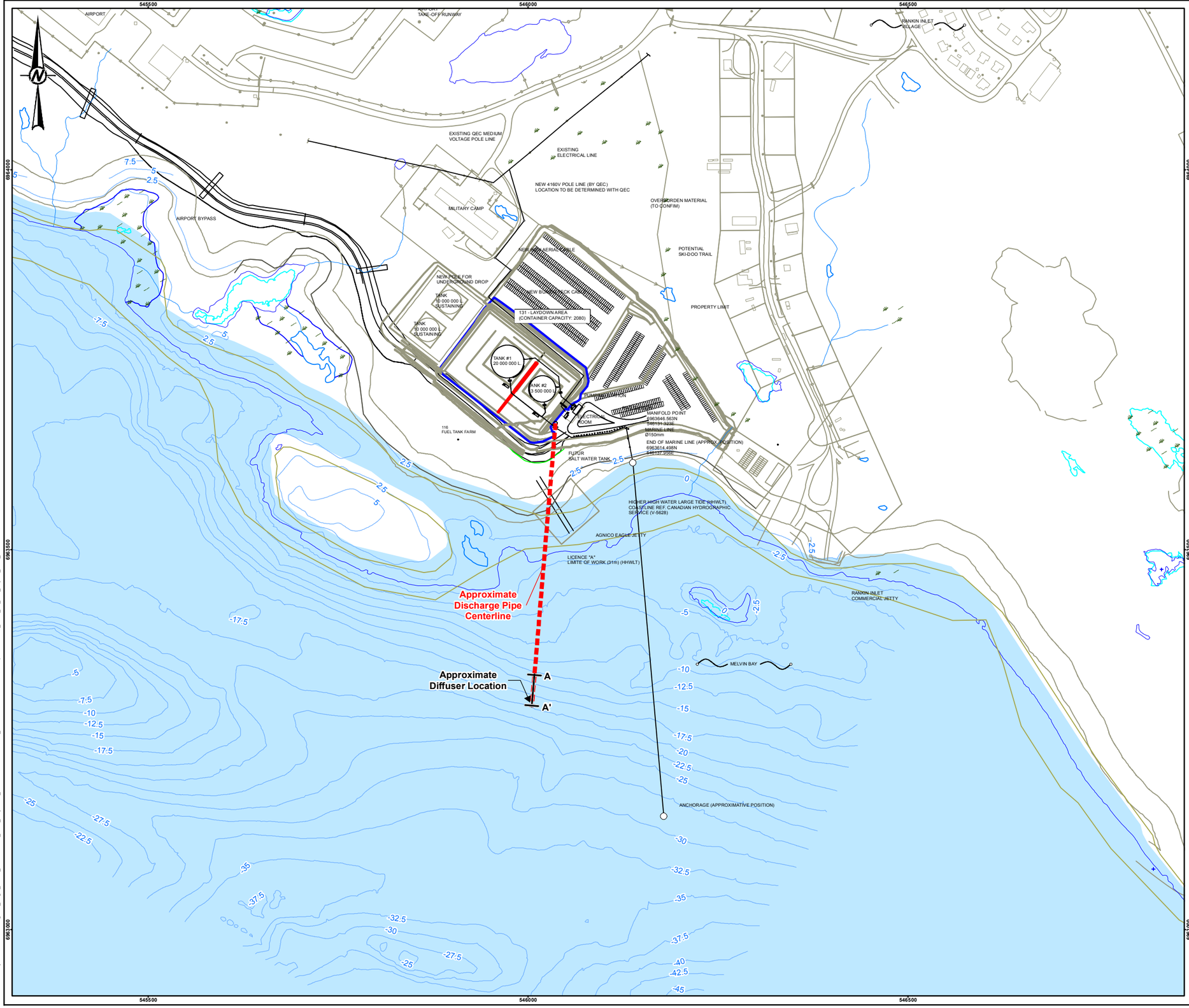
For the purpose of this scope of this work, it is assumed that the discharges will consists of only pumped water at quantities and qualities per the estimated underground inflow volumes (Golder 2016) and estimated groundwater inputs to surface storage for management (Agnico Eagle 2017). Section F.2.3 describes the modelling conditions.

F.2.2 Physical Setting

In August 2011, a field program was conducted by Nunami Stantec at Itivia Harbour, Rankin Inlet, which included the anticipated impact area per the FEIS (Agnico Eagle 2014) and at two nearby reference sites in Melvin Bay (see Figure 4-1 in Appendix B of the FEIS Addendum). Field parameters included temperature, conductivity, pH, dissolved oxygen, salinity, and oxidation-reduction potential. Mean surface water temperature (at 1 m depth) in the harbour was measured to be 8.86 ± 0.52 degrees Celsius (°C), with a salinity of 29.32 ± 0.03 ppt, and a pH of 8.08 ± 0.03. Bottom water (to a depth of up to 13 m below the water surface) was slightly colder than surface water at 8.49 ± 0.57°C; with similar salinity and pH values. No thermal stratification was observed (Agnico Eagle 2014). 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. The engineered marine outfall design, comprised of a discharge pipe and diffuser, is shown in Figure 2.

There is a general southward current in Hudson Bay at Rankin Inlet of about 19 km/day (CCG 2008). Tidal range varies between 2.0 m and 4.6 m with strong cross-currents at Johnston Cove entrance, usually flowing south-west at about 1.85 km/h. Flow through the Access Passage is 0.93 km/h. Sea-ice break-up and freeze-up in Hudson Bay varies each year; spring break up usually occurs in the third week of June, and freeze-up usually begins at the end of October.

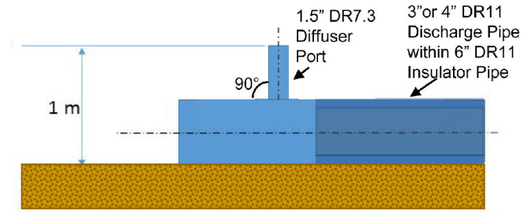
Based on the bathymetry of Melvin Bay at Itivia Harbour, the diffuser is best placed in an area with a greater depth to provide the best possible mixing. The location for the diffuser pipe is proposed to extend from the receiving storage tank at the Itivia Fuel Storage Facility directly south-south-west into Melvin Bay (see Figure 1). The diffuser port 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 (See Section 3.4.6.1 of the FEIS Addendum for additional details).



LEGEND

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

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



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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 MINES LIMITED

AGNICO EAGLE

PROJECT

MELIADINE GOLD PROJECT
NUNAVUT

TITLE

SITE LAYOUT
ITIVIA HARBOUR SITE

CONSULTANT

GOLDER

YYYY-MM-DD	2018-02-26
DESIGNED	CLT
PREPARED	CDB
REVIEWED	BD
APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
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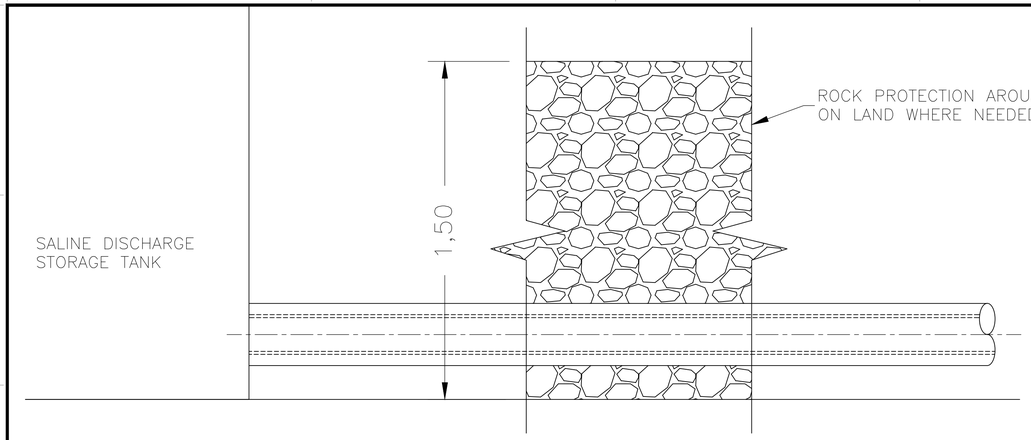
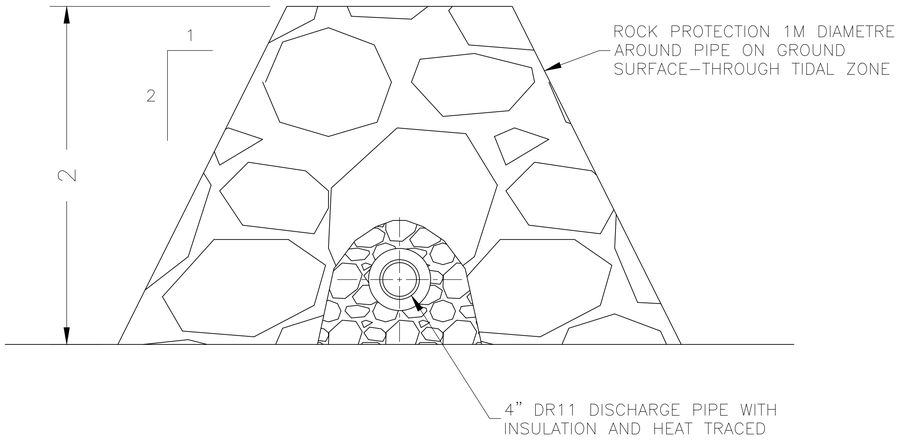
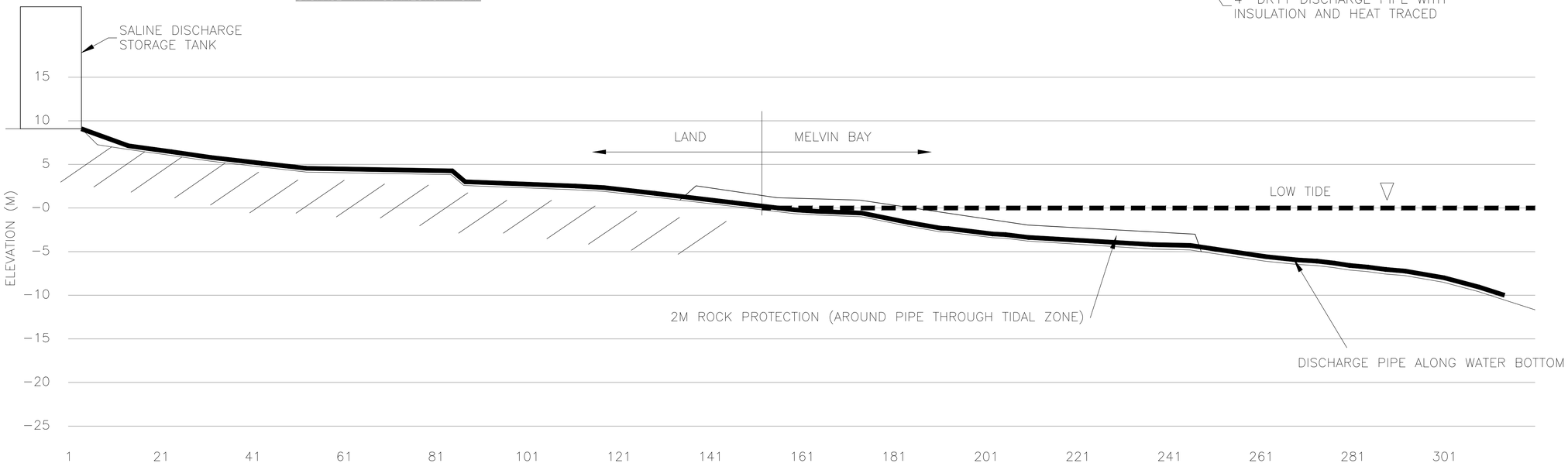


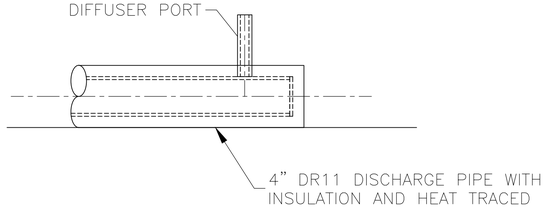
STORAGE TANK CONNECTION POINT





NOTE(S)

- IN CONSIDERATION OF THE EXISTING FACILITIES AND THE BATHYMETRY OF MELVIN BAY, THE PROPOSED LOCATION FOR THE DIFFUSER AND DISCHARGE PIPE IS TO EXTEND IT FROM THE STORAGE TANK AT THE ITIVIA OIL HANDLING FACILITY DIRECTLY SOUTH–SOUTH–WEST INTO MELVIN BAY.
- DISCHARGE PIPE (4" DR11 INSULATED AND HEAT TRACED DISCHARGE PIPE) IS ANTICIPATED TO BE A HIGH–DENSITY POLYETHYLENE (HDPE) PIPE WITH AN OUTFALL LENGTH OF 170M FROM THE LOW TIDE LINE, WITH A SINGLE PORT FOR DISCHARGE TO MEET DISCHARGE CRITERIA.
- THE DISCHARGE PIPE WILL REQUIRE PLACEMENT ON THE SURFACE WITH A ROCK PROTECTION OF 2 M AND 2:1 SIDE SLOPES, THROUGH THE TIDAL ZONE, DUE TO THE PRESENCE OF PERMAFROST ACTIVE LAYER.
- THE DIFFUSER PORT IS PROPOSED TO BE A 1.5 INCH DIAMETER HDPE PIPE, PLACED AT A VERTICAL ANGLE OF 90° FROM THE HORIZONTAL PLANE (UPWARD) FROM THE SEABED AT A DEPTH OF 20 M, TO ENSURE AN UNCONSTRAINED MIXING ZONE AND TO AVOID INTERFERENCE WITH THE USE OF ITIVIA HARBOUR BY SHIPS AND BOATS AT HIGH AND LOW TIDE.
- THE PIPE AND DIFFUSER PORT WILL BE CONSTRUCTED ON SHORE AND THE PIPE FLOATED OUT AND SUNK INTO MELVIN BAY, USING INERT MATERIALS TO MAINTAIN THE PIPE AT THE BOTTOM OF THE BAY (CONCRETE WEIGHTS OR SIMILAR). ALL MATERIALS WILL BE SUCH THAT THEY CAN BE REMOVED UPON END OF MINE LIFE.
- DISCHARGE WOULD BE DURING THE SUMMER MONTHS (MAY – OCTOBER, OPEN WATER SEASON) ONLY.
- 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.



END OF DISCHARGE PIPE

PLAN CLÉ
KEY PLAN

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

Ref. 151-06440-40

NOTES GÉNÉRALES / GENERAL NOTES

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REQUEST FOR PROPOSAL
AGNICO EAGLE DATE : 2018-06-14

NE PAS UTILISER
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NOT FOR CONSTRUCTION
AGNICO EAGLE DATE : 2018-06-14

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DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

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

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT
0	2018-06-14	ISSUED FOR PERMITTING	I.G.	S.D.	
A	2018-06-13	ISSUED FOR COMMENTS	S.P.	S.D.	

REVISIONS

TITRE / TITLE
AGNICO EAGLE – MELIADINE DIVISION
000 – GENERAL
210 – GENERAL ARRANGEMENT
SALINE WATER STORAGE FACILITY
RANKIN INLET
SECTION AND DETAILS

DESSINÉ PAR / DRAWN BY	STEVEN PERRON	DATE 2018-06-13
VÉRIFIÉ PAR / CHECKED BY	UGO BANVILLE, Ing.	2018-06-13
APPROUVÉ PAR / APPROVED BY	STEPHAN DUPUIS, P. Eng.	2018-06-13
ÉCHELLE / SCALE	1:2000	DATE 2018-06-12

NO. DESSIN / DRAWING NO. 65-100-210-201

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F.2.3 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 in is 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 (Table 1) 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 1: 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	-	58165
Total Suspended Solids (TSS)	mg/L	15	159.4
Aluminum	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

Parameter	Units	Discharge Criteria	
		Standard Based (1)	95 UCLM (2)
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
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

Parameter	Units	Discharge Criteria	
		Standard Based (1)	95 UCLM (2)
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 (expected to come into effect in 2018).

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.

(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 salinity of 29,300 mg/L by 290 mg/L (10%). Total dissolved solids (TDS) represents an estimate of the level of ions, typically salt ions, that are present in the water and also includes organic solutes (for example, hydrocarbons and urea). The behaviour of the discharge in the marine environment is also influenced by density and will track other constituents of the treated groundwater effluent. For the purposes of this assessment, it is assumed as a conservative approach that approximately 50% of TDS in the effluent is represented by chloride. As a result, it is considered appropriate to apply the narrative guideline for chloride of ±10% to TDS as well. 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 2011 baseline TDS concentration of 34,300 mg/L at Melvin Bay. Therefore the assumed effluent TDS concentration will be up to approximately 37,700 mg/L.

To reach a TDS concentration difference of no more than 10% at the edge of regulatory mixing zone, the required plume dilution factor via the diffuser is 3, per the equation below:

$$S = \frac{C_{eff} - C_a}{C_{edg} - C_a} = \frac{C_{eff} - C_a}{110\% C_a - C_a} = \frac{37{,}700 - 29{,}300}{110\% * 29{,}300 - 29{,}300} = 3$$

where *S* is required dilution factor, C_{eff} is effluent TDS concentration (37,700 mg/L), C_a is ambient TDS concentration (29,300 mg/L), and C_{edg} is TDS 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 TDS 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.

F.3 NEAR FIELD MODELLING

This section presents the methodology and modelling condition used for the analysis.

F.3.1 Model

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). This model is an internationally recognized model and recognized and supported by the United States Environmental Protection Agency (USEPA) for predicting effluent dilution in an aquatic receiving environment. CORMIX has been applied worldwide for conceptual design and analysis of effluent diffusers. Nearshore ambient and treated groundwater effluent characteristics required to implement the mixing model are presented in the sections that follow.

F.3.2 Conditions for Modelling

F.3.2.1 Ambient Condition

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 29,300 mg/L, respectively
- Water depth at discharge location is 20 m

F.3.2.2 Discharge Condition

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

- Flow rates of 420 m^3/d and 800 m^3/d with TDS of 37,700 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 34.2 mm (standard 1.5 inch port, DR7.3, 254 psi) was used
- Nozzle elevation from seabed: 1 m
- Direction of discharge is perpendicular to the bathymetry contour and 90° vertical angle (upward port) (Figure 2)

F.3.2.3 Modelling Scenarios

Table 2 lists the combination of effluent flow rate and ambient current speed in four simulation scenarios. Table 3 lists the CORMIX model input parameters.

Table 2: Modelling Scenarios

Scenario	1	2	3	4
Treated Groundwater Effluent Rate (m^3/d)	420	800	420	800
Ambient Current speed (m/s)	0.01	0.01	0.20	0.20

Table 3: 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)
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	420 m^3/d and 800 m^3/d	Per underground inflow and storage estimates (Agnico Eagle 2014; Golder 2016)

Parameter	Value	Source
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	0.034 m	Assumed (1.5” port, DR 7.3, 254 psi)

F.4 RESULTS

Figures 3 and 4 present the near-field treated groundwater effluent plume dilution for effluent rates of 420 m³/d and 800m³/d in weak ambient current conditions, via the diffuser. For a discharge of 420 m³/d, the maximum plume height is 7.7 m from the seabed. For a discharge of 800 m³/d, the maximum plume height is 13.7 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 3 and 4. For both scenarios, the plume centreline dilution factor reaches 10 within 1 m horizontal distance and 2 m vertical distance from the port. The dilution factor of 10 is more than three times as large as the required dilution factor of 3, and the horizontal distance of 1 m is much smaller than the regulatory mixing zone boundary of 100 m.

Figures 5 and 6 present the near-field treated groundwater effluent plume dilution for effluent rates of 420 m³/d and 800 m³/d in mean ambient current conditions, via the diffuser. The plume centrelines shown in both figures illustrate dispersion before the plumes reach their respective maximum heights. The maximum height of the plume is 3.6 m above the seabed for a flow rate of 420 m³/d, and 5.5 m above the seabed for a flow rate of 800 m³/d. Relatively stronger mixing is evident from these results compared with the results under weak ambient current conditions, as the effluent jet momentum and ambient current both contribute to initial mixing. For both scenarios, the plume centreline dilution factor reaches 20 within 1 m horizontal distance and 3 m vertical distance from port. The dilution factor of 20 is more than six times as large as the required dilution factor of 3, and the horizontal distance of 1 m is much smaller than the regulatory mixing zone boundary of 100 m.

The changes in salt concentration along the centrelines of the plumes are shown in Figure 7. This figure shows that at about 0.5 m above the port, the plume centreline salt concentration satisfies the design criteria for all scenarios.

To test the plume temperature effect on ambient temperature in Melvin Bay, an additional model run was conducted with conditions identical to those for Scenario 1 except that the treated groundwater effluent temperature is assumed to be at 4°C (reflecting the highest temperature recorded in groundwater data from Diamond Drill Hole or DDH samples, provided by Agnico Eagle in 2017), and that the average ambient water temperature at Melvin Bay of 8°C (Nunami Stantec 2012). To reach the design criteria of 7°C that is 1°C lower than the ambient water temperature (per the BC MOE guideline), the required dilution factor via the diffuser is 3. The simulation results show that this criterion is satisfied within 1 m horizontal distance from the point of discharge.

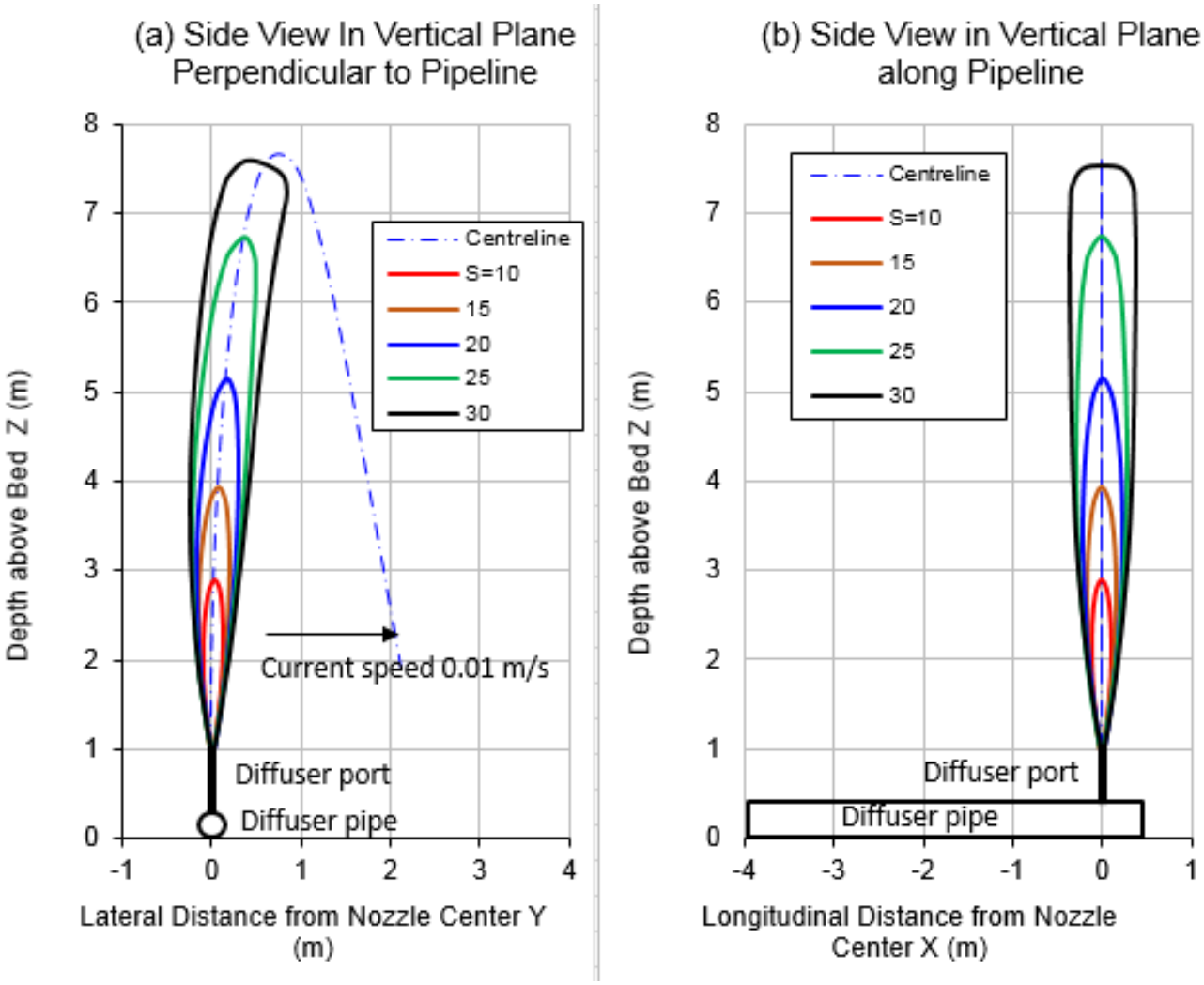

Figure 3: Dilution contours for flow rate of 420 m³/d in weak ambient current (the parameter S is dilution factor)

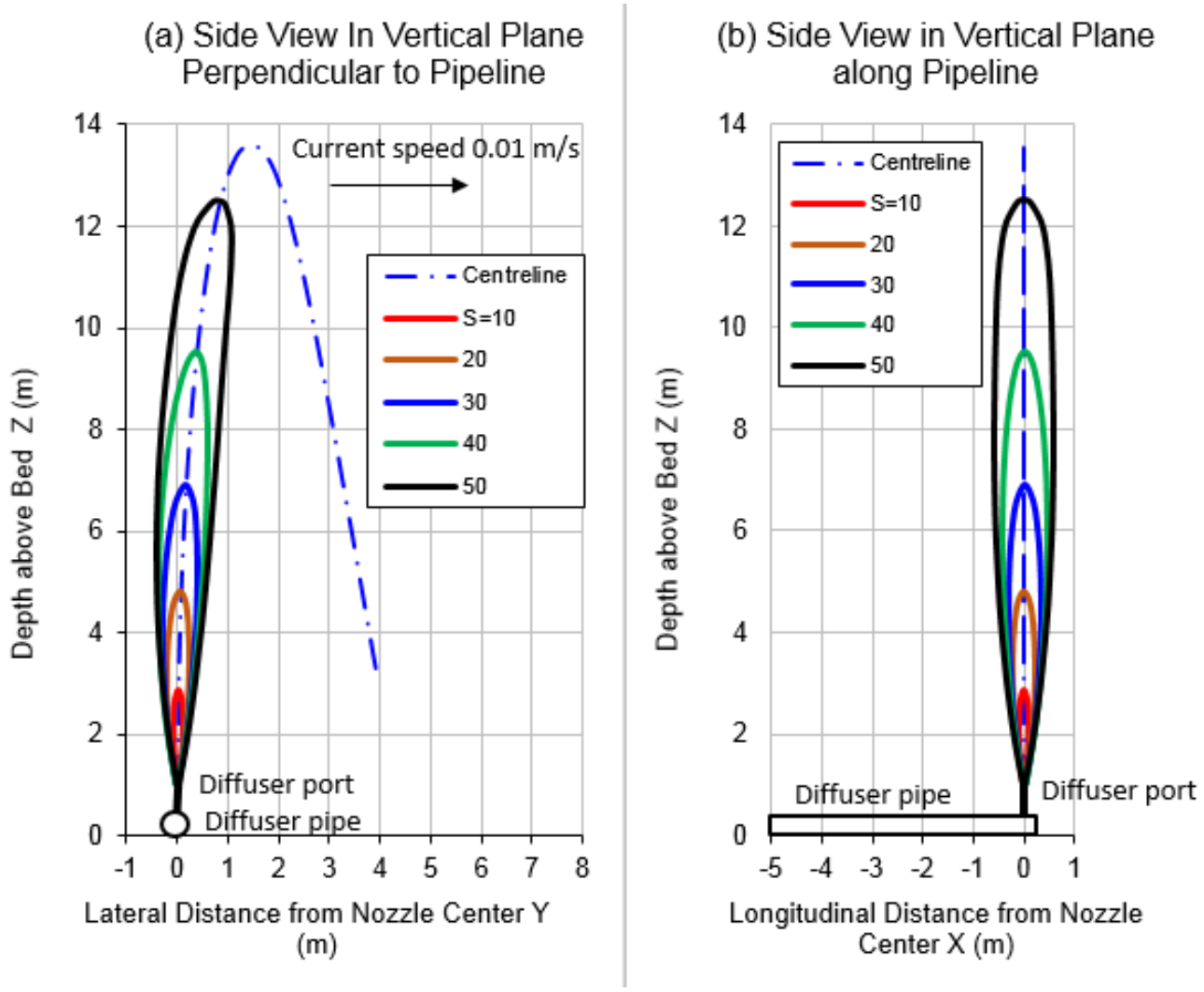

Figure 4: Dilution contours for flow rate of 800 m³/d in weak ambient current (the parameter S is dilution factor)

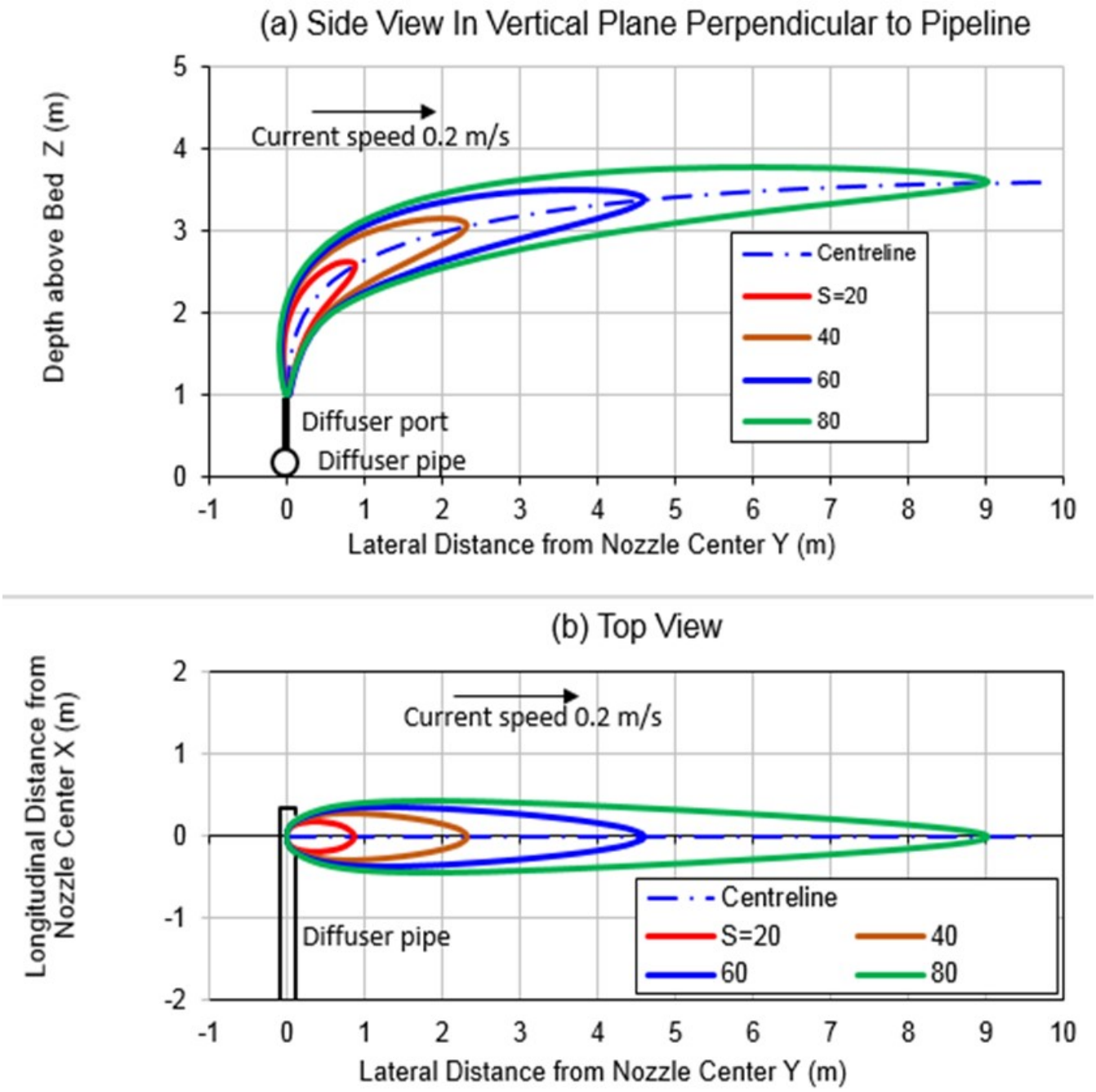

Figure 5: Dilution contours for flow rate of 420 m³/d in mean ambient current (the parameter S is dilution factor)

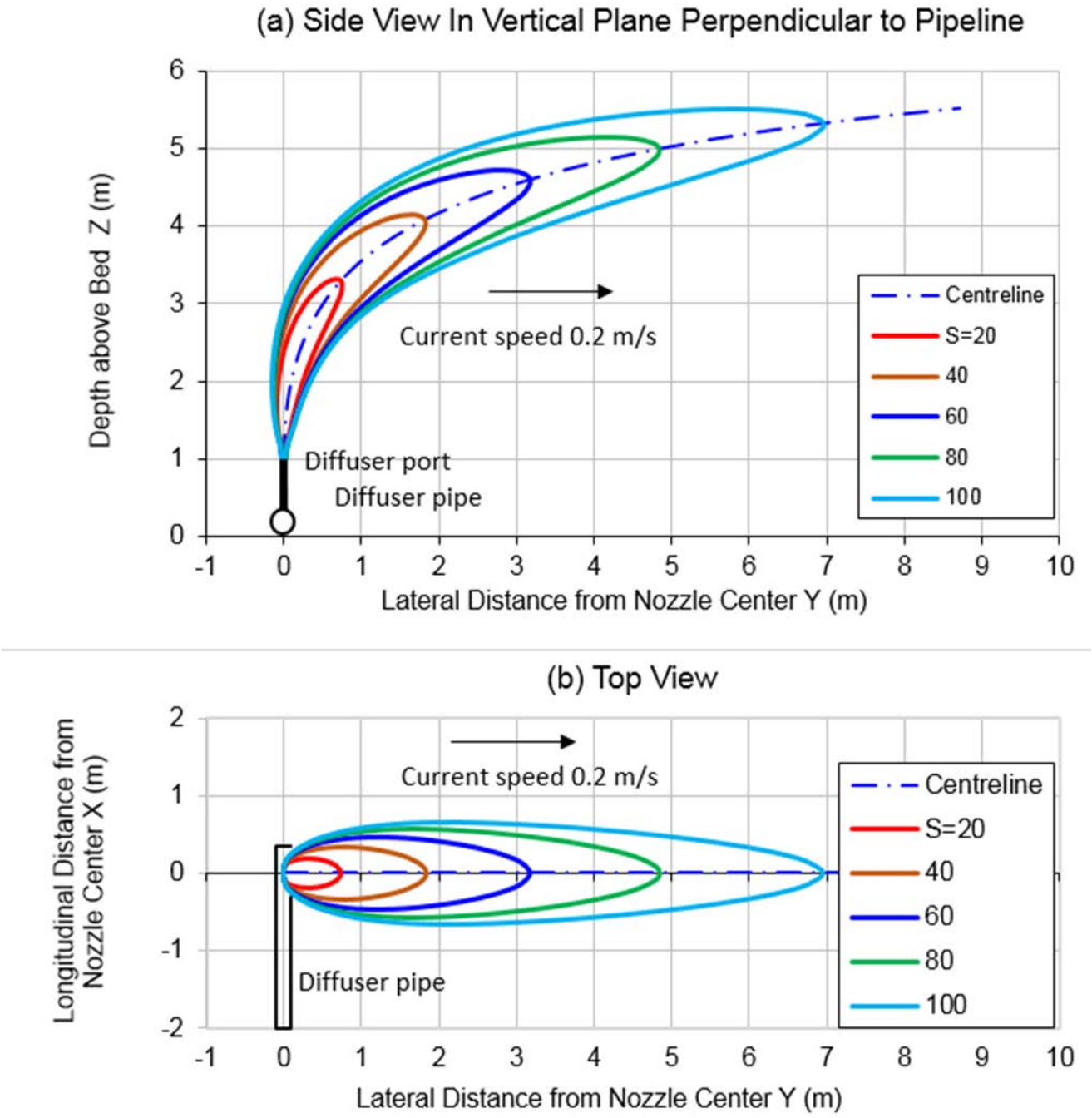

Figure 6: Dilution contours for flow rate of 800 m³/d in mean ambient current (the parameter S is dilution factor)

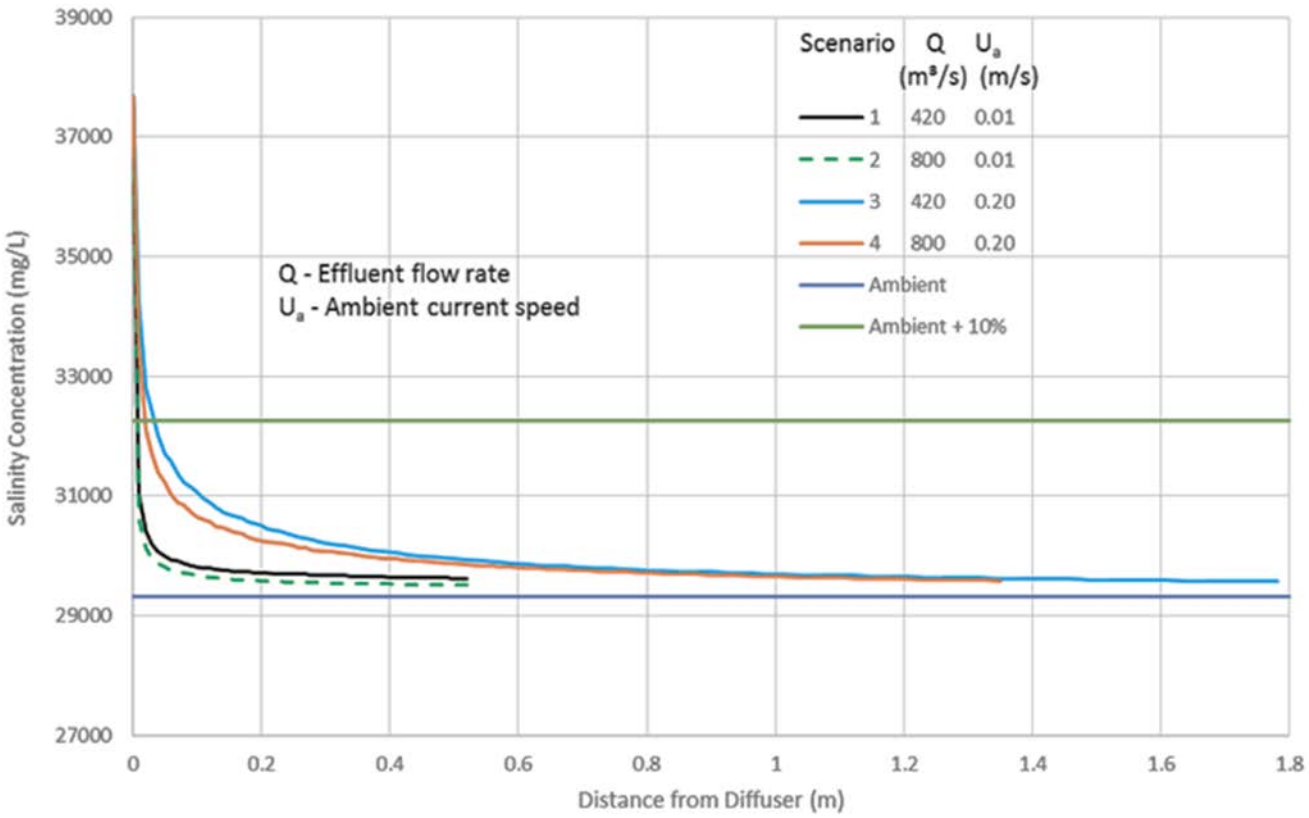

Figure 7: Salt concentration along the plume centreline for all scenarios

F.5 CONCLUSION

The tide in Melvin Bay is expected to provide good flushing and mixing conditions. A conservative approach was used for selecting the ambient flow conditions for the mixing zone analysis for the treated groundwater effluent plumes.

Dilution of the treated groundwater effluent plume is achieved within 3 m of the diffuser under the assumed conditions for the ambient and discharge conditions tested. 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.

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https://golderassociates.sharepoint.com/sites/17491g/shared documents/2000 model updates/appendix f_diffusermemo_1773384_687_rev0.docx

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APPENDIX G • RESIDUAL IMPACT CLASSIFICATION

Methods

The purpose of the residual effect classification is to describe the residual effects from the Project on marine wildlife and wildlife habitat using a scale of common words, rather than numbers or units. There are no other anticipated residual effects on other VEC as a result of the Project. The use of common words or criteria is a requirement in the NIRB Guidelines for the FEIS Addendum (NIRB 2018). The following criteria were used to assess the residual effects from the Project:

- Direction or nature of the impacts
- Magnitude and complexity
- Geographic extent
- Frequency
- Duration
- Reversibility
- Likelihood or probability of effects

The term “effect”, used in the effects analyses and residual effects summary, is regarded an “impact” in the residual impact classification. Therefore, in the residual impact classification, all residual effects are discussed and classified in terms of impacts to marine VECs.

Generic definitions for each of the residual impact criteria are provide below.

Direction: Direction indicates whether the impact on the environment is negative (i.e., less favourable), positive (i.e., beneficial), or neutral (i.e., no change). While the main focus of the impact assessment is to predict whether the development is likely to cause significant adverse impacts on the environment, the positive changes associated with the Project also are reported. Neutral changes are not assessed.

Complexity and Magnitude: Complexity is the degree of intricacy relative to the baseline condition. Complexity is a measure of the number of interconnected or interwoven components. Magnitude is a measure of the intensity of an impact, or the degree of change caused by the Project relative to baseline conditions or a guideline value. The degree of complexity is incorporated within magnitude and is then classified into 4 scales: negligible, low, moderate, and high. For each VEC or VSEC, the scales of magnitude are defined. Magnitude can relate to a percentage change (e.g., change from baseline), or to absolute changes that are above or below guidelines or thresholds. Where possible, magnitude is reported in absolute and relative terms.

Geographic Extent: Geographic extent refers to the area affected, and is categorized into 4 scales; local, regional, beyond regional, and transboundary. Local-scale impacts mostly represent changes that are directly related to the Project footprint and activities, but may also include small-scale indirect impacts. Changes at the regional scale are largely associated with indirect impacts from the Project, and represent the maximum predicted spatial extent of impacts from the Project (zone of influence). Impacts beyond the regional scale are mostly associated with VECs that have large spatial distributions and are influenced by cumulative effects from the Project and other developments, such as groundwater and socio-economics. For the purposes of this Project, transboundary is defined as effects from the Project that result outside of the effects study area.

Frequency: Frequency refers to how often an impact will occur and is expressed as isolated (confined to a discrete period), periodic (occurs intermittently, but repeatedly over the assessment period), or continuous (occurs continuously over the assessment period). Frequency is explained more fully by identifying when it occurs (e.g., once at the beginning of the Project). If the frequency is periodic, then the length of time between occurrences, and the seasonality of occurrences (if present) is discussed.

Duration: Duration is defined as the amount of time from the beginning of an impact to when the impact on a VEC or VSEC is reversed, and is expressed relative to Project phases. Thus, duration is a function of the length of time that the VEC or VSEC is exposed to Project activities or phases (e.g., construction, operation, temporary closure, decommissioning and reclamation or permanent), and its' reversibility.

Reversibility: After removal of the stressor, reversibility is the likelihood and time required for a VEC or VSEC or system to return to a state that is similar to the state of systems of the same type, region, and time period that are not affected by the Project. This term usually has only one alternative: reversible or irreversible. The time frame is provided for reversibility (i.e., duration) if an impact is reversible. Permanent impacts are considered irreversible. In terms of the socio-economic environment, the manageability of impacts is considered rather than their reversibility. Where appropriate, the evaluation identifies the resources that may be directed to facilitate recovery.

Likelihood or Probability of Effects: Likelihood is the probability of an impact occurring and is described in parallel with uncertainty. Four categories are used: unlikely (impact is likely to occur less than once in 100 years), possible (impact will occur at least once in 100 years), likely (impact will likely occur at least once in 10 years), and highly likely (impact has 100% chance of occurring within a year).

The likelihood of an impact was determined based on the probability of the event occurring and the implementation of mitigation measures. Background on how the likelihood of a worst-case diesel fuel spill event was determined is provided in Appendix 8.2-B of the FEIS (Agnico Eagle 2014). Reversibility is defined as the likelihood and time required for a component (e.g., population) or system to recover after removal of the stressor and is a function of resilience. Reversibility is applied to all combinations of magnitude, geographic extent, and duration.

The approach used to classify the magnitude of changes in measurement endpoints (and related impacts) was based on scientific literature and professional opinion, and incorporated conservatism. Other EAs often use the universal effect size approach for categorizing magnitude such as negligible changes (0 to 10%), small changes (10 to 25%), and medium changes (25 to 40%) (Munkittrick et al. 2009). Ideally, effect threshold values would be known, and measurement endpoints could be quantified accurately with a high degree of confidence; however, little is known about ecological thresholds, and biological parameters are typically associated with large amounts of natural variation. Therefore, the classification of magnitude included a level of conservatism so that the impacts would not be underestimated.

For marine VECs, the assessment and classification of residual impacts was based on the predicted cumulative changes from reference conditions through application of the Project and into the future case. The spatial boundary of the assessment for Project impacts is at the RSA scale. The incremental effects from the Project relative to baseline conditions were also classified. Essentially, the only difference in the outcome of impact criteria between cumulative and incremental effects from the Project is in the magnitude and geographic extent of impacts. The magnitude for cumulative impacts involves changes from reference conditions through application of the Project and into the future case, while incremental impacts are based on changes from the Project relative to baseline values. Cumulative impacts from the Project and other Reasonably Foreseeable Future Development influence a population throughout its entire annual range (including migratory movements where applicable). In contrast, the geographic extent of incremental impacts from the Project may have a local or regional influence on marine wildlife populations.

Effects statements are used to focus the analysis of changes to marine VECs that are associated with one or more primary pathways. The residual effects assessment presents a qualitative assessment for criteria such as magnitude, geographic extent, duration, and frequency. Pathways associated with each effects statement are classified using scales (categorical values such as negligible, low, or high) for each impact criterion (e.g., magnitude).

To provide transparency, the definitions for these scales were ecologically or logically based on marine VECs. Although professional judgement is inevitable in some cases, an effort was made to classify impacts using scientific principles and supporting evidence where possible. The scale for the residual impact criteria for classifying effects from the Project are specifically defined for marine VECs, and definitions for each criterion are provided, in Table 19 of the FEIS Addendum document.

Environmental Significance

Approach and Methods

The evaluation of significance for marine VECs considers the entire set of pathways that influence a particular assessment endpoint. The relative contribution of each pathway is then used to determine the significance of the Project on assessment endpoints. For example, a pathway with a high magnitude, large geographic extent, and long-term duration would be given more weight in determining significance relative to pathways with smaller scale effects. The pathways that are predicted to have the greatest influence on changes to assessment endpoints are assumed to contribute the most to the determination of environmental significance.

Qualitative key factors were considered in the determination of environmental significance for marine VECs as follows:

- results from the residual impact classification of primary pathways
- magnitude, geographic extent, and duration (which includes reversibility) of the impact were the principal criteria used, with frequency and likelihood as modifiers
- professional judgment and ecological principles, such as resilience, were used to predict the duration and associated reversibility of impacts
- ecological or socio-economic context/value

- historical, cultural, and archaeological significance of the geographic area likely to be affected by the Project
- value attached to the individual VEC based on consultation with potentially affected communities and relevant individuals and organizations

Environmental significance is used to identify predicted impacts that have sufficient magnitude, duration, and geographic extent to cause fundamental changes to marine VECs. The following definitions are used for assessing the significance of impacts on marine VECs, and the associated continued opportunity for traditional use of marine VECs.

- Not significant – impacts are measurable at the individual level, and strong enough to be detectable at the population level, but are not likely to decrease resilience and increase the risk to population maintenance and opportunities for traditional and non-traditional use.
- Significant – impacts are measurable at the population level and likely to decrease resilience and increase the risk to population maintenance and impact opportunities for traditional and non-traditional use. A number of high magnitude and irreversible impacts at the population level (regional scale) would likely be significant.