AGNICO EAGLE

MELIADINE MINE

Ocean Discharge Monitoring Plan

JUNE 2020
VERSION 3

EXECUTIVE SUMMARY

Agnico Eagle Mines Limited (Agnico Eagle) is developing the Meliadine Gold Project (the Project or 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 includes 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.

The underground mine will operate below the base of the continuous permafrost and will act as a sink for groundwater flow during operation, with water induced to flow through the bedrock to the underground mine workings.

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 Mine Water Management Plan (WMP; Agnico Eagle 2020c). The management of groundwater is further described in the Mine Groundwater Management Plan (GWMP; Agnico Eagle 2020a), which entails 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 (Nunavut Water Board; NWB 2016). 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 Mine's Ocean Discharge Monitoring Plan (ODMP) 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 (QA/QC), 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.
2	July 2019	All	All	Updated Plan to comply with applicable commitments and/or approval conditions for the Mine, including incorporation of the 2018 Marine Reconnaissance results, 2018 Modelling Assessment for groundwater discharge and per requirements under MDMER for water quality.	Golder Associates Ltd.
3	June 2020	All	All	General Plan update	Agnico Eagle Mines Ltd.
		2	4-11	Updated Plan to reflect the increased discharge to sea of 1600 m^3/day	
		3	13-14	Updated to include toxicity testing of the effluent	

ACRONYMS

Agnico Eagle	Agnico Eagle Mines Limited
ANOVA	analysis of variance
CALA	Canadian Association for Laboratory Accreditation
CCME	Canadian Council of Ministers of the Environment
DDH	Diamond Drill Hole
CTD	Conductivity, Temperature, Depth
ECCC	Environment and Climate Change Canada
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	Meliadine Gold Mine
MMER	Metal Mining Effluent Regulations (to 2017)
NIRB	Nunavut Impact Review Board
NWB	Nunavut Water Board
ODMP	Ocean Discharge Monitoring Plan
QA/QC	Quality Assurance and Quality Control
TDS	total dissolved solids
TSS	total suspended solids
WMP	Water Management Plan
WQG	water quality guideline

SECTION 1 • INTRODUCTION

Agnico Eagle Mines Limited (Agnico Eagle) is developing the Meliadine Gold Project (the Project or 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 Mine is located within the Meliadine Lake watershed of the Wilson Water Management Area (Nunavut Water Regulations Schedule 4). The projected life of the Mine consists of 3.5 years of construction, 8.5 years of operations, and 3 years of closure.

The mine plan includes underground mining methods for the development of the Tiriganiaq gold deposit. 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 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 2020c) and the Groundwater Management Plan (GWMP; Agnico Eagle 2020a). 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 after treatment, in compliance with Agnico Eagle's Type A Water Licence 2AM-MEL1631, Part E, Item 14 (Nunavut Water Board; NWB 2016).

This document presents the Ocean Discharge Monitoring Plan (ODMP) for the discharge of excess treated groundwater into the marine environment at Itivia Harbour in Melvin Bay, to support long-term groundwater management for the Mine after treatment of the saline underground inflows to meet discharge water quality criteria for Melvin Bay and/or background conditions. This ODMP has been prepared in accordance with the Nunavut Impact Review Board (NIRB) Project Certificate No. 006 (Amendment 001) issued on February 26, 2018, and applicable legislation. As per the MDMER (GC 2018), the regulation applies to effluent discharge from a mine exceeding a flow rate of 50 cubic metres (m^3) per day.

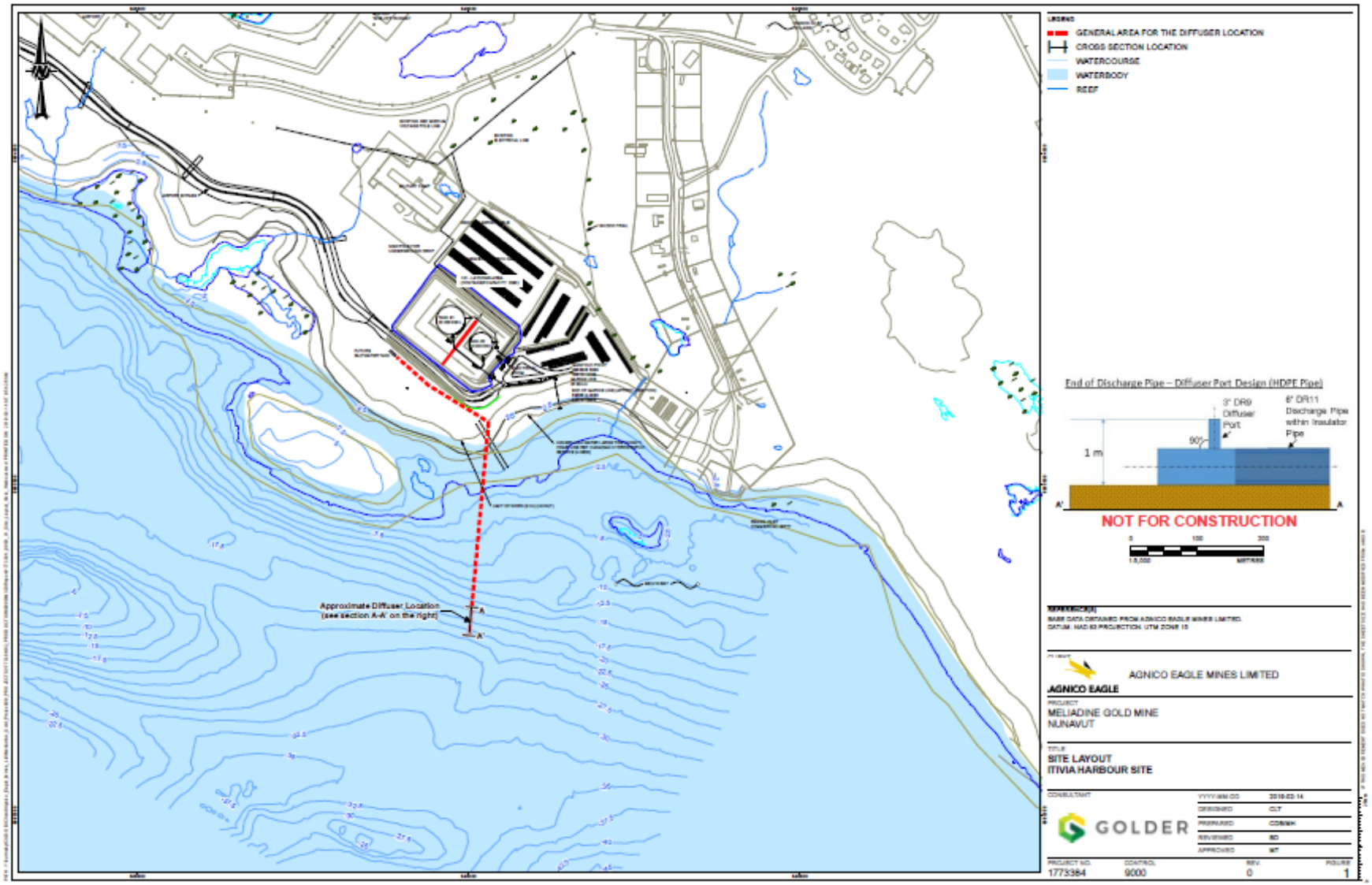
The ODMP describes the following:

- Compliance with the federal Metal and Diamond Mining Effluent Regulations (MDMER).
- Adherence to relevant Canadian Council of Ministers of the Environment (CCME) Guidelines for the Protection of Aquatic Life and British Columbia Ministry of the Environment Guidelines in the regulatory mixing zone.
- Measures to detect short- and long-term effects of the discharge on the receiving environment.

- Identification of unforeseen adverse effects and provide early warnings of undesirable changes in the water quality.
- Inform potential mitigation measures based on results reported.

The ODMP will be updated as the Mine development advances, to include changes and/or regulatory conditions as applicable through construction, operations and closure.

Figure 1: Site Layout – Itivia Fuel Storage Facility



SECTION 2 • RATIONALE FOR MONITORING APPROACH

The ODMP outlines 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.

The ODMP focuses on water quality. No adverse effects are predicted from the marine discharge, based on the environmental conditions recorded, hydrogeological investigations and modelling assessments completed, adherence to existing project management plans in addition to this ODMP, and the effects assessed in the FEIS Addendum (Agnico Eagle 2018b). This is based on the following rationale:

- Only excess groundwater from development of the underground mine will be discharged to Melvin Bay.
- Groundwater will be treated prior to discharge to comply with MDMER.
- Modelling assessment results indicate that compliance with the applicable discharge criteria will be met well within the mixing zone (i.e., discharge will meet relevant CCME and BCMOE guidelines, as well as background concentrations, in Melvin Bay as a result of diffusion well within the 100 m regulatory mixing zone) (Golder, 2019b).

Summaries of relevant information and studies identified above are presented in the following subsections.

2.1 Discharge Overview

Treated groundwater effluent is trucked to the discharge facility at the Itivia Fuel Storage Facility in Itivia Harbour, Rankin Inlet, for discharge during the summer season (June to October), for a maximum discharge of 1,600 m^3/day. Truck loads will be approximately 36 m^3 per truck. Further information on trucking can be found in the Roads Management Plan (Agnico Eagle, 2019c).

The Itivia Fuel Storage Facility layout and outflow/diffuser placement are shown in Figure 1. The discharge facility includes a storage tank of approximately 50,000 L volume and a 778 m pipeline outflow extending to an engineered diffuser located in Melvin Bay. The storage tank is installed in a containment area, built on geomembrane with underlying and overlaying granular materials and surrounded by berms. A truck discharge pump is connected to the 778 m long HDPE pipeline outflow. Ballast weights are attached to the pipe to sink and hold it onto the seabed. A diffuser is connected at the end of the pipe (approximately 20 m below surface) to ensure effective diffusion of the treated groundwater effluent into the marine environment. The storage tank is used to contain treated groundwater until the next day if the discharge limit is attained upon the truck's arrival (Agnico Eagle 2019b).

The treated groundwater effluent is discharged seasonally in a controlled manner, through a diffuser to allow for maximum dilution and minimum impact on the marine environment. The receiving environment discharge location is estimated at a distance of approximately 230 m from the shoreline

and a depth of approximately 20 m. Treated groundwater effluent quality is required to meet the Canadian federal end-of-pipe discharge criteria (per the amended MDMER; GC 2018) and to be non-acutely lethal. Treated groundwater is discharged into Melvin Bay via an engineered diffuser (Agnico Eagle 2018b) to meet Canadian Water Quality Guidelines (WQG; CCME 2003), or background concentrations for parameters without guidelines, at the edge of the mixing zone (as described in Sections 3 and 4).

2.2 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 2005; 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 2018b).
- 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°C at the surface to 8.5°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 the 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 (ISQG; CCME 2001) for all parameters except chromium. Chromium concentrations slightly exceeded the 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.
- 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).

- 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).
- 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 2019d). 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 2019d).

2.2.1 Marine Reconnaissance Survey Summary

A marine reconnaissance survey was carried out in September 2018 to establish appropriate reference areas and collect baseline data on physical properties of the water column, water and sediment quality, benthic substrate, benthic communities and marine mammal occurrence (Golder 2019a).

For the purpose of the ODMP, this section will focus on water quality results; however, sediment quality, benthic substrate and benthic community data are available in Appendix B. The program collected data from the exposure area and three reference areas (A, B and R1).

In situ profiles were taken using a conductivity, temperature and depth (CTD) probe. Uniform physical properties were observed in the water column, indicating well-mixed conditions with no vertical stratification. Water temperature was slightly lower near the bottom and ranged from 5.1 to 6.2°C, whilst salinity results ranged from 30.7 to 30.9 ppt. Water was clear, with turbidity usually between 1.2 and 2.4 NTU, and the exposure area and reference area R1 were slightly more turbid than reference areas A and B. A maximum turbidity was 6.1 NTU was observed at surface in reference area B, which could possibly be related to dust deposition. Chlorophyll *a* concentrations were typical for Arctic waters, being classified as oligotrophic to mesotrophic marine systems (0.4 to 1.5 µg/L), consistent with total phosphorus results.

Total suspended solids concentration varied between non-detect (<2 mg/L) to 3.8 mg/L, while total organic carbon concentrations were between 1.01 and 1.79 mg/L, with large fraction of dissolved organic carbon. As observed in previous programs, results for several nutrients and most metals were below detection limits and did not exceed CCME guidelines. Variability in concentrations of detected metals was small, with greater variability recorded between sampling days. This observation

emphasizes the well-mixed characteristic of the waters in Melvin Bay and adjacent areas, as well as similarity among areas. Similar oceanographic conditions were observed for reference areas A, B and R1 and the exposure area, and with the exception of R1, which is shallower, similar depth contours were also observed.

2.3 Hydrogeological Investigations

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. The model was then subsequently updated in 2019 with piezometer data records and observed inflows intersected during drilling campaigns (Groundwater Management Plan; Agnico Eagle 2020a). Maximum inflow rates to the Tiriganiaq Underground Mine are expected to be 580 m^3/day (Agnico Eagle, 2020a).

Historically, groundwater investigations suggested that total dissolved solids (TDS) concentrations are relatively consistent below the permafrost at approximately 64,000 mg/L (Golder 2016). Groundwater quality samples have been collected from 2017 through 2019 from diamond drillholes (DDHs) intersecting water bearing structures. Results from the 146 samples collected from 2017 to 2019 indicate stable and consistent concentrations for several parameters and indicate that TDS concentrations are less than predicted at a mean concentration of 56,000 mg/L. Since mining operations include drill-and-blast excavation, certain parameters are expected to be influenced by explosives (particularly ammonia and nitrate). Chloride, sodium and calcium are also naturally high in concentration in the untreated groundwater, averaging higher concentrations than those recorded in Melvin Bay (Tables 1 and 2). Therefore, to minimize effects on the environment, and to comply with the effluent discharge criteria and objectives (as described in Section 3), groundwater is treated prior to discharge.

Table 1: Summary of Average Water Temperature and Salinity in Melvin Bay under Background Conditions and in Untreated Groundwater

Parameter	Averages	
	Melvin Bay	Untreated Groundwater
Temperature (°C)	5.92 to 8.75	-3.4 to +3.8 [(a)]
Salinity	30.7 to 30.9 psu	55 to 56 ppt [(b)]
Total Dissolved Solids (mg/L)	34,727	55,700

Source: Melvin Bay – 2018 Marine Reconnaissance data (Golder 2019a) and Nunami Stantec (2012). Mine Groundwater – Agnico Eagle 2017 data.

(a) Average temperatures per observations of Diamond Drill Hole (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 Mine.

(b) Estimated average groundwater salinity based on average TDS concentrations in groundwater presented in FEIS Addendum, Section 3.4.2, Table 3 (55,700 mg/L average TDS; Agnico Eagle 2018b). Salinity in groundwater has not been measured. TDS values are comparable to salinity as TDS represents an estimate of the total concentration 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. Note on units for salinity – in practice the units of psu and ppt are considered the same (nearly equivalent by design).

Table 2: Summary of Average Concentrations of Selected Ions in Melvin Bay under Background Conditions and in Untreated Groundwater

Ion	Averages	
	Melvin Bay	Untreated Groundwater[(a)]
Chloride (Cl) - (mg/L)	16,655 to 20,000	32,315
Sodium (Na) - Total (mg/L)	9,344 to 11,000	14,365
Calcium (Ca) - Total (mg/L)	360	2,032

Source: Melvin Bay - 2018 Marine Reconnaissance data (Golder 2019a) and Nunami Stantec (2012). Mine Groundwater– Agnico Eagle 2017 data (Agnico Eagle 2018b).

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

2.4 Modelling Assessments

The assessment of effects in the FEIS Addendum (Agnico Eagle 2018b) used a numeric simulation to model behaviour of the effluent plume in the marine environment (refer to Appendix E of the FEIS Addendum, Agnico Eagle 2018b). This model showed that a discharge of 420 m^3/day effluent through the diffuser will reach the required dilution factor within a short distance from the diffuser port (within 1 to 3 m). The plume is characterized by negative buoyancy and the maximum plume height expected is about 14 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 MDMER), discharge through a diffuser that aids in mixing, and implementation of the water quality monitoring per MDMER Schedule 5 Section 7(1).

A modelling assessment was conducted in February 2019 (Golder 2019b), consisting of nearshore oceanographic modelling of the discharge and is presented in Appendix C. The study had the objective of modelling the near-field dispersion of the treated groundwater effluent plume and assessing the plume dilution behavior for additional discharge scenarios from those evaluated for the FEIS Addendum, and did not include geotechnical, structural or hydraulic engineering assessments of the outfall. The scenarios modelled assumed the discharge at the quantities and qualities per the estimated underground inflow volumes (Golder 2016) and estimated groundwater inputs to surface storage for management after treatment and transport to the Itivia Fuel Storage Facility.

Discharge conditions for modelling took into account marine environment temperatures during open water conditions (assumed at 0°C conservatively to account for the early and late stages of the open water season), outfall lengths and water depth at discharge location, single diffuser nozzle elevated above the seabed, direction of discharge (upward port), and treated groundwater effluent temperature.

The model input for effluent discharge rate was applied at 800 m^3/12 hours (for an equivalent of 1,600 m^3/day). Modelling for weak and mean current conditions was completed, including a temperature sensitivity analysis simulation for a treated groundwater effluent temperature of 20°C and marine environment temperature of 8.5°C. Temperature sensitivity was analyzed to account for changing ambient conditions in the ocean water and to account for the highest possible (though not likely) possible effluent temperature.

Results from the modelling assessment indicated that, under all scenarios, the plume centerline dilution factor reaches the desired dilution factor of 11 within a short distance from the diffuser port (Golder 2019b). In summary, the results show that:

- The required dilution is met within 1 m horizontal and 6 m vertical distance from the diffuser, under the assumed conditions (including sensitivity analysis for temperature variation).
- The plumes rise higher in the water column as discharge temperatures increase due to slight reductions in density (reduced negative buoyancy).
- At a flow rate of 800 m^3/12 hours or 1,600 m^3/day, the dilution factors at 100 m from the diffuser are increased due to accelerated plume mixing due to higher discharge velocities.
- 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.
- The modelling results are considered to be valid for placement of the diffuser in Melvin Bay in water depths of at least 20 m.

2.5 Project Management Plans

Agnico Eagle has developed Management Plans that are applicable to the 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 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 existing plans that have been developed for the 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 Ocean Discharge Activities

Management Plan	Reference
Risk Management and Emergency Response Plan	Updated and resubmitted (Agnico Eagle 2015)
Hazardous Materials Management Plan	Updated and resubmitted (Agnico Eagle 2018a)
Spill Contingency Plan	Updated and resubmitted (Agnico Eagle 2019a)
Water Management Plan	Updated and resubmitted (Agnico Eagle 2020c)
Mine Waste Management Plan	Updated and resubmitted (Agnico Eagle 2020b)
Roads Management Plan	Updated and resubmitted (Agnico Eagle 2019c)
Groundwater Management Plan	Updated and resubmitted (Agnico Eagle 2020a)
Shipping Management Plan (including the Marine Environmental Management Plan as Appendix D)	Updated and resubmitted (Agnico Eagle 2019d)
Ocean Discharge Monitoring Plan	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) terms and conditions, as adaptive management measures or changes are applied as the Project develops.

2.6 Potential Effects

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

- Change in fish and benthic invertebrate 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.
- Change in water quality of the marine environment 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 is treated prior to discharge to comply with the effluent discharge criteria (refer to Section 3). These criteria are set to be protective of marine aquatic life. For parameters with no regulated guidelines for discharge, the discharge concentration objectives conservatively considered for the assessment were 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.

SECTION 3 • MONITORING DESIGN

The following are the main components of the ODMP:

- Effluent monitoring at the Final Discharge Point (FDP; end-of-pipe monitoring) to verify compliance of saline groundwater properties with the discharge criteria and to characterize effluent quality under MDMER.
- Environmental effects monitoring to assess short- and long-term effects to water quality from the discharge of treated groundwater effluent on marine environment (Receiving Environment, Exposure Area and Reference Area A), in relation to CCME and BCMOE guidelines as well as background concentrations.

The objectives of the ODMP are to:

- Comply with applicable regulatory requirements.
- Detect short- and long-term effects of the discharge on the receiving environment based on the results obtained, and identify unforeseen adverse effects and provide early warnings of undesirable changes in the water quality.
- Inform mitigation through adaptive management measures, as appropriate, based on the results and trends observed.

Table 4: Ocean Discharge Monitoring Program – Monitoring Locations

Description	Location	Centroid Location Coordinates (NAD 83)
Final Discharge Point (FDP; end-of-pipe monitoring)	MEL-26, Sampling Valve (downstream of the storage tank)	62°48’01.99” N 92°06’00.05” W
Receiving Environment	MWE-1, Diffuser Location	62°47’48.43” N 92°05’53.10” W
Exposure Area	Melvin Bay	62°47’49.24” N 92°05’52.97” W
Reference Area A	Melvin Bay	62°46’55.38” N 92°07’01.43” W

A summary of monitoring components, sampling frequency and design is provided in Table 5.

Table 5: Ocean Discharge Monitoring Program – Sampling Summary

Monitoring Component	Sampling Frequency	Monitoring Location	Sample Replication and Number of Samples
Deleterious Substances (MDMER Schedule 4)	Once per week	▪ FDP	One grab sample.
Effluent Characterization	Four times a year, at least one month apart, during discharge	▪ FDP	One grab sample.
In situ Water Column Measurements	Four times a year, once a month during discharge	▪ Receiving Environment ▪ Exposure Area ▪ Reference Area A	7 stations in the Receiving Environment and Exposure Area, 3 stations in Reference Area A. One vertical profile per station.
Water Quality	Four times a year, once a month during discharge	▪ Receiving Environment ▪ Exposure Area ▪ Reference Area A	7 stations in the Receiving Environment and Exposure Area, 3 stations in Reference Area A. One sample at 1 m below the surface and one sample at 5 m above the bottom at each station.
Acute lethality	Every month (sampled concurrently with effluent characterization)	▪ 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

Notes:
Sampling requirements per Metal and Diamond Mining Effluent Regulations (MDMER; GC 2018).
FDP = Final Discharge Point (end of pipe).
Receiving Environment = Diffuser Location.

3.1 Effluent Monitoring

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

3.1.1 Deleterious Substances

Effluent water at the FDP (end-of-pipe) is measured for dissolved oxygen, pH, temperature and specific conductivity per MDMER, and analysed for concentrations of deleterious substances listed in MDMER Schedule 4 (GC 2019) once per week during discharge.

3.1.2 Acute Lethality

End-of-pipe effluent is sampled once per month over the open water season for acute lethality testing per MDMER requirements. Acute lethality testing is conducted on Three-spine stickleback in accordance with the procedures set out in sections 5 or 6 of Reference Method EPS 1/RM/10 (ECCC 20188). Effluent characterization samples (Section 3.1.3) are collected at the same time to aid in interpretation of acute lethality test results.

3.1.3 Effluent Characterization

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

- General parameters, including pH, TDS, total suspended solids, hardness, alkalinity, specific conductivity, salinity and temperature;
- anions including sulphate and chloride;
- nutrients, including ammonia and nitrate;
- total metals, including those listed in MDMER Schedule 4 and Schedule 5, paragraph 4 (1).

3.1.4 Sublethal Toxicity Testing

Sublethal toxicity testing of effluent is conducted twice a year at least one month apart, at the beginning and at the end of discharge for three years, and once a year after the third year. The following tests are 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 are conducted on aliquots of the same sample collected for effluent characterization.

3.2 Water Quality Monitoring

Agnico Eagle adheres to MDMER EEM requirements for water quality assessments outlined in Table 5. Overall, samples are collected four times a year, at least one month apart during discharge, at seven stations in the exposure area and three stations in reference area A. Further details on sampling and analytical requirements are provided below.

3.2.1 Sampling Locations and Depths

Current sampling locations are based on the diffuser location provided to ECCC on April 29, 2019 in compliance with the MDMER for a new discharge point. The central coordinates for the monitoring locations are presented in Table 6 for the FDP, Receiving Environment, and the Exposure Area. Locations are sampled based on the following rationale:

- One station at the FDP (sampling valve downstream of the storage tank).
- One station at the Receiving Environment location to characterize water quality at the point of the discharge.
- Four stations at 100 m in the Exposure Area – these stations are at the edge of the mixing zone and can be downstream of the Receiving Environment discharge point depending on current direction (i.e., tidal and wind-driven).
- Two stations at 250 m in the Exposure Area – as per MDMER Schedule 5, these are additional stations to estimate concentration of effluent in the Exposure Area at 250 m from the discharge point.
- Two water depths are sampled at each station to account for horizontal and vertical dispersion of the discharge plume due to oceanographic conditions of water column structure, e.g., horizontal and vertical currents, mixing/stratification. These are 1 m below the water surface and 5 m above the bottom.

At Reference Area A, three sampling stations are visited to comply with the recommended minimum requirement to account for variability, as per the Metal Mining Technical Guidance Document (TGD; GC 2012). As in the exposure area, samples are collected from two depths at each sampling station.

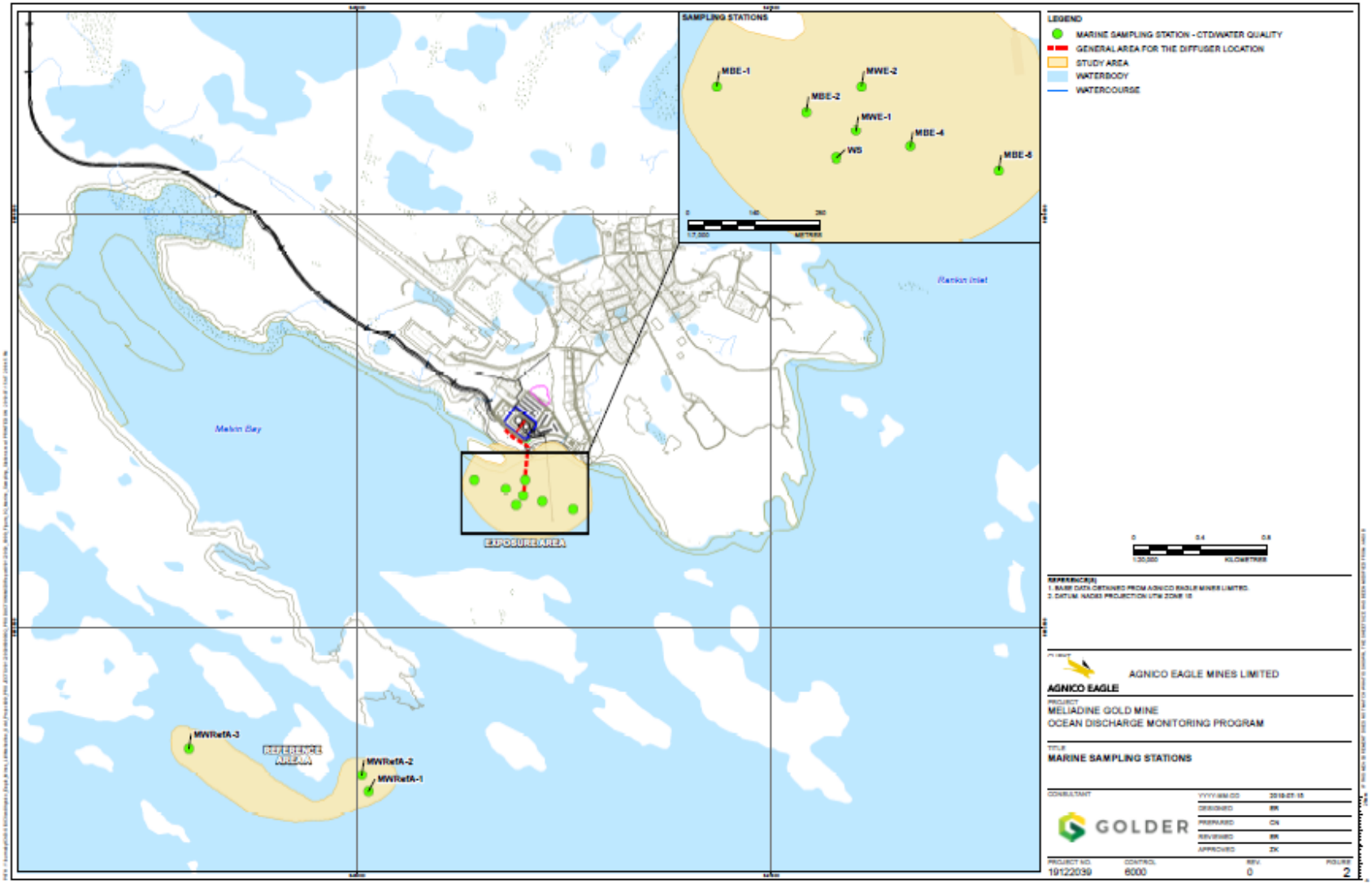
Coordinates for the Exposure Area and the Reference Area A are provided below in Table 6 and Figure 2.

Table 6: List of Sampling Stations and Coordinates in Melvin Bay

Sampling Area	Station Name	UTM Coordinates NAD 83 Zone 15		Geographical Coordinates System NAD 83	
		Easting (m)	Northing (m)	Longitude (°)	Latitude (°)
Receiving Environment (Discharge Point)	MWE-1	546002	6963295	-92.0980	62.7970
Exposure Area	WS	545960	6963239	-92.0989	62.7965
	MWE-2	546014	6963391	-92.0978	62.7979
	MBE-1	545708	6963391	-92.1038	62.7979
	MBE-2	545897	6963337	-92.1001	62.7974
	MBE-4	546117	6963262	-92.0958	62.7967
	MBE-5	546304	6963213	-92.0922	62.7962
Reference Area A	MWRefA-1	545070	6961511	-92.1168	62.7811
	MWRefA-2	545025	6961609	-92.1176	62.7820
	MWRefA-3	543985	6961768	-92.1380	62.7836

Notes: UTM = Universal Transverse Mercator coordinate system; NAD 83 = North American Datum 83.

Figure 2: Ocean Discharge Monitoring Plan – Marine Sampling Stations



3.2.2 Field and Laboratory Requirements

To be compliant with all requirements from the MDMER and provide sufficient information for the interpretation of the results, *in situ* profile measurements are taken with a CTD probe at every water quality sampling station to assess water column physical properties (i.e., temperature, salinity, and turbidity). Dissolved oxygen point measurements are taken to adhere to MDMER requirements.

Samples are stored in clean laboratory-provided containers, preserved accordingly and sent to accredited commercial laboratories for analysis as quickly as feasible. For parameters with short hold-time requirements (i.e., 72 h or less: pH, turbidity, ammonia, nitrate, nitrite), hold-time exceedances are expected to occur.

Laboratory analysis follow the MDMER detection limit requirements as per Schedule 3 and include deleterious substances listed in Schedule 4 and Schedule 5 paragraph 4(1), as well as other metals and additional parameters recommended by TGD (GC 2012).

Table 7 provides a list of parameters to be analyzed, minimum recommended detection limits and recommended hold-time for analysis.

Table 7: List of Sampling Parameters for Water Quality Monitoring

Parameter Group	Parameter	Units	Method Detection Limit Required	Recommended Hold-Time for analysis[(a)]
Conventional Parameters	pH	-	-	0.25 h
	Total Dissolved Solids	mg/L	-	7 days
	Total Suspended Solids	mg/L	2	7 days
	Specific Conductivity	µS/cm	1	28 days
	Hardness	mg $CaCO_3$/L	1	180 days
	Alkalinity	mg $CaCO_3$/L	2	14 days
	Salinity	-	-	28 days
Major Ions	Calcium	mg/L	-	180 days
	Chloride	mg/L	60	28 days
	Fluoride	mg/L	-	28 days
	Magnesium	mg/L	-	180 days
	Potassium	mg/L	-	180 days
	Sodium	mg/L	-	180 days
	Sulphate	mg/L	0.6	28 days
Nutrients	Ammonia	mg-N/L	0.05	3 days
	Nitrate	mg-N/L	1.47	3 days
	Nitrite	mg-N/L	-	3 days
	Total Kjeldahl Nitrogen	mg-N/L	-	28 days
	Orthophosphate	mg-P/L	-	3 days
	Total Phosphorus	mg-P/L	0.05	3 days
	Silicate	mg/L	-	28 days
	Total Organic Carbon	mg/L	-	28 days
	Dissolved Organic Carbon	mg/L	-	28 days

Parameter Group	Parameter	Units	Method Detection Limit Required	Recommended Hold-Time for analysis[(a)]
Total Metals	Aluminium	mg/L	0.005	180 days
	Antimony	mg/L	-	180 days
	Arsenic	mg/L	0.0025	180 days
	Barium	mg/L	-	180 days
	Beryllium	mg/L	-	180 days
	Bismuth	mg/L	-	180 days
	Boron	mg/L	-	180 days
	Cadmium	mg/L	0.000045	180 days
	Chromium	mg/L	0.00445	180 days
	Cobalt	mg/L	0.00125	180 days
	Copper	mg/L	0.001	180 days
	Iron	mg/L	0.15	180 days
	Lead	mg/L	0.0005	180 days
	Manganese	mg/L	0.005	180 days
	Mercury	mg/L	0.00001	28 days
	Molybdenum	mg/L	0.0365	180 days
	Nickel	mg/L	0.0125	180 days
	Selenium	mg/L	0.0005	180 days
	Silver	mg/L	-	180 days
	Strontium	mg/L	-	180 days
	Thallium	mg/L	0.0004	180 days
	Tin	mg/L	-	180 days
	Titanium	mg/L	-	180 days
	Uranium	mg/L	0.0075	180 days
	Vanadium	mg/L	-	180 days
	Zinc	mg/L	0.010	180 days
Radionuclides	Radium 226	Bq/L	0.01	180 days
Other	Cyanide	mg/L	0.005	14 days

(a) Provided by ALS and may vary depending on the laboratory responsible for analysis.

3.3 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 is 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 are trained to be proficient in standardized sampling procedures, data recording using standardized forms, and equipment operations applicable to the monitoring program. Field work will be completed according to specified instructions and established technical procedures for sample collection, preservation, handling, storage, and shipping. Canadian Association for Laboratory Accreditation (CALA) 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 is utilized so that an organized consistent system of data control, data analysis, and filing will be applied to the program.

The QC component consists of applicable field and sample handling procedures, and the preparation and submission of two types of QC samples for laboratory analysis: blanks (e.g., travel, field, equipment) and duplicate/split samples. Quality control procedures implemented for this program will consist of the preparation and submission of field blanks, trip blanks, and duplicate water samples. QC samples will be collected with a frequency of approximately 5 to 10% of the total number of samples as duplicates, per current Mine site practices.

SECTION 4 • BENCHMARKS AND DIFFERENCE CRITERIA

This section sets quality benchmarks and difference criteria against which the effluent and/or the marine environment will be monitored, and whose exceedance will be considered to indicate effects of the treated effluent discharge. The following criteria are discussed:

- A benchmark is a set concentration of a substance in water that is expected to be protective of aquatic life, e.g., CCME WQGs for the protection of aquatic life.
- A difference criterion is a magnitude of environmental change, which, if reached, indicates a change outside of background variability. As per the TGD (GC 2012), a factor of two will be used as difference criteria for water quality parameters when comparing exposure data to reference or baseline.

4.1 Effluent Monitoring

The benchmarks applicable for effluent monitoring (i.e., end-of-pipe) for deleterious substances are the authorized limits outlined in Schedule 4 of the MDMER. The maximum authorized concentrations for monthly mean, composite and grab samples are presented in Table 8. The values provided below are in force to May 31, 2021. In anticipation of the revised limits coming into force on June 1, 2021, the plan will be updated accordingly.

Table 8: Authorized Limits of Deleterious Substances in Effluent

Deleterious Substance[(a)]	Unit	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Composite Sample	Maximum Authorized Concentration in a Grab Sample
Arsenic	mg/L	0.50	0.75	1.00
Copper	mg/L	0.30	0.45	0.60
Cyanide	mg/L	1.00	1.50	2.00
Lead	mg/L	0.20	0.30	0.40
Nickel	mg/L	0.50	0.75	1.00
Zinc	mg/L	0.50	0.75	1.00
Total Suspended Solids	mg/L	15.00	22.50	30.00
Radium 226	Bq/L	0.37	0.74	1.11

Note: All concentrations are total values.

(a) Per Metal and Diamond Mining Effluent Regulations (MDMER; GC 2019) Schedule 4 Authorized Limits of Deleterious Substances - Maximum Authorized Monthly Mean Concentration (in force as of June 1, 2018). This will be complied with at the FDP or end-of-pipe (i.e., after treatment).

In compliance with MDMER Section 14.2 groundwater effluent is not expected to be acutely lethal to threespine stickleback. As previously indicated, the groundwater effluent is treated prior to discharge in compliance with MDMER requirements, and the modelling assessment (Section 2.4) shows that the required dilution is met well within the regulatory mixing zone from the diffuser, under the assumed conditions. If the salinity value of the effluent is equal to or greater than ten parts per thousand, the mine will evaluate whether the effluent is acutely lethal by conducting an acute lethality test in accordance with the procedures set out in section 5 or 6 of Reference Method EPS 1/RM/10.

4.2 Water Quality

The benchmarks used for water quality variables in the receiving environment are water quality guidelines currently in effect, consisting of the CCME WQG 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, located 100 m from the diffuser (Table 9).

For parameters for which no WQGs exist, concentrations from the exposure area will be compared to baseline concentrations and concentrations in the reference area.

Concentration of a parameter will be considered elevated in the exposure area in comparison to baseline or reference area data based on a difference of more than a factor of two. A factor of two is recommended to ensure that differences observed are real differences, rather than a result of background or analytical variation (GC 2012).

Table 9: Summary of Water Quality Guidelines

Parameter	Unit	CCME[a]		BC MOE[b]	
		Short-term	Long-term	Short-term	Long-term
Ammonia (total)	mg/L as N	-	-	0.71 – 312[c]	0.11 – 47[c]
Arsenic (total)	µg/L	-	12.5	12.5	-
Boron (total)	mg/L	-	-	-	1.2
Beryllium (total)	µg/L	-	-	-	100
Cadmium (total)	µg/L	-	0.12	-	0.12
Chloride	mg/L	-	-	Narrative[d]	-
Chlorine-produced oxidants	µg/L	-	0.5	40	3
Chromium (III)	µg/L	-	56	-	56
Chromium (VI)	µg/L	-	1.5	-	1.5
Colour (apparent)	Pt-Co	-	Narrative[e]	-	Narrative[f]
Colour (real)	Pt-Co	-	Narrative[g]	-	Narrative[h]
Copper (total)	µg/L	-	-	3	≤2
Cyanide	µg/L	-	-	1[i]	
Dissolved Oxygen	mg/L	-	>8 and Narrative[j]	-	-
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 and Narrative [k]	7.0 - 8.7	-
Salinity	-	-	Narrative[l]	-	-
Selenium (total)	µg/L	-	-	1 or 2[m]	-
Silver (total)	µg/L	7.5	-	3	1.5
Temperature	°C	-	± 1 change from ambient background	-	± 1 change from ambient background
Turbidity	NTU	-	Narrative[n]	Narrative[o]	-
Total Suspended Solids	mg/L	-	Narrative [p]	Narrative [q]	-
Vanadium (total)	µg/L	-	-	-	50
Zinc	µg/L	-	-	55	10

Notes:

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

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

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

(d) 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.

(e) The mean absorbance of filtered water samples at 456 nm shall not be significantly higher than the seasonally adjusted expected value for the system under consideration.

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

(g) The mean percent transmission of white light per metre shall not be significantly less than the seasonally adjusted expected value for the system under consideration.

(h) 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.

(i) BC MOE Guideline is applicable for weak acid dissociable cyanide.

(j) The CCME guidelines for dissolved oxygen (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.

(k) 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 (CCME guidelines). 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.

(l) 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 (CCME guidelines and BC MOE Environment Guidelines).

(m) BC MOE selenium guideline is defined as alert concentration: 1 µg/L and WQG: 2 µg/L .

(n) 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.

(o) 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.

(p) The CCME WQG for total suspended solids (TSS) 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.

(q) The BC MOE WQG for total suspended solids (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.
- Change from background of 10% when background is > 100 mg/L at any time during high flows or in turbid waters.

SECTION 5 • REPORTING

Reporting will include the raw data obtained during sampling programs, as well as data interpretation, graphical presentation and comparison to applicable guidelines, baseline data and literature data, where applicable. Monitoring results will be integrated to evaluate the presence and overall direction of change to marine water quality. Report structure will be in compliance with applicable MDMER reporting requirements.

Reports will be prepared and delivered to Environment and Climate Change Canada (ECCC, as per the MDMER requirements), and to NIRB and NWB annually following the discharge of treated groundwater effluent to the marine environment. Reports will be available on the respective public registries for regulator and stakeholder review and input.

SECTION 6 • REFERENCES

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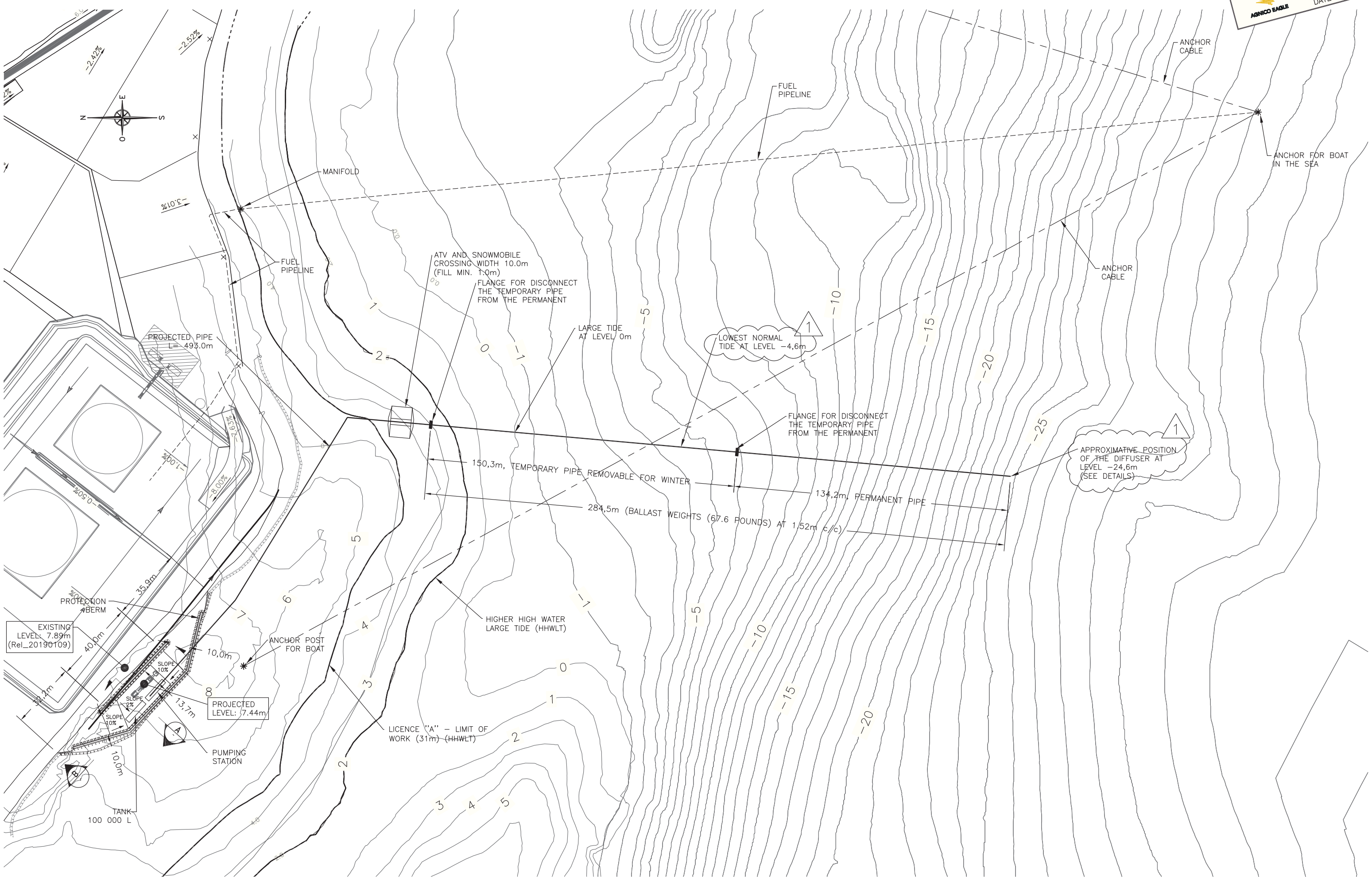
APPENDIX A – SALINE EFFLUENT DISCHARGE SYSTEM CONSTRUCTION DRAWINGS

NO. DESSIN
DRAWING NO. 65-180-230-200-1_R1

FORMAT ARCHD

POUR CONSTRUCTION
FOR CONSTRUCTION
DATE : 2019-02-14



PLAN VIEW
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PLAN CLÉ
KEY PLAN

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

Ref. 181-15686-00

NOTES GÉNÉRALES / GENERAL NOTES

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

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

AGNICO EAGLE

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

REVISIONS

Stéphan Dupuis 139669 QUÉBEC
S. DUPUIS LICENSEE NT/NU
2019-02-14

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

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

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

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

AE-CART-ARCH D

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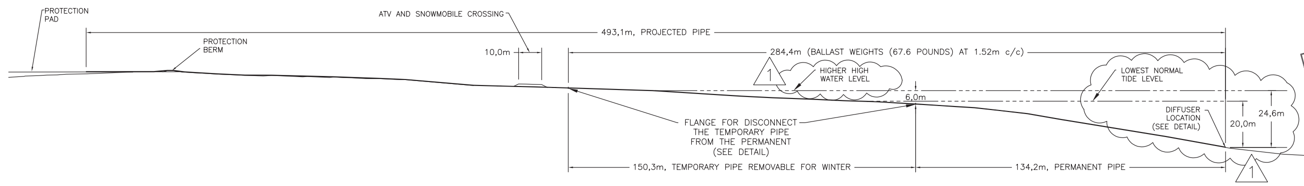

LONGITUDINAL PROFILE – PIPE
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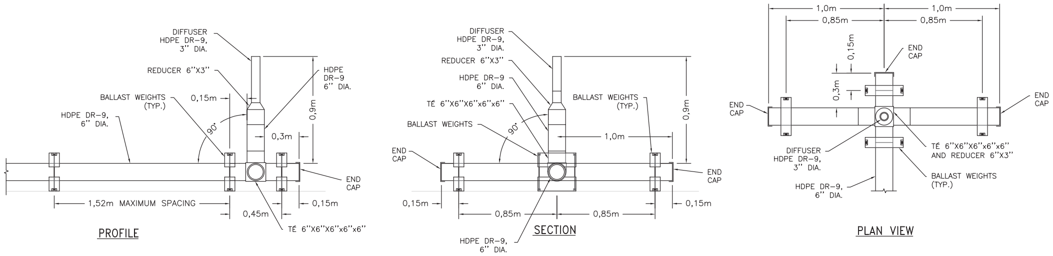
POUR CONSTRUCTION
FOR CONSTRUCTION
DATE : 2019-02-14



DETAILS – DIFFUSER
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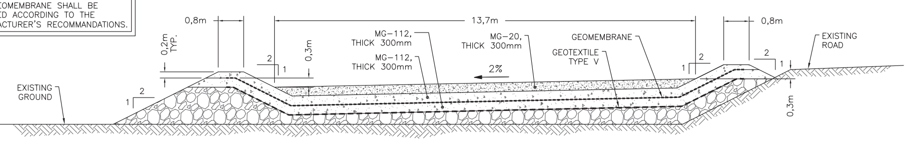
NOTE:

THE GEOMEMBRANE SHALL BE COVERED ACCORDING TO THE MANUFACTURER'S RECOMMANDATIONS.



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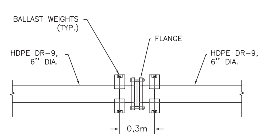

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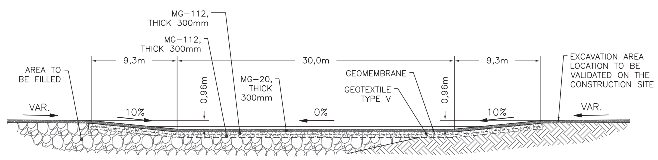

SECTION "B" – PAD
Scale: 1: 250

NOTES:

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

2) POST-INSTALLATION SURVEY

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

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

PLAN CLÉ
KEY PLAN

wsp
1075, 3e AVENUE E.
VAL-D'OR (QUÉBEC) CANADA J9P 0J7
TÉL. : 1-819-825-4711 | TÉLÉC. : 1-819-825-4715 | WWW.WSP.COM

Ref. 181-15686-00

NOTES GÉNÉRALES / GENERAL NOTES

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

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

AGNICO EAGLE

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

REVISIONS

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

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

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

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

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

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

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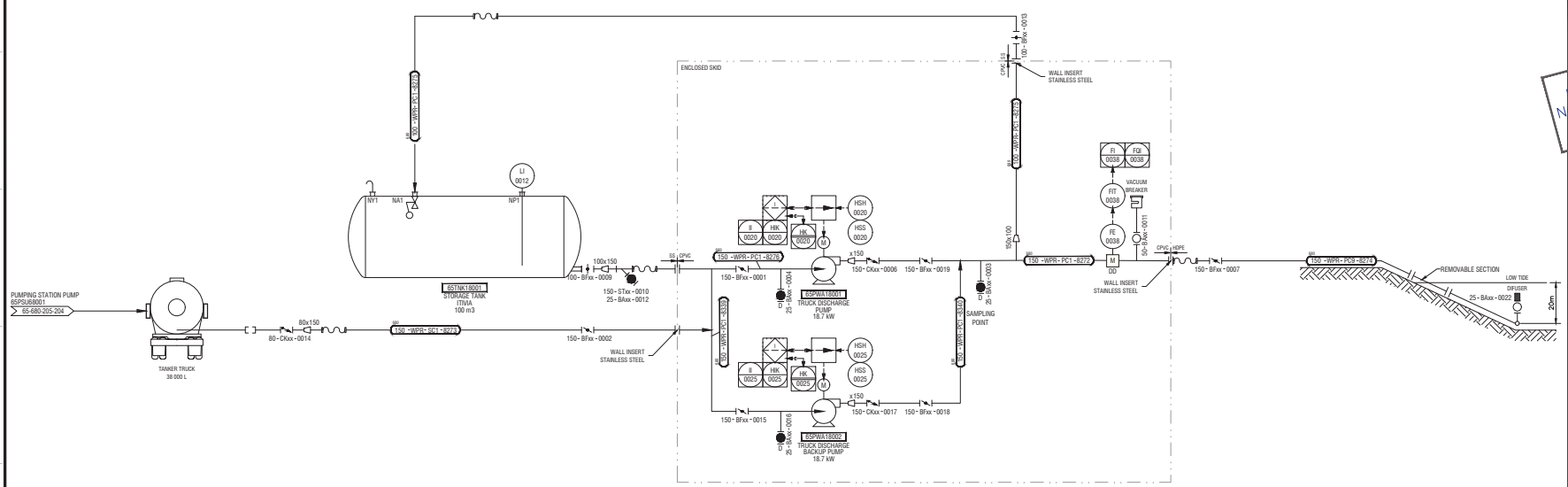

NE PAS UTILISER POUR CONSTRUCTION
NOT FOR CONSTRUCTION
DATE : 19-02-07

PLAN CLÉ
KEY PLAN

NOTES GÉNÉRALES / GENERAL NOTES

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

TYPE / TITLE	# DWG
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AGNICO EAGLE

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

REVISIONS

08/02/2019

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

DESSINÉ PAR / DRAWN BY	JONATHAN LAVOIE	DATE 2019-01-17
VÉRIFIÉ PAR / CHECKED BY	SÉBASTIEN PERRON	2019-02-07
APPROUVÉ PAR / APPROVED BY	ÉRIC LAVOIE, P. Eng.	2019-02-07
ÉCHELLE / SCALE	NO SCALE	DATE 2019-01-23

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

NO. PROJET / PROJECT NO.	REVISION	FEUILLE / SHT
6528	0	1 / 1

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

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

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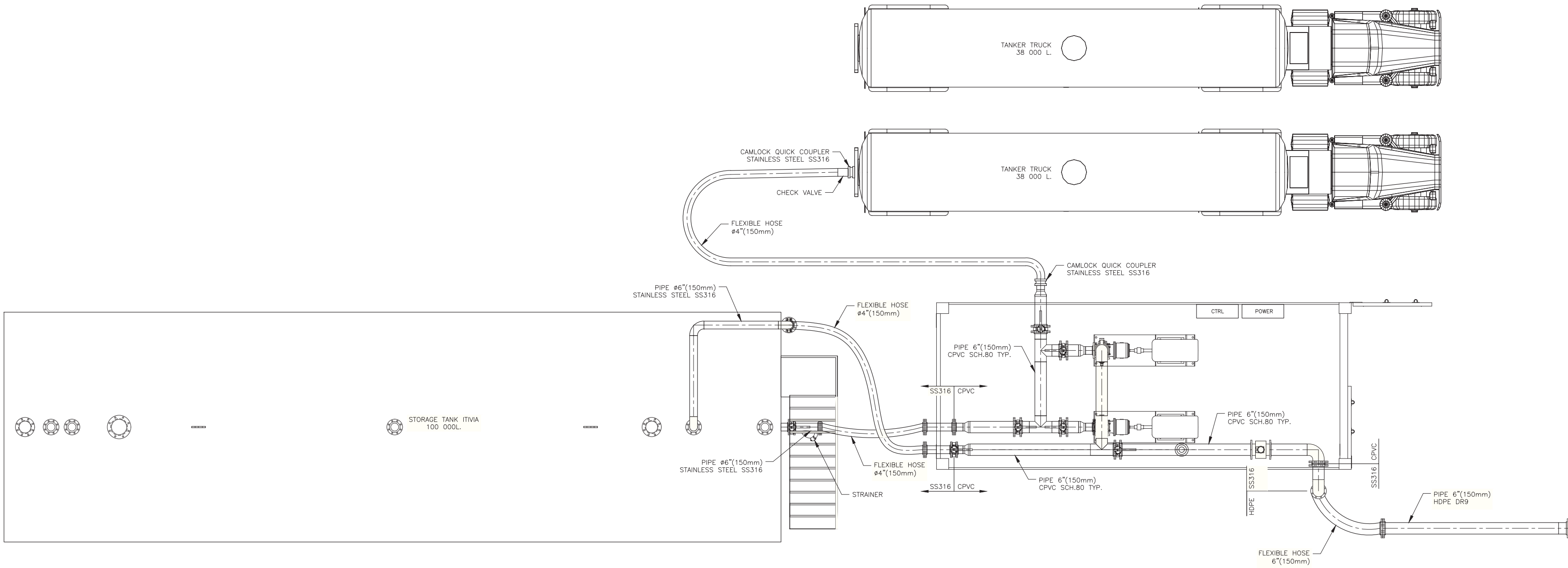

PLAN VIEW – SALINE EFFLUENT DISCHARGE SYSTEM
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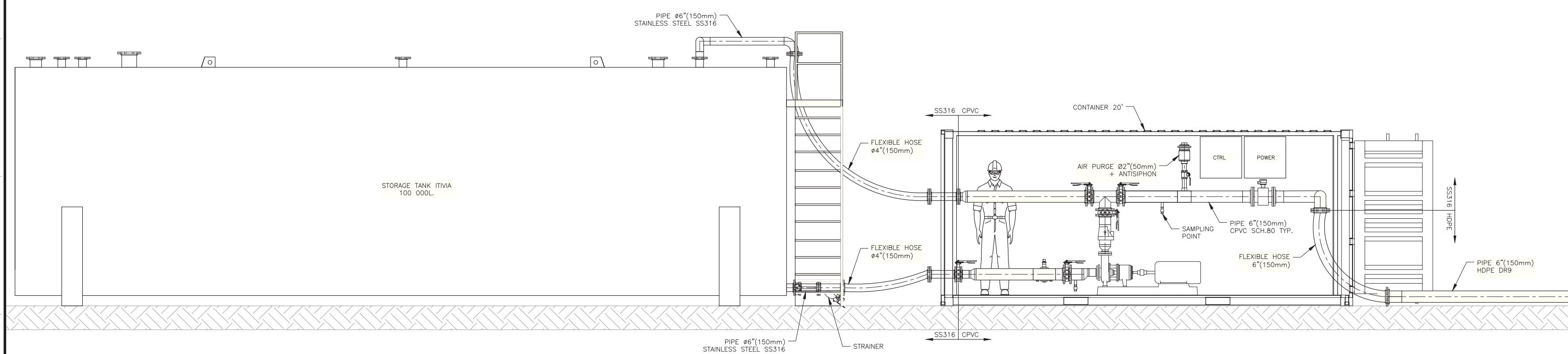

ELEVATION VIEW – SALINE EFFLUENT DISCHARGE SYSTEM
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PLAN CLÉ
KEY PLAN

wsp
1075, 3e AVENUE EST
VAL-D'OR (QUÉBEC) CANADA J9P 0J7
TÉL. : 819 825-4274 | TÉLÉC. : 819 824-1514 | WWW.WSPGROUP.COM
Ref. 181-15686-00

NOTES GÉNÉRALES / GENERAL NOTES

POUR SOUMISSION
FOR TENDER
DATE : 2019-02-05

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

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

TITRE / TITLE	# DWG
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AGNICO EAGLE

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

REVISIONS

Dominique Richard

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

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

NO. DESSIN DRAWING NO. 65-180-210-200

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

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FILE NO. 65-180-210-200_R0.dwg

APPENDIX B – MARINE RECONNAISSANCE PROGRAM 2018

REPORT

Meliadine Gold Mine Ocean Discharge Monitoring Plan - Marine Reconnaissance and Baseline Programs

2018 Marine Reconnaissance Survey Data Report

Submitted to:

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Meliadine Division, Nunavut, Canada
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Doc707-18103567

February 2019

Distribution List

One electronic copy to Agnico Eagle Mines Ltd.

One electronic copy to Golder Associates Ltd.

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APPENDICES

1.0 INTRODUCTION

As described in the Final Environmental Impact Statement Addendum (FEIS Addendum; Agnico Eagle 2018), to support long-term groundwater management for the Mine, Agnico Eagle has proposed to directly discharge excess groundwater effluent into Melvin Bay, after treatment to meet discharge water quality criteria for Melvin Bay and/or background conditions.

The conceptual Ocean Discharge Monitoring Plan (ODMP), included in the FEIS Addendum (as Appendix E; Agnico Eagle 2018), outlines objectives, rationale, and details for protection of water/sediment quality and biological components on the marine environment in Melvin Bay. The ODMP will align with Environmental Effects Monitoring (EEM) study design requirements per Metal and Diamond Mine Effluent Regulations (MDMER; SOR/2002/222). The proposed EEM design for treated groundwater discharge to Melvin Bay is based on a before/after, control/impact (BACI) approach with monitoring studies conducted in the exposure (impact) and reference (control) areas. As per of the EEM design, 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 are identified by comparing data collected from the exposure area during monitoring studies to data from reference areas and to baseline (pre-discharge) conditions.

Golder was retained by Agnico Eagle to conduct marine environmental reconnaissance surveys in Melvin Bay to establish appropriate reference areas and collect preliminary baseline data on physical properties of the water column, water and sediment quality, benthic substrate, benthic communities (infauna[1], epifauna[2] and epiflora[3]), and marine mammal occurrence.

1.1 The Purpose and Scope of Work

The purpose of the reconnaissance survey was to:

- Establish reference area(s) that have similar physical and ecological characteristics as the exposure area (i.e., similar water depth and substrate), but located outside of the influence of the treated effluent discharge or other confounding factors.
- Update previously collected baseline data on the marine and coastal environment.

Marine baseline studies were previously conducted for the Mine in Itivia Harbour and involved gathering of environmental data in an exposure and two reference areas (Nunami Stantec 2012). However, the surveys targeted shallower depths (up to 9 m shallower) than that of the discharge location, therefore, the survey locations and data gathered were considered not suitable as reference areas for the purpose of future environmental effects monitoring for treated groundwater effluent discharge.

The 2018 reconnaissance survey consisted of collection of data on physical properties of water column and limited sampling of water, sediments and benthic infauna in the exposure and candidate reference areas selected during a desktop review, as well as bio-physical surveys of the intertidal zone and observations of marine mammal occurrence.

[1] Infauna - organisms living in the substrate of the seafloor (e.g., polychaete worms, clams).
[2] Epifauna – organisms living on the seafloor (e.g., sea stars, crabs).
[3] Epiflora – vegetation living on the sea floor.

2.0 MATERIALS AND METHODS

2.1 Desktop Review

A preliminary desktop review was completed prior to undertaking fieldwork and consisted of a review of the existing baseline report (Nunami Stantec 2012) and the satellite, topographic and navigation maps of Melvin Bay and adjacent areas of western Hudson Bay. The purpose of the review was to identify candidate reference area(s) based on the following criteria:

- similar topographic and bathymetric features to the location of the proposed diffuser in Melvin Bay (the exposure area);
- safe and unhindered access by a boat;
- relatively short distance from the exposure area, so the reference area(s) would have similar environmental characteristics and would be exposed to similar natural influences; and
- located outside of the potential zone of influence from the engineered diffuser and other anthropogenic factors.

Four candidate reference areas as well as a reference area previously surveyed by Nunami Stantec were selected based on the above criteria and are shown on Figure 1.

2.2 Field Program

The 2018 marine reconnaissance survey was conducted from 10 to 20 September 2018 by two Golder scientists using an 18-foot aluminium boat (Figure 3). The main purpose of the survey was to collect preliminary physical and ecological data and investigate whether the candidate reference areas were suitable for future marine EEM.

2.2.1 Study Areas

The reconnaissance surveys were conducted in the Exposure Area and three reference areas (A, B and R1) (Figure 2). Reference areas C and D (Figure 1) were not surveyed; Reference Area C was located at a distance that could not be safely accessed compared to Areas A and B, and Reference Area D was located in an area with high wind and wave exposure.

Exposure Area surveys were focused primarily at the future location of the proposed discharge pipe and diffuser near the existing Itivia Harbour fuel storage facility at a depth of 20 m in Melvin Bay. Surveys included water column profiling, water and sediment quality sampling, benthic infauna sampling, intertidal surveys and marine mammal observations (Table 1).

Reference areas A and B included water column profiling, water and sediment quality sampling, and benthic infauna sampling. A depth of 20 m (the depth of the proposed discharge diffuser) was selected for monitoring of sediment quality and benthic infauna community composition to avoid influence of depth as a potential factor affecting the monitoring endpoints.

Reference Area R1 had previously been surveyed in 2012 (Nunami Stantec 2012). Therefore, only water column profiling, water quality sampling, and intertidal surveys were conducted in 2018. R1 is at a shallower depth than the Exposure Area (the maximum depth is 15 m) and was not selected as a reference location for sediment quality and benthic infauna sampling.

Marine mammal observations were conducted in all study areas.

A list of sampling and measurements collected during the Reconnaissance Survey by stations is presented in Table 1.

Table 1: Surveys Conducted at Exposure and Reference Areas in 2018; 'X' indicates survey was conducted, '-' indicates survey was not conducted.

Surveys	Exposure Area	Reference Areas		
		A	B	R1
water column profiling	X	X	X	X
water quality sampling	X	X	X	X
sediment quality sampling	X	X	X	-
benthic invertebrates sampling	X	X	X	-
intertidal transect survey	X	X	X	X
marine mammal observations	X	X	X	X

[1] previously surveyed by Nunami Stantec (2012)

Table 2: Summary of survey stations and collected data

Station	Area	Coordinates (15 V)	Samples collected and replicates				
			Water column profiles (In situ)	Discrete water quality samples	Sediment quality samples	Benthic infauna samples	Intertidal transect surveys
WN	Exposure	546022 E 6963370 N	1	-	-	-	-
WC	Exposure	546002 E 6963295 N	1	-	-	-	-
WS	Exposure	545960 E 6963238 N	1	-	-	-	-
MWE-1	Exposure	546002 E 6963295 N	-	1 at 1 m; 1 at 18 m	-	-	-
MWE-2	Exposure	546021 E 6963373 N	-	1 at 1 m; 2a at 5 m	-	-	-
MBE-1	Exposure	545710 E 6963402 N	-	-	4b	3	-
MBE-2	Exposure	545894 E 6963340 N	-	-	3	3	-
MBE-3	Exposure	545991 E 6963294 N	-	-	3	3	-
MBE-4	Exposure	546123 E 6963268 N	-	-	3	3	-
MBE-5	Exposure	546304 E 6963213 N	-	-	3	3	-
MWRefA-1	Reference A	545070 E 6961511 N	1	1 at 1 m; 1 at 15 m	-	-	-
MWRefA-2	Reference A	545055 E 6961615 N	1	1 at 1 m; 1 at 15 m	-	-	-
MBRefA-1	Reference A	545070 E 6961511 N	-	-	3	3	-
MBRefA-2	Reference A	545028 E 6961609 N	-	-	3	3	-
MWRefA-3	Reference A	543992 E 6961780 N	1	1 at 1 m and 1 at 15 m	-	-	-

Table 2: Summary of survey stations and collected data

Station	Area	Coordinates (15 V)	Samples collected and replicates				
			Water column profiles (In situ)	Discrete water quality samples	Sediment quality samples	Benthic infauna samples	Intertidal transect surveys
MBRefA-3	Reference A	543984 E 6961768 N	-	-	3	3	-
CTD-1	Reference B	542232 E 6961875 N	1	-	-	-	-
CTD-2	Reference B	540426 E 6962686 N	1	-	-	-	-
CTD-3	Reference B	541626 E 6962080 N	1	-	-	-	-
MWRefB-1	Reference B	541626 E 6962080 N	-	1 at 1 m and 1 at 15 m	-	-	-
MBRefB-1	Reference B	541650 E 6962064 N	-	-	1	-	-
WW-1	Reference R1	545249 E 6963763 N	1	1 at 1 m and 1 at 10 m	-	-	-
WW-2	Reference R1	545249 E 6963857 N	1	-	-	-	-
Transect EXP-T1	Exposure	546085 E 6963605 N to 546131 E **6963519 N**	-	-	-	-	1
Transect EXP-T2	Exposure	546037 E 6963557 N to 546054 E 6963507 N	-	-	-	-	1
Transect REF-T1	Reference R1	545395 E 6963954 N to 545392 E 6963923 N	-	-	-	-	1
Transect REF-T2	Reference R1	545335 E 6963972 N to 545326 E 6963947 N	-	-	-	-	1
		Total	**11**	**15**	**26**	**24**	**4**

(a) includes blind water quality duplicate (Dup A)

(b) includes blind sediment quality duplicate (Dup A)

2.2.2 Water Quality

2.2.2.1 In situ Profiling

In situ parameters measured at each location included water depth, temperature, conductivity (salinity), dissolved oxygen, turbidity, chlorophyll concentration and transparency (Sechi depth). Vertical profiles were collected using an RBR XR-620 CTD (conductivity, temperature, depth) probe equipped with dissolved oxygen, turbidity and fluorometer sensors at stations in the Exposure and Reference areas (Figure 2 and Table 2). Measurements were taken throughout the water column by lowering the probe from the surface to the bottom at a vertical speed of approximately 0.5 m/sec while the probe was recording measurements at a frequency of 6 Hz (6 measurements per second).

Secchi depth was measured with a 30-cm white disk, which was lowered over the shaded side of the boat until no longer visible, raised back into view again and re-lowered. The second disappearance depth was recorded as the Secchi depth, from which photic zone depth can be calculated.

2.2.2.2 Discrete Water Quality Sampling

Discrete water quality samples were collected from stations in the Exposure and Reference areas shown on Figure 2 and in Table 2. Samples were collected at two depth intervals: 1 m below the surface, and at a depth approximately 5 m above the seafloor.

A water quality sampler (Kemmerer sampler) was lowered to target depth and a messenger was released along a tag line to trigger closure of the bottle sampler. After retrieval of the sampler, water samples were transferred to pre-labelled sample bottles and preservatives were added as required. Water samples were refrigerated until they were shipped to the analytical laboratory. Additionally, a blind duplicate sample was collected for quality assurance / quality control (QA/QC) purposes (refer to Section 2.3 for additional QA/QC details) at MWE-2D (deep sample).

Samples were sent to ALS analytical laboratories (ALS) for analysis of the following parameters:

- Conventional parameters, including pH, total dissolved solids (TDS), total suspended solids (TSS), hardness, electrical conductivity, and salinity.
- Major ions including sulphate and chloride.
- Nutrients, including ammonia, nitrate and phosphate, organic carbon.
- Total metals and dissolved metals including those listed in MDMER Schedule 4 and Schedule 5 paragraphs 4.

Water sampling effort was recorded in field log sheets presented in APPENDIX B.

2.2.3 Sediment Quality

Sediment quality samples were collected from stations in the Exposure Area and Reference areas A and B where water depth was approximately 20 m (Figure 2; Table 2). Three sediment samples were collected at each station.

Sediment samples were collected using a Petite Ponar grab sampler with an area of 0.0225 m^2 (Figure 4). Sediment samples were collected with three replicates from each station and each replicate sample consisted of approximately one to three grab samples, depending on grab penetration, to collect sufficient volume of substrate for analysis. Each grab sample was examined for acceptability based on the following criteria:

- sediment did not contain large foreign objects;

- grab showed adequate penetration depth and sufficient sediment volume (at least 25% full);
- grab was not overfilled (i.e., sediments did not touch the top of the grab);
- grab was not leaking (i.e., overlying water was present); and
- sample was not disturbed or winnowed (i.e., sediment surface was relatively flat).

Upon acceptance, the top 5 cm of sediment was removed from the grab using a clean stainless-steel spoon and transferred to a clean stainless-steel bowl. Sediments from all composite grabs were homogenized together until the colour and texture were consistent throughout the sample (Figure 5). Aliquots of the homogenized sediment were transferred to clean, labelled glass jars. Sediment samples were stored on ice packs in a cooler prior to shipment to the analytical laboratory.

Additional information, including the number of unsuccessful grabs, sediment appearance and odour (if any), presence of debris in sample, presence of live organisms in sample, and deviations from the planned sampling program, were recorded on field data sheets (APPENDIX C). The date, time, transect name, station number, and GPS coordinates of each sample were recorded. All sampling gear was rinsed and scrubbed with brushes with a biodegradable laboratory-grade detergent between sampling collections. Samples were kept in coolers in the field and in refrigeration until sent to ALS laboratories where they were analysed for the following parameters:

- particle size distribution (Wentworth scale);
- total organic carbon;
- nutrients; and
- total metal concentrations.

2.2.4 Benthic Infauna

Benthic infauna samples were collected from five stations in the Exposure Area and three stations in Reference Area A from a depth of 20 m. In general, benthic infauna samples were collected using the same device (Petite Ponar) and from the same locations as sediment quality samples with the exception of station MBRefB-1, where no benthic infauna samples were collected due to weather and safety constraints.

Benthic infauna samples were collected in triplicate from each station, with each replicate sample consisting of three to six grab samples, depending on grab penetration. Each benthic sample was examined for acceptability using criteria similar to that for sediment sampling.

Upon acceptance, contents of the grab sampler were transferred to an aluminum sieving tray (Figure 6). The contents were gently rinsed through a 1-mm mesh sieve with filtered seawater (Figure 7) and preserved in a 10% buffered formalin solution in pre-labeled 1 L wide-mouth HDPE sample jars. Larger organisms were removed during the rinsing process using forceps and preserved in separate jars to avoid crushing with hard substrate material. The containers were then sealed and inverted several times to promote homogenization with the formalin. Containers were labeled internally (water-resistant labels) and externally. Field observations (e.g., sediment characteristics) were recorded on field data sheets (APPENDIX D). Samples were sent to Biologica for species identification to the lowest practical taxonomic level and abundance determination.

2.2.5 Intertidal Habitat Surveys

Surveys in the intertidal zone were conducted along two transects in the Exposure Area and two transects in Reference Area R1 to characterize the epifloral and epifaunal communities and substrate type. Transect locations were selected with consideration for accessibility and safety for steep rocky shorelines and randomly within shallower sloped intertidal zones. Surveys were carried out on foot during low tide periods to maximize observations of the exposed intertidal zone.

Transect lines were positioned perpendicular to the shoreline starting from the ordinary high water (OHW) level and ending at the water line and start and end points were geo-referenced. A 0.25-m^2 quadrat (Figure 8) was positioned at 7 m intervals along each transect and the following key physical and biological information was collected for each quadrat:

- substrate types were identified on the surface using the size class categories, i.e., bedrock, boulder (>25 cm), cobble (6.5 to 25 cm), gravel, (0.2 to 6.5 cm) sand (0.06 to 0.2 mm) and silt/mud/clay (<0.06 mm), and recorded as percent cover (e.g., boulder 5%; cobble 15%; gravel 60%, sand 20%).
- presence and cover of macrophyte[4] epiflora (e.g., periphyton, filamentous algae, kelp) in each quadrat.
- presence and abundance of invertebrate epifauna in each quadrat (when present, bivalve siphon holes and/or crab burrows were also recorded, but not counted).
- other notable biophysical components such as presence of wood debris, shells or detrital vegetation.
- photographs taken showing representative features.

Notes on general and other features of the shoreline (e.g., shore type, wave exposure, presence of biobands and anthropogenic debris) were recorded at each transect. All observational data was recorded on Project-specific field data forms presented in APPENDIX E.

2.2.6 Marine Mammal Observations

Every hour marine areas around the boat were observed for a duration of up to 5 minutes for the presence of marine mammals. Observations were to be recorded on survey log sheets and included the following information:

- date and time of observation;
- location;
- species observed;
- number of animals observed;
- behaviour; and
- any other observations.

In addition, incidental marine mammal observations occurring during the fieldwork were recorded. Marine mammal observation data collected during the 2018 Reconnaissance Program would be used as a basis for recommendations for any potential 2019 marine mammal studies.

[4] Macrophyte – aquatic vegetation visible to the naked eye.

2.3 Quality Management

The overall goal of the Project was to collect quality data, which was achieved through consistent and thorough data collection, consultation amongst data recorders, and attention to detail during data entry.

Field staff was trained to be proficient in standardized sampling procedures, data recording using standardized forms, and equipment operations applicable to the monitoring program. All field work was completed according to specified instructions and established technical procedures for standard sample collection, preservation, handling, storage, and shipping protocols. Preliminary interpretation of the records and data QA/QC was carried out in the field to ensure the data collected met client specifications for quality and documentation of liability controls. At the end of the field survey, data was entered and organized in a database for subsequent analysis and interpretation. Field data recorded in notebooks was transferred to an electronic database.

A thorough QA/QC check of the data during the data analysis stage was conducted. The QA/QC measures set in place include a multi-tiered technical review team that review all data for consistency of methods and results and independently test random data samples for quality.

General QA/QC tasks completed during the survey include, but not limited to, the following:

- Preparing geo-referenced field maps for use during the surveys to accurately document the location of any observations.
- Preparing Project-specific data collection forms to ensure a comprehensive and accurate field data collection process.
- Collecting geo-referenced coordinates in the field for comparison with field maps to confirm the location of documented observations.
- Maintaining adequate photo documentation to illustrate the various features and species observed during field surveys, and to be kept for subsequent review and reporting.
- Collating and reviewing field data collected among observers to ensure consistent methods and calibrate observer estimates (e.g., estimation of substrate and vegetation cover in quadrat sampling).
- Reviewing all data and reports to review accuracy (e.g., species identification) and consistency (e.g., measurement units).
- Allowing regular communications between the Project Manager and field staff.
- Quality Control (duplicate) samples were collected in the field.
- Accredited laboratories will be selected for sample analysis. Performance quality of selected laboratories were verified through Golder's internal vendor approval and assessment procedures.
- Field data sheets were reviewed by the field supervisor at the end of each day for completeness and accuracy.
- Chain-of-custody documentation were used to track sample shipments to the individual subcontractor laboratories
- Samples were packaged and shipped to the laboratory in accordance with holding times and storage conditions in an effort for analyses to be met.

- Laboratory QA/QC for sediment samples included recommended sample holding times and the analysis of laboratory control samples, laboratory duplicates, and spiked samples to assess precision and accuracy of analytical methods. Laboratory QA/QC reports were reviewed upon receipt to confirm that the laboratory data quality objectives (DQOs) had been met and that the appropriate QA/QC information had been reported.

2.3.1 Water Quality

2.3.1.1 In Sutu Profiling

Maintenance and calibration of the RBR XR-620 CTD profiler and associated sensors are performed by the instrument provider ASL Environmental (completed immediately prior to the reconnaissance program). No field quality checks of any of the parameters were required beyond the cast acceptability check and range checks. DO, pH, pressure offset, and transmissivity performance were carefully monitored and calibrated prior to and immediately following the reconnaissance program.

Immediately following data collection, all data were checked for erroneous values, outliers and to be certain that all data and configuration files were present and properly named. All data were reviewed graphically for outliers as well as trends, and to confirm that all sensors were functioning properly during the deployment. All profile data, datasheets and field notes were saved to a laptop computer and backed up on an external hard drive.

2.3.1.2 Discrete Water Quality Sampling

QA/QC measures were implemented to minimize possible contamination of the collected water samples. Industry standard sampling protocols were followed including collection, handling and shipping procedures. Samples were collected in laboratory-sterilized water bottles and included collection and analysis of a duplicate sample.

A blind duplicate water sample was taken from MWE-2D (Dup A). A number of duplicate analyses were also run by the ALS laboratory for QA/QC. For each pair of QA/QC duplicate water samples, the relative percent differences (RPD) can be calculated, using the following formula:

$$RPD = \left(\frac{sample - duplicate}{(sample + duplicate)/2}\right) \times 100$$

The RPD between the duplicates is a measure of the variability inherent in field sampling (environmental heterogeneity, sampler handling leading to contamination). It is suggested that any field duplicates with RPD values exceeding 20% should be noted and the data should be interpreted accordingly (BCMOE 2013). Where concentrations are within five times the method detection limit (MDL), no RPD calculation is required as long as the difference between replicates is within a value equal to two times the MDL. This is due to the RPD being more sensitive to variation as values approach the analytical detection limit.

2.3.2 Sediment Quality

To confirm sediment sample integrity, the following QA/QC measures were undertaken:

- Samples were collected and processed by qualified experienced personnel.
- Samples were collected in such a way that no foreign material was introduced to the sample.
- Sample handling or contact with contaminated materials/surfaces was minimized.
- Samples were placed in appropriate clean containers in such a way that no material of interest was lost due to adsorption, degradation, or volatilization.

- Sufficient sediment volumes were collected so that required detection limits can be met, and quality control samples can be analyzed.
- Equipment including the grab sampler, stainless steel bowls and spoons were washed with laboratory-grade biodegradable detergent between each station to prevent cross-contamination. Equipment was rinsed between grab samples.
- A duplicate sample (Dup A) was collected from MBE-1 Replicate 3 (APPENDIX C). The duplicate was a discrete homogenized sample from a separately collected grab (as opposed to a split sample). In accordance with the BC Field Sampling Manual (BC MOE 2013), an RPD value of ±50% can be used to identify differences between original and duplicate samples. Values less than five times the MDL should not be included in the RPD calculations because analytical variability near the MDL is higher and does not provide a good measure of variability associated with the collection of field samples.

2.3.3 Benthic Infauna

Field QA/QC procedures are discussed in Section 2.2.4. Biologica laboratory QA/QC measures included an assessment of sorting recovery, identification error, and precision/accuracy of sub-sampling. The taxonomic laboratory identified organisms to the lowest practical taxonomic level. Laboratory procedures included sample sorting measures, spot-checks, preliminary counting of major groups, and collaborative identification to accurately identify species to their lowest taxonomic level. Results of QA/QC measures implemented by the taxonomic laboratory are reported in APPENDIX H.

Benthic data was checked and no obvious signs of error in sample analysis were found. Incidental organisms, including meiofauna and zooplankton species, were removed from benthic analysis.

2.3.4 Intertidal Habitat Surveys

The following measures were undertaken to achieve the QA/QC objectives of the surveys:

- assessment was conducted by qualified and competent personnel;
- photo documentation of each transect line and quadrat was collected and maintained;
- species identification and quantitative assessment was verified by two field personnel;
- geo-referenced location coordinates collected in the field were plotted on electronic maps (e.g., Google earth) to confirm the location of documented observations; and
- field data sheets were reviewed by the project supervisor to confirm completeness and accuracy.

3.0 RESULTS

3.1 Study Areas

Reference areas A and B were determined suitable for future monitoring reference sites for the Exposure Area since both have similar bathymetric (within 20-m) and topographic profiles, easily accessible by boat and at a relatively short distance from Rankin Inlet, and located outside of the potential zone of influence from the discharge and other anthropogenic factors. These features make Reference areas A and B more suitable than Reference areas C and D, which are located in areas less safely accessible.

3.2 Water Quality

3.2.1 In Situ Profiling

Vertical profiles of the water column measured during the surveys are presented in Figure 9 to Figure 15. Graphs were smoothed by using running averages.

Oceanographic conditions measured during the survey were similar among the study areas. Physical properties of water were uniform throughout the entire column and displayed a well mixed pelagic environment with no vertical stratification indicating strong oceanic influence with no or little freshwater influence. Water temperature was slightly lower at the bottom and higher at the surface at some locations, however, horizontal variations in water temperature between different sites were, in general, greater than vertical differences at each station. Water temperature ranged from 5.1 to 6.2°C. Salinity was uniform throughout the water column and ranged between 30.7 and 30.9 PSU for all survey areas and depths. An exception was a cast at station CTD-1 where salinity was slightly lower (30.5 PSU) at the surface (top 10 cm).

Water was, in general, clear throughout all study areas. Turbidity was slightly higher in Melvin Bay (Exposure Area and Reference Area R1) than in Reference areas A and B and ranged between 1.2 and 2.4 NTU. An exception was the CTD-1 (Reference Area B) cast where turbidity at the surface was 6.1 NTU, which may have been caused by wind-generated dust deposition at the moment of measurement.

Chlorophyll concentrations ranged from 0.4 to 1.5 µg/L corresponding to typical for Arctic waters oligotrophic (nutrient poor) to mesotrophic (with moderate level of nutrients) marine systems (CCME 2007 adopted from Vollenweider et al 1998). Chlorophyll maximums occurred at depths below 5 to 10 m. Dissolved oxygen concentrations were also vertically uniform at all survey locations and ranged from 6.5 ml/L to 8 ml/L.

3.2.2 Discrete Water Samples

Analytical results of discrete water quality samples are presented in APPENDIX F and APPENDIX G. Recommended hold times were exceeded for several components, i.e., TDS, TSS, pH, dissolved orthophosphate, nitrate, nitrite and total phosphorus, due to delivery delays caused by the remote location.

Results of the QA/QC assessment procedures conducted by the laboratory are also presented in APPENDIX F and APPENDIX G. RPDs were calculated between sample MWE-2D and its blind field duplicate (DUP A), and no RPD value was found exceeding 20% (APPENDIX F-2).

Laboratory derived results for salinity were similar to those measured in situ, albeit having a slightly wider range (29.7 – 31.3 PSU). Concentrations of TSS were low ranging from below the detection limit of 2 mg/L to 3.8 mg/L. Water quality results were screened against the Canadian Council of Ministers of Environment (CCME) guidelines for the protection of aquatic life for marine environments (CCME 2014). None of the parameters exceeded CCME guidelines.

3.3 Sediment Quality

Field observations recorded in sediment sampling logs (APPENDIX C) show that benthic substrate was similar throughout the surveyed areas and predominantly consisted of silt and clay. The only exception was station MBRefB1 (Reference Area B) where sediment consisted of a coarser substrate, mixture of sand, gravel and silt.

Analytical results of sediment quality samples including the internal QA/QC assessment procedures conducted by the laboratory are presented in APPENDIX G. RPDs were calculated between sample MBE-1 Replicate 3 and its blind duplicate (DUP A) (APPENDIX G-2). RPDs for molybdenum and nickel exceeded 50% and were 111% and 54%, respectively. Differences in metal concentrations between the two samples can be attributed to spatial variability in sediment composition in the study area, since these samples were collected from two different grabs.

Analysis showed that sediment at stations, except MBRefB1, consisted predominantly of fine particles (silt) and was classified as silty loam or silt. Sediment at MBRefB1 had a higher percentage of sand and was classified as sandy loam. A preliminary screening against CCME guidelines showed that concentration of chromium in one sample (MBE-1 replicate 3 [57 mg/kg]) exceeded the Interim Sediment Quality Guideline (ISQG) for the protection of aquatic life in the marine environment for chromium of 52 mg/kg (CCME 2014). Concentrations of all other analyzed parameters were below sediment quality guidelines.

3.4 Benthic Infauna

Information on the analysis of benthic infauna samples, including taxonomic and abundance data, laboratory analytical methods, and QA/QC results are presented in APPENDIX H. A total of 24 samples (eight stations with three samples collected at each) were analysed. A total of 1,400 benthic infauna (benthos) organisms were observed, representing 52 unique taxa (species or genus level). Unique taxa for 83 organisms could not be determined and were identified to a higher taxonomic level (genus or family). Incidental organisms, including meiofauna (e.g. nematodes), plankton (Brachyura larvae) and fragments of indeterminate species, removed from benthos were reported separately; a total of 13 incidental organisms were found in benthic infauna samples.

Abundance per sample ranged from 15 organisms (MBE-1-3) to 120 organisms (MBE-5-2); the average abundance ranged from 36 (MBE Ref A-1) to 97 organisms (MBE-5) per station. Taxonomic richness (number of taxa per sample) ranged from 8 (MBE Ref A-1-3) to 19 (MBE Ref A-3-2); the average taxonomic richness ranged from 10 (MBE Ref A-1) to 17 taxa (MBE Ref A-3) per station (APPENDIX H).

Benthic communities in the study areas were dominated by polychaete worms, which represented 63% of all organisms and 40% of identified unique taxa. Crustaceans were the second largest group of benthic invertebrates representing 31% of all organisms and 29% of identified unique taxa. The single most abundant taxon (338 organisms) across all stations was amphipod crustacean *Protomedeia sp*., which constituted 24% of all organisms. Taxonomic composition of benthic infauna communities between the Exposure and Reference A Areas was, in general, similar with few notable exceptions. Polychaete worm (*Ophelina acuminata*) was found in high abundance (40 organisms) in samples from the Reference A area but was not found in any samples from the Exposure Area. Smooth nutclam (*Ennucula tenuis*) and amphipod (*Bathymedon obtusifrons*) were found in relatively high abundance (17 and 10 organisms, respectively) in several samples from the Exposure Area, but none were found in the Reference Area A.

All samples were analysed in whole due to relatively low volumes of sediments and debris in sample containers (APPENDIX H). All analysed samples were re-sorted for QA/QC purposes to assess sorting efficiency; 100% sorting efficiency was achieved for all analysed samples (APPENDIX H).

All benthic infauna specimens were archived in air-tight glass vials with glycerin and 70% ethanol for long-term storage.

3.5 Intertidal Habitat

Data collected during the intertidal habitat surveys is presented in the form of field-filled data sheets in APPENDIX E. The intertidal zone in the Exposure Area was characterized as a gently-sloped flat topography (Figure 16). The length of intertidal transect EXP-T1 in the Exposure Area was approximately 100 m. The substrate was predominantly hard and composed of boulders, coble and gravel, intermittent, at places, with sandy patches in the lower areas. Epiflora and epifauna were sparse, particularly in the upper and middle parts of the intertidal zone. Epiflora was more abundant in the lower intertidal zone in the Exposure Area where approximately 30-m-wide band of vegetation (up to 55% cover) was observed represented mainly by rockweed (*Fucus* sp.; Figure 17). Epifauna was mostly represented by molluscs, such as snails *Littorina spp.* and mussels.

The intertidal zone in Reference Area R1 had a steeper slope than the Exposure Area, particularly in the upper areas (Figure 18). The length of intertidal transects in Reference Area R1 ranged between 27 and 31 m. The substrate in this area was similar to that of the Exposure Area, however, abundance and diversity of epiflora and epifauna were considerably lower in Reference Area R1.

3.6 Marine Mammals

No marine mammals were observed during the surveys at any of the surveyed sites.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Reference areas A, B and R1 had similar oceanographic conditions as the Exposure Area. Reference areas A and B have the same depth contours as the Exposure Area, but Reference Area R1 is located at a shallower water depth than the Exposure Area and was not selected as a reference area for sediment and benthic infauna monitoring. Reference Area A had similar substrate types as the Exposure Area, while Reference Area B had a slightly coarser substrate. Although a limited number of sediment samples (1 sample only) and no benthic infauna samples were collected at Reference Area B due to weather issues, there is a potential to still use this site as a future reference area.

Based on the 2018 Marine Reconnaissance Surveys and the requirements for EEM, the following are recommended to improve future surveys:

- Conduct Baseline Study Program during the summer of 2019 prior to treated groundwater effluent discharge as outlined in Golder's Proposal No P18103567. The studies will consist of complete baseline data collection for water and sediment quality, benthic invertebrates, fish population and fish tissue studies per EEM study requirements under MDMER. Sampling at reference areas (A and B) be conducted in concurrence with sampling at the Exposure Area for the environmental effects monitoring purposes.
- Commence field surveys earlier in the season, July or August of 2019, at a period with reduced wind conditions in the marine environment. This will allow for safer marine vessel operations and sampling activities and potentially fewer delays due to unfavourable weather.

Signature Page

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Original signed by:

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5.0 REFERENCES

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Vollenweider, R.A., F. Giovanardi, G. Montanari and A. Rinaldi. 1998. Characterization of the trophic conditions of marine coastal waters with special reference to the NW Adriatic Sea: Proposal for a trophic scale, turbidity and generalized water quality index. Environmetrics 9: 329-357.

APPENDIX A

Figures and Photos

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POTENTIAL REFERENCE AREA C

RANKIN INLET

POTENTIAL REFERENCE AREA D

REFERENCE AREA R1

EXPOSURE AREA

REFERENCE AREA B

REFERENCE AREA A

HUDSON BAY

LEGEND

- STUDY AREA
- MINE FOOTPRINT
- WATERSHED BOUNDARY
- WATERCOURSE
- WATERBODY

0 1.5 3
1:75,000 KILOMETRES

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

CLIENT
AGNICO EAGLE MINES LIMITED
AGNICO EAGLE

PROJECT
MELIADINE GOLD MINE
OCEAN DISCHARGE MONITORING PLAN – MARINE RECONNAISSANCE AND BASELINE PROGRAMS

TITLE
RECONNAISSANCE STUDY AREA OVERVIEW MAP

CONSULTANT
GOLDER

YYYY-MM-DD	2019-02-22
DESIGNED	AO
PREPARED	CN
REVIEWED	AO
APPROVED	MT

PROJECT NO.	CONTROL	REV.	FIGURE
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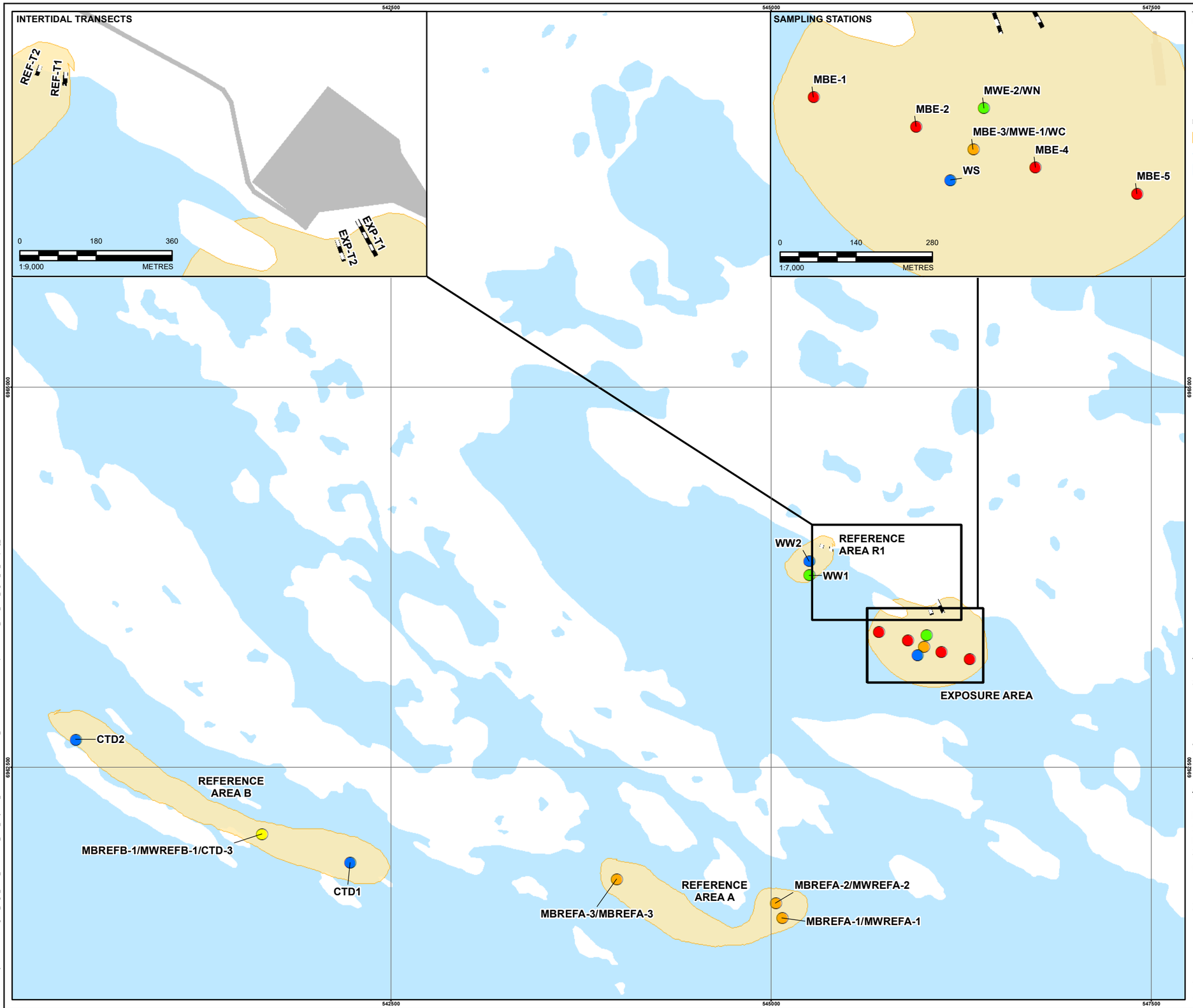

LEGEND

- SEDIMENT, BENTHIC INFAUNA
- CTD, WATER QUALITY, SEDIMENT, BENTHIC INFAUNA
- CTD, WATER QUALITY, SEDIMENT CHEMISTRY
- CTD, WATER QUALITY
- CTD
- TRANSECT
- STUDY AREA
- WATERCOURSE
- WATERBODY

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REFERENCE(S)
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2. DATUM: NAD83 PROJECTION UTM ZONE 15

CLIENT
AGNICO EAGLE MINES LIMITED
AGNICO EAGLE

PROJECT
MELIADINE GOLD MINE
OCEAN DISCHARGE MONITORING PLAN – MARINE RECONNAISSANCE AND BASELINE PROGRAMS

TITLE
SAMPLING STATIONS

CONSULTANT
GOLDER

YYYY-MM-DD	2019-02-22
DESIGNED	AO
PREPARED	CN
REVIEWED	AO
APPROVED	MT

PROJECT NO.	CONTROL	REV.	FIGURE
18103567	5000/5001	0	2

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Figure 3: Survey boat at the Exposure Area.

Figure 4: Sediment sampling using Petite Ponar grab

Figure 5: Homogenized sediment sample

Figure 6: Benthic infauna 1-mm sieving tray

Figure 7: Washed benthic infauna sample

Figure 8: Intertidal survey quadrat (0.5 m x 0.5 m)

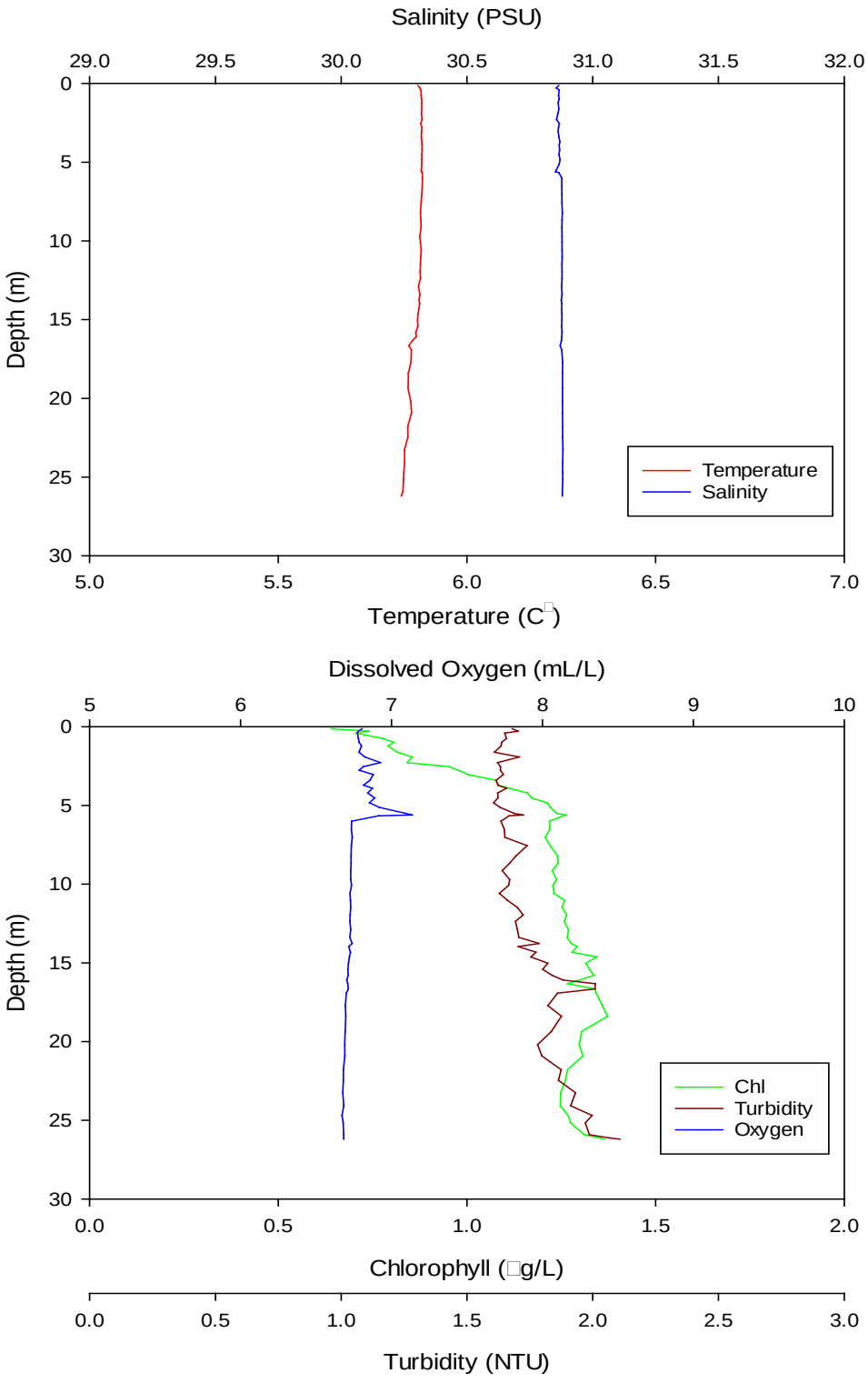

Figure 9: Exposure Area vertical water column profiles: temperature and salinity (top), and turbidity, chlorophyll and oxygen concentrations (bottom)

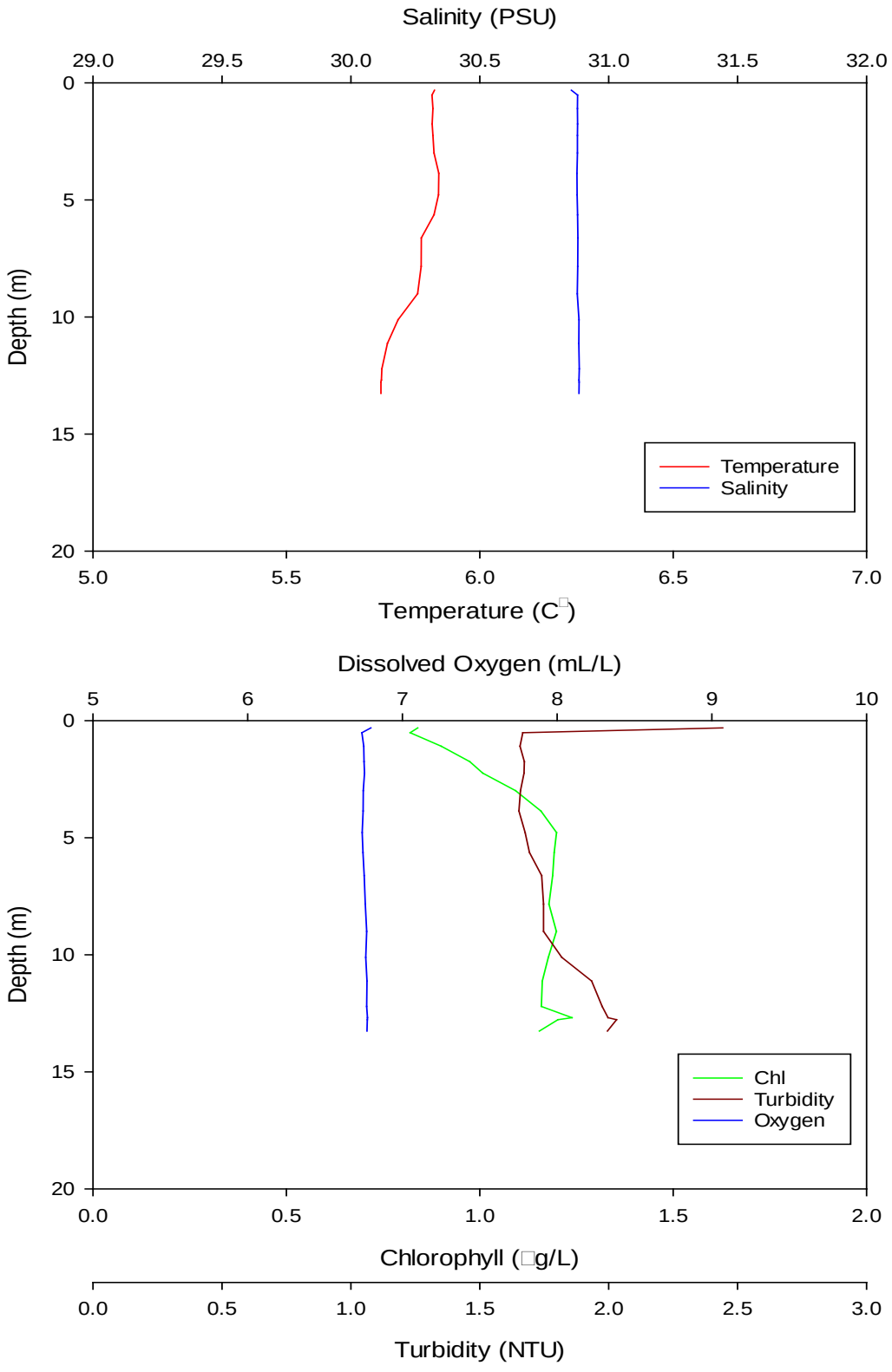

Figure 10: Reference Area R1 vertical water column profiles: temperature and salinity (top), and turbidity, chlorophyll and oxygen concentrations (bottom)

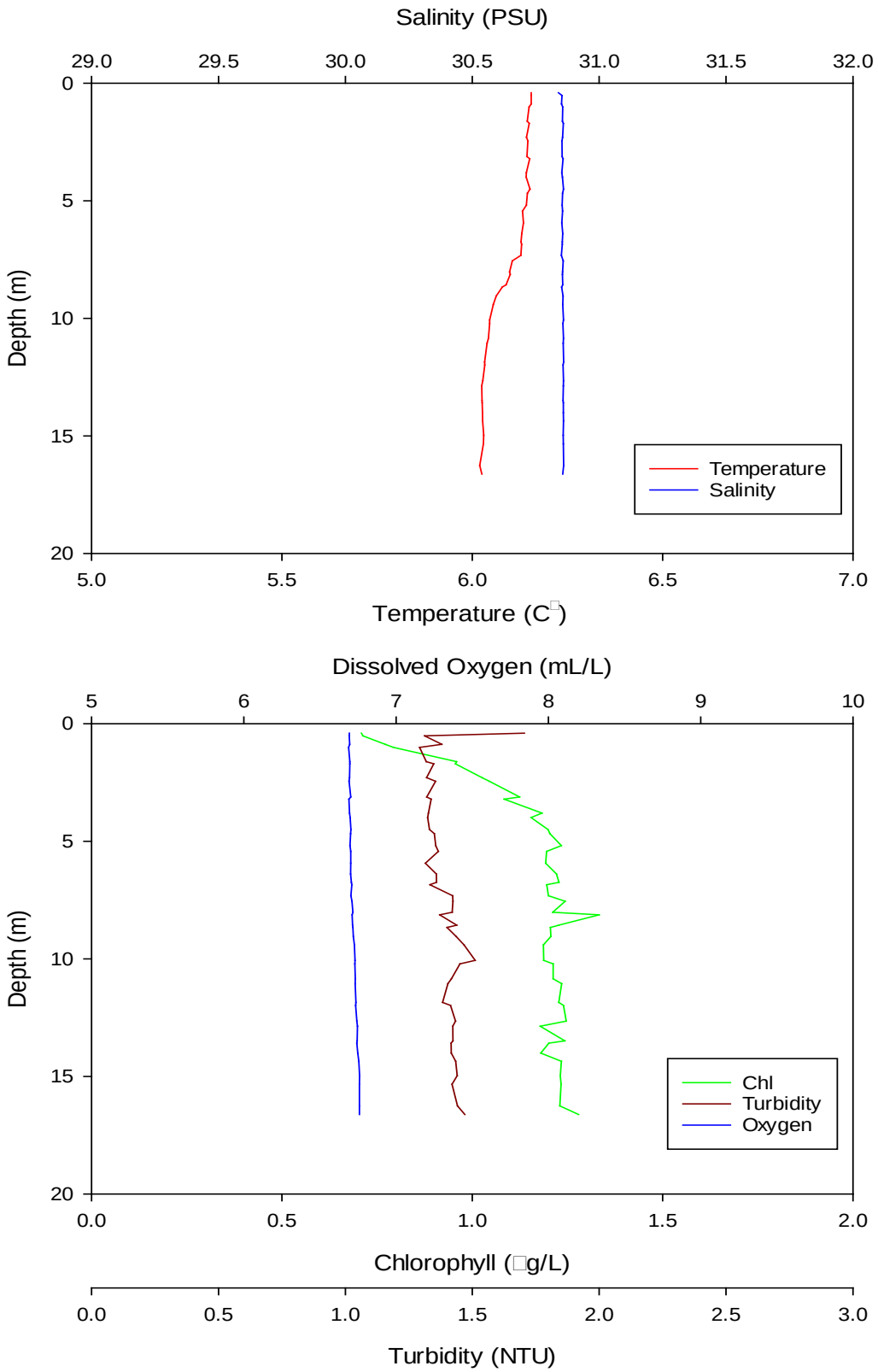

Figure 11: NWRefA-2 (Reference Area A) vertical water column profiles: temperature and salinity (top), and turbidity, chlorophyll and oxygen concentrations (bottom)

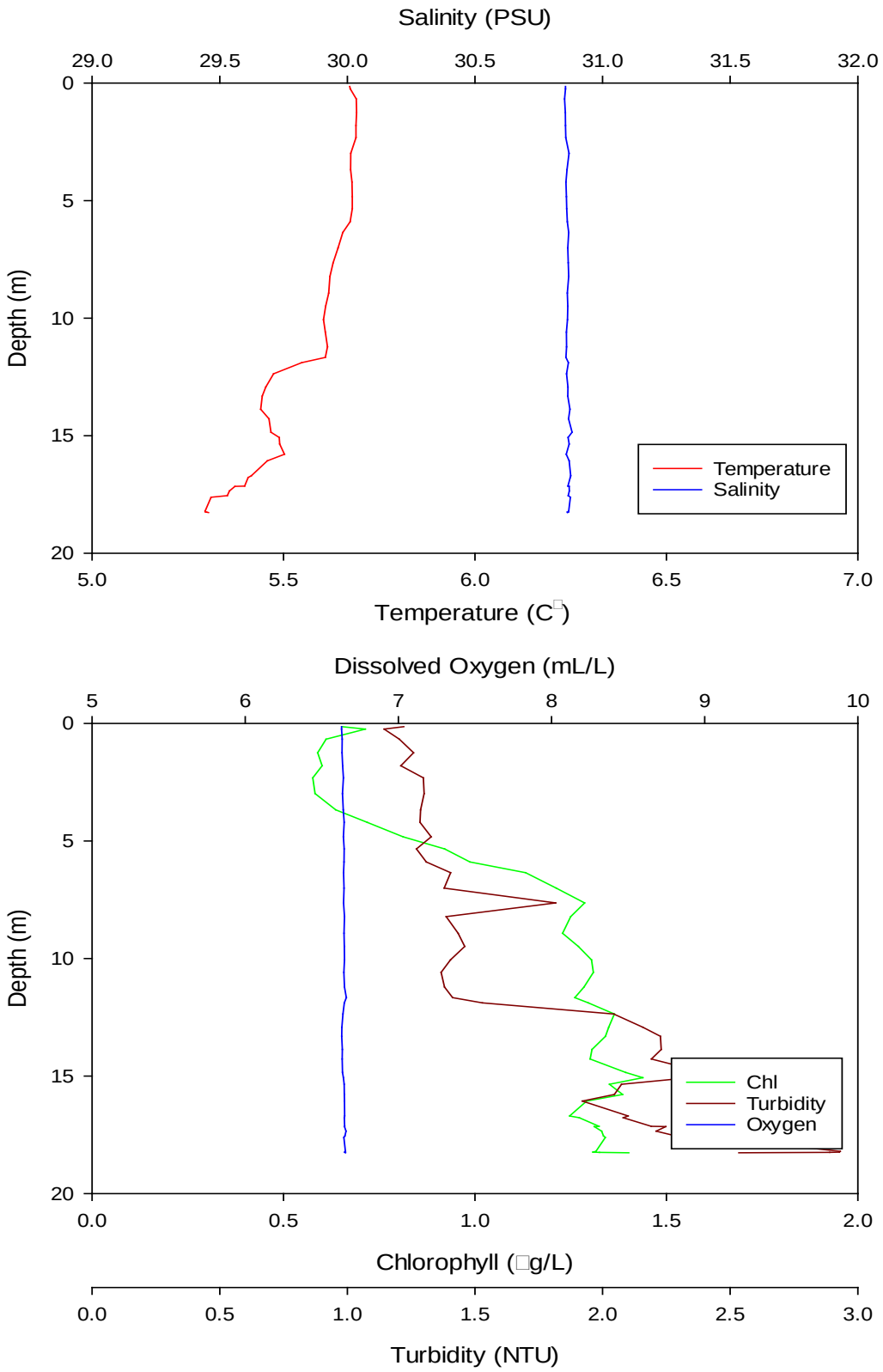

Figure 12: NWRefA-3 (Reference Area A) vertical water column profiles: temperature and salinity (top), and turbidity, chlorophyll and oxygen concentrations (bottom)

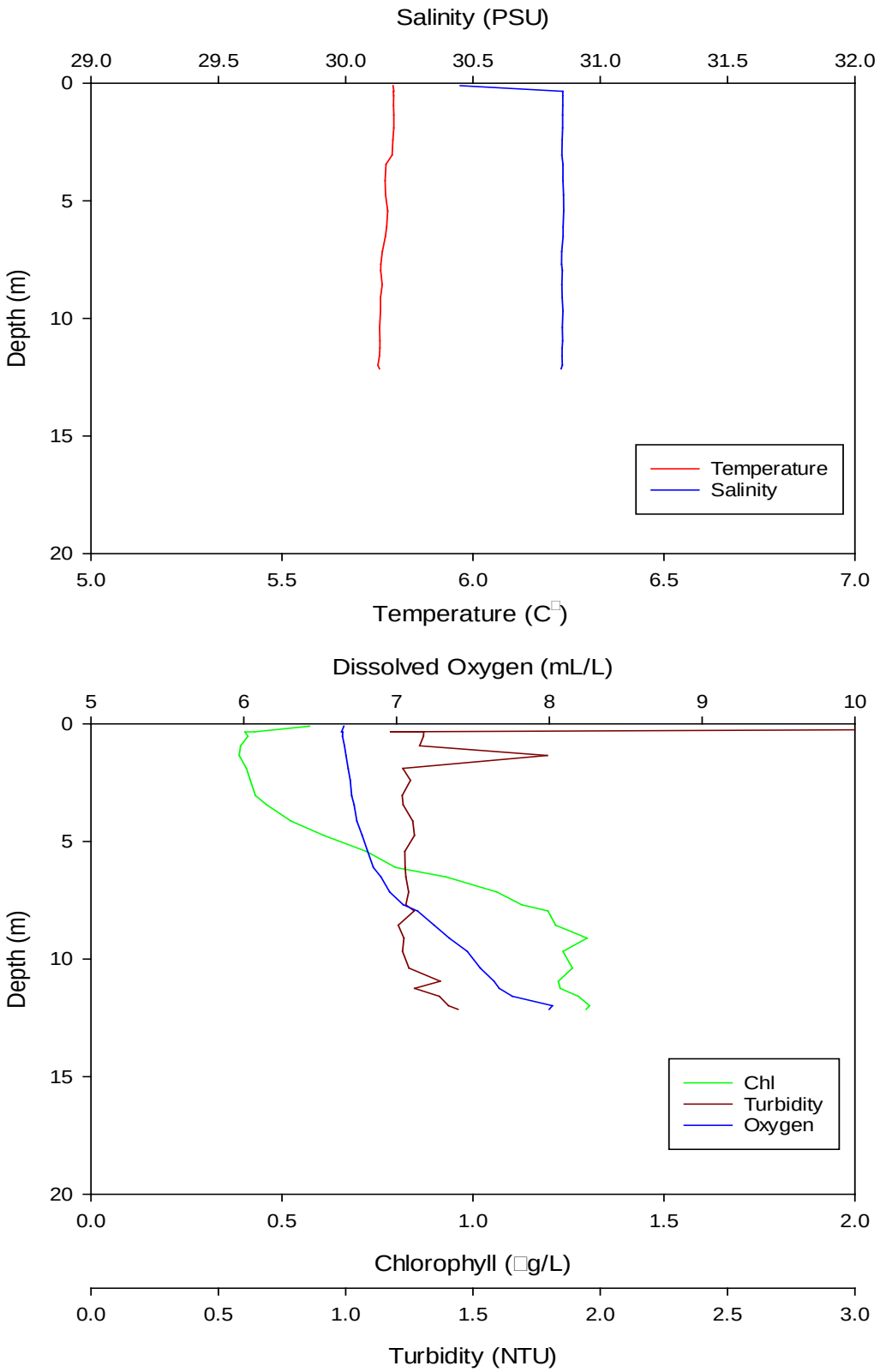

Figure 13: CTD-1 (Reference Area B) vertical water column profiles: temperature and salinity (top), and turbidity, chlorophyll and oxygen concentrations (bottom)

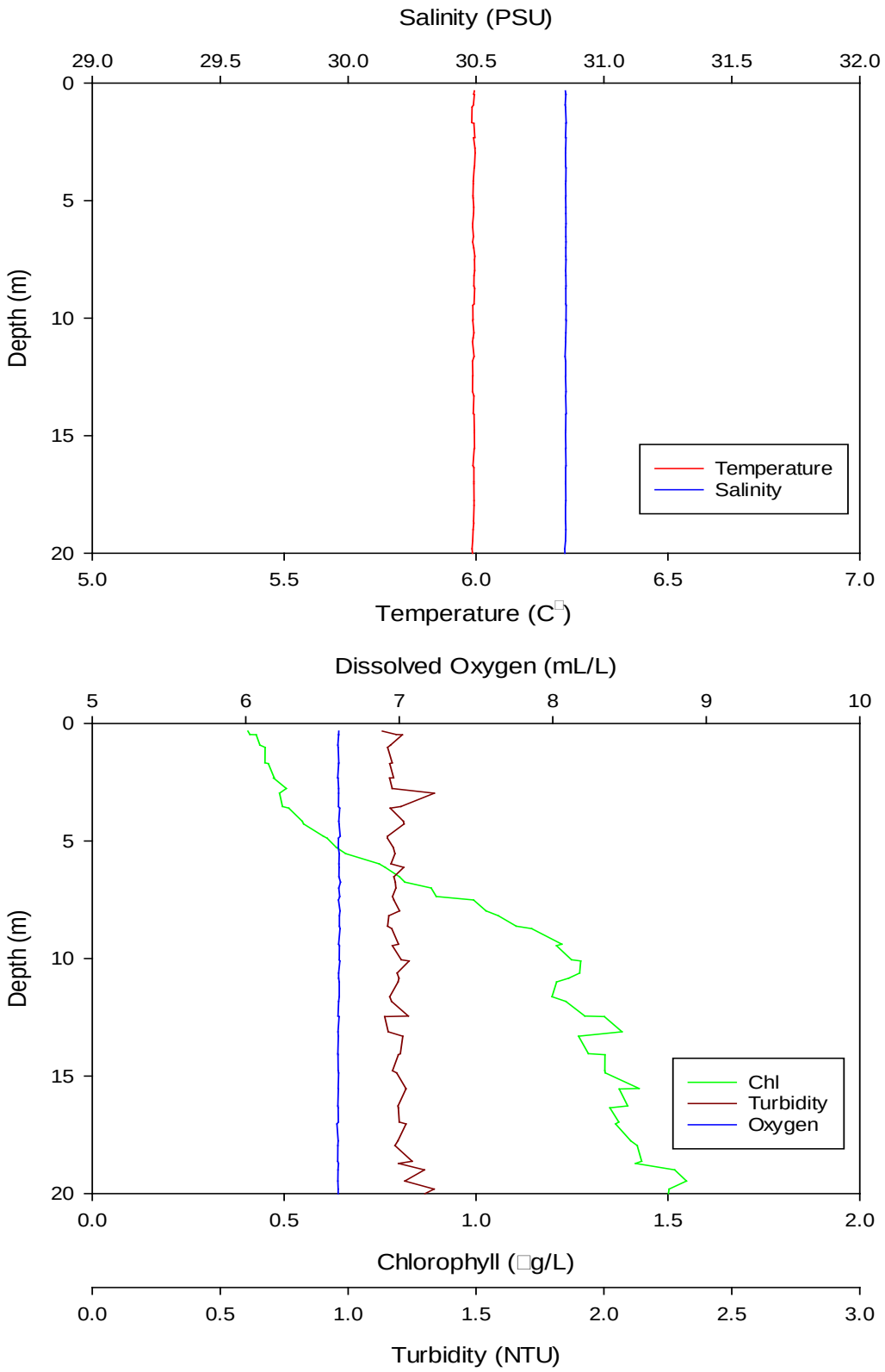

Figure 14: CTD-2 (Reference Area B) vertical water column profiles: temperature and salinity (top), and turbidity, chlorophyll and oxygen concentrations (bottom)

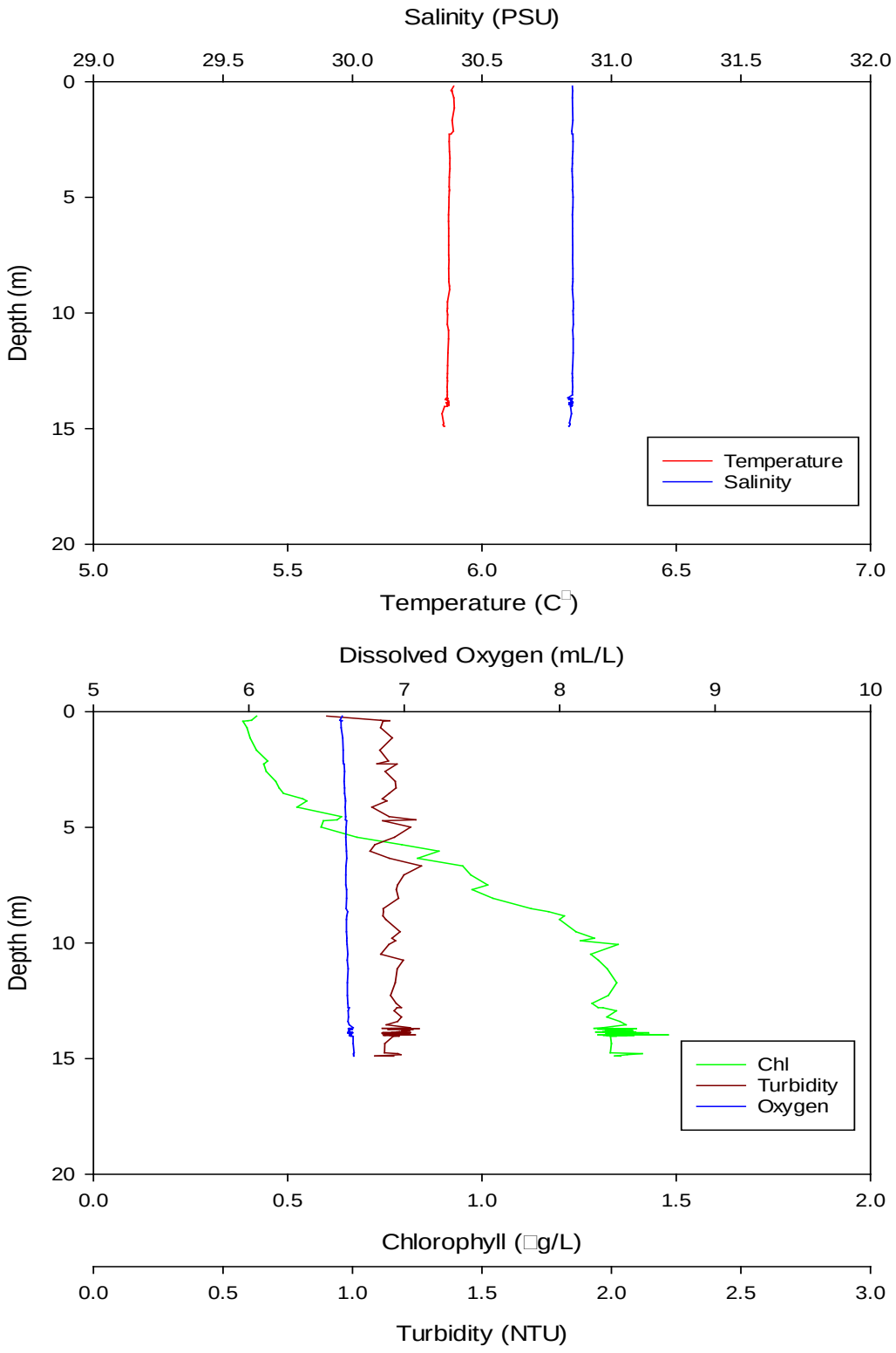

Figure 15: CTD-3 (Reference Area B) vertical water column profiles: temperature and salinity (top), and turbidity, chlorophyll and oxygen concentrations (bottom)

Figure 16: Intertidal Transect EXP-T1 (Exposure Area), September 14, 2018

Figure 17: An epifloral band in the lower intertidal zone in the Exposure Area represented mostly by rockweed (*Fucus* sp.), September 14, 2018

Figure 18: Intertidal transect REF-T1 in the Reference Area R1, September 15, 2018

APPENDIX B

Water Quality Sampling Field Logs

18103562

Meliadine Marine Recon

CTD and Water Quality Sampling **Project #:** **Project title:** 2018

Station name: WW1 **# of Casts/Bottles:** 1/7 **Date:** Sep 17 **Sampled By:** AR & JG

Coordinates: **Easting:** 0545241 **Northing:** 6963763 **Time:** 18^15 **Water Depth (m):** 15

Weather: rainy & snowy **Wind Spd/Dir:** 20 SW **Tide:** low @ 1745

Sample Name	Sample Depth (m)	Duplicate Name	# of Bottles Filled	Comments
WW1S	1	/	7	5.4. 5.2 -5.3 Secchi
WW1D	10	/	7	

Station name: MWE-1 **# of Casts/Bottles:** 1 **Date:** Sep 17 **Sampled By:** AR JG

Coordinates: **Easting:** 15U 0546002 **Northing:** 6963295 **Time:** 18:46 **Depth (m):** 24

Weather: cloudy, light rain **Wind Spd/Dir:** 15 S kt **Tide:** rising

Sample Name	Sample Depth (m)	Duplicate Name	# of Bottles Filled	Comments
MWE-1D	16	/	7	Secchi: 5.4 & 5.2 -5.3m
MWE-1S	1	/	7	

Station name: **# of Casts/Bottles:** **Date:** **Sampled By:**

Coordinates: **Easting:** **Northing:** **Time:** **Depth (m):**

Weather: **Wind Spd/Dir:** **Tide:**

Sample Name	Sample Depth (m)	Duplicate Name	All Bottles Checked (Y/N)?	Comments

1B|03567/ Meliadine Marine Reason

CTD and Water Quality Sampling **Project #:** **Project title:** 2018

Station name: MW Reg A 3 **# of Casts/Bottles:** 1/7 **Date:** Sept 20 **Sampled By:** AR SK

Coordinates: **Easting:** 15V 0543992 **Northing:** 6961780 **Time:** 0930 **Water Depth (m):** 21

Weather: sun + cloud **Wind Spd/Dir:** SSW 15kt **Tide:** low slack

Sample Name	Sample Depth (m)	Duplicate Name	# of Bottles Filled	Comments
MWReg A 3.S	1	N/A	7	CTD
MWReg A 3.D	15	N/A	7	

Station name: MW Reg B1 **# of Casts/Bottles:** 1/7 **Date:** Sept 20 **Sampled By:** AR

Coordinates: **Easting:** 15V 0541626 **Northing:** 6962080 **Time:** 1120 **Depth (m):** 5K ~~19m~~

Weather: cloudy 1°C **Wind Spd/Dir:** 15kt south **Tide:** flood

Sample Name	Sample Depth (m)	Duplicate Name	# of Bottles Filled	Comments
MWReg B1S	1	/	7	secchi = lost = 5.7 resight = 5.5 actual = 5.6m
B1D	15	/	7	wavelets make sighting difficult

Station name: **# of Casts/Bottles:** **Date:** **Sampled By:**

Coordinates: **Easting:** **Northing:** **Time:** **Depth (m):**

Weather: **Wind Spd/Dir:** **Tide:**

Sample Name	Sample Depth (m)	Duplicate Name	All Bottles Checked (Y/N)?	Comments

18103567

Meliadine Marine Recon

CTD and Water Quality Sampling **Project #:** **Project title:** 2018

Station name: MWE-2 **# of Casts/Bottles:** 1 cast / 7 **Date:** Sept 17 2018 **Sampled By:** AR & JG

Coordinates: Easting: 15V 0546021 WP127 **Northing:** 6963373 **Time:** 16:30 **Water Depth (m):** 8.6 m

Weather: cloudy **Wind Spd/Dir:** W 20 kt **Tide:** low @ 17:40

Sample Name	Sample Depth (m)	Duplicate Name	# of Bottles Filled	Comments
MWE-2	1m	N/A	7	secchi lost 4.5 re-sight 4.2 actual 4.35
MWE-2D	5m	DUP A	7	

Station name: MB Ref A-1 **# of Casts/Bottles:** 1 / 7 **Date:** Sept 17 **Sampled By:** AR JG

Coordinates: Easting: same as MB Ref A **Northing:** **Time:** 17[10] **Depth (m):** 20

Weather: cloudy **Wind Spd/Dir:** SW 20 kt **Tide:** low slack

Sample Name	Sample Depth (m)	Duplicate Name	# of Bottles Filled	Comments
MB Ref A-1S	1m	✓	7	secchi lost 5.8 re-sight 5.6 actual (5.7)
" 1D	15m	✓	7	

Station name: MW Ref A-2 **# of Casts/Bottles:** 7 **Date:** Sept 17 **Sampled By:** AR

Coordinates: Easting: 15V 0545055 **Northing:** 6961615 **Time:** 17[45] **Depth (m):** 21

Weather: cloudy 2°C **Wind Spd/Dir:** SW 20 kt **Tide:** low slack

Sample Name	Sample Depth (m)	Duplicate Name	All Bottles Checked (Y/N)?	Comments
MW Ref A-2S	1	✓	Y	secchi 5.4 5.2 = 5.3
" 2D	16	✓	Y	difficult w/ chop & waves

APPENDIX C

Sediment Sampling Field Logs

Chemistry

Page 1 of 1

SEDIMENT SAMPLING LOG - GRAB

Project No: 1810 3567 · 4000

Project Title: Meliadine - diffuser

Date: Sept 13 2018

Sampled by: AR, SG

Station Number (ID): MBE-1 Rep3

Sampling Method: P. ponar

Weather: sunny ; wind E 5kt

Lat/Longitude: 15 V 0545710 6963402

Sampling Depth: 22m

# of Attempts to Obtain Sample: see below

Time of Collection: 17:15

Sediment Description

Grain Size (boulder, cobble, gravel, sand, silt, clay; trace, some, -y, and); **Inclusions** (shells, organisms, other non-soil components) **Consistency/Compactness** (v loose, loose, compact, dense, v dense; vsoft, soft, firm, stiff, v stiff, hard); **Moisture Content** (dry, moist, wet, saturated); **Colour; Structure; Contaminants** (staining/odour/sheen); **Other** (wood, debris, organisms).

- silt & clay ; thin light brown veneer (unconsolidated) over dense, stiff
- soft veneer
- worms, clam -no odour, sheen, or stain
- v. small trace organics (dark brown)

Approx % collected in grab sample Rep 1 25% + 15%, Rep2 - 25+25, Rep 3 40-50%

Photograph Reference Number(s): AR phone

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

- polychaetes (lg + small)
- lg clam (Sp = Mya (?)) > most fauna out of MBE's

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ TOC
- ☐ Other
- ☐ PAH
- ☐ Total PCBs
- ☐ Toxicity
- ☐ PAH Fingerprinting
- ☐ AVS SEM
- ☐ LEPH/HEPH

Other Notes: # of Grabs for Analysis:

Rep 1 : 2 grab ; 5 attempts 1 lg clam (~18 yrs old)

2 : 2 " ; 4 attempts

3 : 4 grabs ; 5 attempts Rep 3 = DUP (A)

Reviewed By: AR

Chemistry

SEDIMENT SAMPLING LOG - GRAB

Project No: 18103567 · 4000

Project Title: Meliadine diffuser

Date: Sept 13 2018

Sampled by: AR, JG

Station Number (ID): MBE-2 Reps

Sampling Method: Petit Ponar

Weather: sunny; wind S 5kt

Lat/Longitude: 15 V 0545894 6963340

Sampling Depth: 21 m

# of Attempts to Obtain Sample: see below

Time of Collection: 16:05

Sediment Description

Grain Size (boulder, cobble, gravel, sand, silt, clay; trace, some, -y, and); **Inclusions** (shells, organisms, other non-soil components) **Consistency/Compactness** (v loose, loose, compact, dense, v dense; vsoft, soft, firm, stiff, v stiff, hard); **Moisture Content** (dry, moist, wet, saturated); **Colour; Structure; Contaminants** (staining/odour/sheen); **Other** (wood, debris, organisms).

- + silt + clay ; trace shell
- v dense, stiff
- light brown veneer over light to med grey ; overall light brown when mixed
- no odour, stain or sheen
- traces of minute organic debris ; 2x small polychaete

Approx % collected in grab sample: 5% - 20% ; Rep 3 = 40% %

Photograph Reference Number(s): AR phone

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ TOC
- ☐ Other
- ☐ PAH
- ☐ Total PCBs
- ☐ Toxicity
- ☐ PAH Fingerprinting
- ☐ AVS SEM
- ☐ LEPH/HEPH

Other Notes:

# of Grabs for Analysis:

Rep 1 = 2 grabs ; 6 attempts

Rep 2 = 3 " ; 15 "

Rep 3 = 1 ; 4

Reviewed By: AR

Chemistry

Page 1 of 1

SEDIMENT SAMPLING LOG - GRAB

Project No: 18103567 / 4000

Project Title: Meliadine Diffuser

Date: Sept 13 2018

Sampled by: AR, JG

Station Number (ID): MBE-3 Reps

Sampling Method: Petit Ponar

Weather: wind SE 5kt

Lat/Longitude: 15 V 0545991 6963294

Sampling Depth: 21 m

# of Attempts to Obtain Sample: see below

Time of Collection: 15:00 → 16:00

Sediment Description

Grain Size (boulder, cobble, gravel, sand, silt, clay; trace, some, -y, and); **Inclusions** (shells, organisms, other non-soil components) **Consistency/Compactness** (v loose, loose, compact, dense, v dense; vsoft, soft, firm, stiff, v stiff, hard); **Moisture Content** (dry, moist, wet, saturated); **Colour; Structure; Contaminants** (staining/odour/sheen); **Other** (wood, debris, organisms).

- silt + clay, v. thin light brown veneer over med / dark veined clay
- V. dense, stiff
- no odour, sheen, or stain
- no organic debris, or shell

Approx % collected in grab sample: 15-30 %

Photograph Reference Number(s): AR phone

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ TOC
- ☐ Other
- ☐ PAH
- ☐ Total PCBs
- ☐ Toxicity
- ☐ PAH Fingerprinting
- ☐ AVS SEM
- ☐ LEPH/HEPH

Other Notes: low tide 14:45

# of Grabs for Analysis:

Rep 1 = 3 grabs, 10 attempts

Rep 2 = 2 " ; 2 "

Rep 3 3 " ; 8 attempts

Reviewed By: _____

Chemistry

SEDIMENT SAMPLING LOG - GRAB

Project No: 18103567 - 4000
Project Title: Meliadine Dewaterer
Date: Sep 13 2018
Sampled by: AR, SG
Station Number (ID): MBE-4
Sampling Method: Petit Ponar
Weather: mostly sunny ; wind 5kt W
Lat/Longitude: 15V 0546123 6963268
Sampling Depth: 19m (low tide)
# of Attempts to Obtain Sample: ↓
Time of Collection: 1400

Sediment Description
Grain Size (boulder, cobble, gravel, sand, silt, clay; trace, some, -y, and); **Inclusions** (shells, organisms, other non-soil components) **Consistency/Compactness** (v loose, loose, compact, dense, v dense; vsoft, soft, firm, stiff, v stiff, hard); **Moisture Content** (dry, moist, wet, saturated); **Colour; Structure; Contaminants** (staining/odour/sheen); **Other** (wood, debris, organisms).

- unconsolidated veneer over firm/compact silt
- light brown over light grey silt ; Rep 3 darker/med grey under layer
- trace organic debris (minute brown stringy pieces to 3mm)
- no odour, sheen, staining
- 1 polychaete ; 1 piece clam shell

Approx % collected in grab sample: 25% - 40%

Photograph Reference Number(s): andrew's phone

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ Grain Size
- ☐ TOC
- ☐ Other
- ☐ PAH
- ☐ Total PCBs
- ☐ Toxicity
- ☐ PAH Fingerprinting
- ☐ AVS SEM
- ☐ LEPH/HEPH

Other Notes:

# of Grabs for Analysis:

Rep 1 : 2 grabs (2 attempts)
Rep 2 : 3 grab (4 attempts)
Rep 3 : 2 grab (3 attempts)

Reviewed By: AR

Chemistry

SEDIMENT SAMPLING LOG - GRAB

Project No: 13103567

Project Title: Mediadura

Date: Sept 13 2018

Sampled by: A. Rippington ; J. Goodyear

Station Number (ID): MBE-5

Sampling Method: Petit Ponar

Weather: wind SW 7kt mostly sunny

Lat/Longitude: 15V 0546299 , 6963211

Sampling Depth: 21 m

# of Attempts to Obtain Sample: 1

Time of Collection: 12:20

Sediment Description

Grain Size (boulder, cobble, gravel, sand, silt, clay; trace, some, -y, and); **Inclusions** (shells, organisms, other non-soil components) **Consistency/Compactness** (v loose, loose, compact, dense, v dense; vsoft, soft, firm, stiff, v stiff, hard); **Moisture Content** (dry, moist, wet, saturated); **Colour; Structure; Contaminants** (staining/odour/sheen); **Other** (wood, debris, organisms).

- silt w/ few gravel ; no shell or worms greyish light brown
- compact & dense beneath unconsolidated 2cm veneer
- no odour, sheen or ~~staining~~ (staining Rep 2)
- ~~no organic~~ trace debris

Approx % collected in grab sample 15 20% - 30% %

Photograph Reference Number(s) :

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ TOC
- ☐ Other
- ☐ PAH
- ☐ Total PCBs
- ☐ Toxicity
- ☐ PAH Fingerprinting
- ☐ AVS SEM
- ☐ LEPH/HEPH

Other Notes: Sandhill crane x 56

# of Grabs for Analysis: 3 Rep 1 2 for Rep 2 & Rep 3

Rep 1, 2, 3

Reviewed By: _____

Chemistry

SEDIMENT SAMPLING LOG - GRAB

Meliadine

Project No: ~~13-1447-0183 / 2000~~ 18103567/4000

Project Title: ~~Shell~~ SQT Marine Sediment Investigation

Date: ~~October~~ Sept 19 2018

Sampled by: AR, ~~JS, DS~~ JG

Station Number (ID): MB Ref A 1 Rep 1/2/3

Sampling Method: ~~Van Veen (Chemistry + Toxicity Samples)~~ ~~Standard Ponar (Benthic Samples)~~ Petit

Weather: mostly sun; wind 10kt SW

Lat/Longitude: 15 V 0545070 6961511

Water Depth: 21 m

Time of Collection: 0830

Sieve Mesh Size: ~~500 micron~~

Sediment Description

Grain Size (boulder, cobble, gravel, sand, silt, clay; trace, some, -y, and); **Inclusions** (shells, organisms, other non-soil components) **Consistency/Compactness** (v loose, loose, compact, dense, v dense; vsoft, soft, firm, stiff, v stiff, hard); **Moisture Content** (dry, moist, wet, saturated); **Colour; Structure; Contaminants** (staining/odour/sheen); **Other** (wood, debris, organisms).

- loose light brown 1cm veneer over med. density compact light gray
- no odour or sheen, trace orangey brown streaks in Rep 2
- dark gray streak in Rep 3
- polychaetes

Approx % Collected in Grab Sample/ Number of Attempts to Obtain Sample :

Chemistry Grab 1 45+25 Grab 2 30+30 Grab 3 20+35 2 grabs for each sample

Benthic Grab 1 ~~\~~ Grab 2 ~~\~~ Grab 3 ~~\~~

attempts ~~4~~ (4) (6) (3)

Photograph Reference Number(s) :

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for: ☒ Chemistry ~~☐ Toxicity~~ ~~☐ Benthic Invertebrate Taxonomy~~

Grabs for Analysis (Chemistry and Toxicology) : 2 each

of Jars Per ~~Benthic~~ Replicate Sample: Rep 1 ~~\~~ Rep 2 ~~\~~ Rep 3 ~~\~~

Notes:

Reviewed By: _____

Chemistry Page 1 of 1

SEDIMENT SAMPLING LOG - GRAB

Project No: ~~13-1447-0183 / 2000~~ 18103567.4000 Project Title: ~~Shell SQT~~ Meliadine Marine Sediment Investigation

Date: ~~October~~ 19 2013 2018 Sampled by: ~~AR~~, JS, ~~DS~~ SG

Station Number (ID): Sept MBRg A-2 Sampling Method: ~~Van Veen (Chemistry + Toxicity Samples)~~ Standard Ponar (Benthic Samples) Petit Ponar

Weather: mostly sun, SW 10kt Lat/Longitude: 15V 0545028 6961609

Water Depth: 21 m

Sieve Mesh Size: ~~500 micron~~ Time of Collection: 945

Sediment Description

Grain Size (boulder, cobble, gravel, sand, silt, clay; trace, some, -y, and); **Inclusions** (shells, organisms, other non-soil components) **Consistency/Compactness** (v loose, loose, compact, dense, v dense; vsoft, soft, firm, stiff, v stiff, hard); **Moisture Content** (dry, moist, wet, saturated); **Colour; Structure; Contaminants** (staining/odour/sheen); **Other** (wood, debris, organisms).

- same as MBRg A-1
- light brown over med gray
- penetration to 6cm / 7cm
- no odour, sheen, trace darker gray stain/streak below 2cm

Approx % Collected in Grab Sample/ Number of Attempts to Obtain Sample :

Chemistry Grab 1 45+25 Grab 2 20+45 Grab 3 55

~~Benthic~~ Grab 1 _____ Grab 2 _____ Grab 3 _____

attempts 4 3 1

Photograph Reference Number(s) :

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for: ☒ Chemistry YES ~~☐ Toxicity~~ ~~☐ Benthic Invertebrate Taxonomy~~

Grabs for Analysis (Chemistry and Toxicology) : see above 1 # of Jars Per benthic Replicate Sample: Rep 1 1 Rep 2 1 Rep 3 1

Notes:

Reviewed By: _____

18103567-4000

SEDIMENT SAMPLING LOG - GRAB

Meliadine

Project No: 13-1447-0183 / 2000

Project Title: ~~Shell SQT~~ Marine Sediment Investigation

Date: Sept. ~~October~~ 19 ~~2013~~ 2018

Sampled by: ~~AR~~, JS, DS ~~JG~~

Station Number (ID): MB Ref A-3

Sampling Method: ~~Van Veen (Chemistry + Toxicity Samples)~~ Standard Ponar (Benthic Samples) Petit

Weather: Mostly Sunny Sea ~~State~~ = .3 M Wind 11 knots from WNW

Lat/Longitude: 15V 0543984 6961763

Water Depth: ~21 m

Time of Collection: 12⁰⁰

Sieve Mesh Size: ~~500~~ 500 micron

Sediment Description

Grain Size (boulder, cobble, gravel, sand, silt, clay; trace, some, -y, and); **Inclusions** (shells, organisms, other non-soil components) **Consistency/Compactness** (v loose, loose, compact, dense, v dense; vsoft, soft, firm, stiff, v stiff, hard); **Moisture Content** (dry, moist, wet, saturated); **Colour; Structure; Contaminants** (staining/odour/sheen); **Other** (wood, debris, organisms).

- light brown over med grey w/ dark grey to black pockets
- silt + clay unconsolidated over med firm / to firm beneath
- mild sulfur organic odour, no stain, or sheen
- amphipods (lots); polychaete

Approx % Collected in Grab Sample/ Number of Attempts to Obtain Sample :

Chemistry Grab 1	20+45	Grab 2	20+55	Grab 3	20+25
Benthic Grab 1	\	Grab 2	\	Grab 3	\
Attempts	3		3		3

Photograph Reference Number(s) :

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Rep 1 - pre mix

Sample Control Number (SCN):

Analysis for: ☑ Chemistry ☐ Toxicity ☐ Benthic Invertebrate Taxonomy

Grabs for Analysis (Chemistry and Toxicology) :

of Jars Per benthic Replicate Sample: Rep 1 _____ Rep 2 _____ Rep 3 _____

Notes:

Reviewed By: _____

Chain

1B103567.4000 SEDIMENT SAMPLING LOG - GRAB Meliadine

Project No:	~~13-1447-0183/2000~~	Project Title:	~~Shell SQT~~ Marine Sediment Investigation
Date:	~~October~~ Sept 19 2018	Sampled by:	AR, ~~JS, DS~~ JG
Station Number (ID):	MBRef B1	Sampling Method:	Van Veen (Chemistry + Toxicity Samples) Standard Ponar (Benthic Samples)
Weather:	sunny wind 17 kt W	Lat/Longitude:	15V 541650 6962064
Water Depth:	19 m		
Sieve Mesh Size:	500 micron 1mm	Time of Collection:	15:30

Sediment Description
Grain Size (boulder, cobble, gravel, sand, silt, clay; trace, some, -y, and); **Inclusions** (shells, organisms, other non-soil components) **Consistency/Compactness** (v loose, loose, compact, dense, v dense; vsoft, soft, firm, stiff, v stiff, hard); **Moisture Content** (dry, moist, wet, saturated); **Colour; Structure; Contaminants** (staining/odour/sheen); **Other** (wood, debris, organisms).

- gravel, sand, some silt
- fine branched brown algae; small red blades
- mixed color grey + black fines sediment
- no odour, stain, or sheen

Approx % Collected in Grab Sample/ Number of Attempts to Obtain Sample :

Chemistry Grab 1 10%, 15% & 20% Grab 2 / Grab 3 /

Benthic Grab 1 _____ Grab 2 _____ Grab 3 _____

attempts (10)

Photograph Reference Number(s) :

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for: ☒ Chemistry ☑ Toxicity ☑ Benthic Invertebrate Taxonomy

Grabs for Analysis (Chemistry and Toxicology) : _____

of Jars Per benthic Replicate Sample: _____

Rep 1 _____ Rep 2 _____ Rep 3 _____

Notes: * several rejections due to ↑ gravel

Reviewed By: _____

APPENDIX D

Benthic Infauna Sampling Field Logs

Benthic

SEDIMENT SAMPLING LOG - GRAB

Meliadine

Project No: ~~13-1447-0183 / 2000~~ 1810356

Project Title: ~~Shell SQT~~ Marine Sediment Investigation

Date: ~~October~~ Sept 15 2018

Sampled by: AR, ~~JS~~, DS JG

Station Number (ID): MBE 1

Sampling Method: ~~Van Veen (Chemistry + Toxicity Samples)~~, Standard Ponar (Benthic Samples) Petit

Weather: Wind 14 Gusts to 20 knots Snow Squalls then Sun

15V 0545719 6963378

Lat/Longitude:

Water Depth: 21

Sieve Mesh Size: ~~500 micron~~ 1 mm

Time of Collection: 13:36 → 15:00

Sediment Description

Grain Size (boulder, cobble, gravel, sand, silt, clay; trace, some, -y, and); **Inclusions** (shells, organisms, other non-soil components) **Consistency/Compactness** (v loose, loose, compact, dense, v dense; vsoft, soft, firm, stiff, v stiff, hard); **Moisture Content** (dry, moist, wet, saturated); **Colour; Structure; Contaminants** (staining/odour/sheen); **Other** (wood, debris, organisms).

- silt clay ; brown layer over gray ; unconsolidated veneer = ~~0.5 to~~ cm to 0.5 cm
- dense ; compact , stiffer with depth
-
- euphausid, polychaete

Approx % Collected in Grab Sample/ Number of Attempts to Obtain Sample :

~~Chemistry Grab 1~~ ~~Grab 2~~ ~~Grab 3~~

Benthic Grab 1 30+23+15 (4) Grab 2 25+40 (8) Grab 3 50+0 (4)

Photograph Reference Number(s) :

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

photos ~~#~~ lost ; memory card issue

Sample Control Number (SCN):

Analysis for: ~~☐ Chemistry~~ ~~☐ Toxicity~~ ☒ Benthic Invertebrate Taxonomy

Grabs for Analysis (Chemistry and Toxicology) :

of Jars Per benthic Replicate Sample: Rep 1 1 Rep 2 1 Rep 3 1

Notes:

very windy 17 → 20 kt

low tide ~ 16:00 0.77 m

Reviewed By: AR

Benthics Infauna

18103567/4000 **SEDIMENT SAMPLING LOG - GRAB** Meliadine

Project No: ~~13-1447-0183 / 2000~~

Project Title: ~~Shell SCH~~ Marine Sediment Investigation

Date: ~~October~~ Sept 16 2013

Sampled by: AR, ~~JS~~ DS JG

Station Number (ID): MBE - 2

Sampling Method: ~~Van Veen (Chemistry + Toxicity Samples)~~ ~~Standard~~ Ponar (Benthic Samples) Petit

Weather: part sun ; wind 15+ kt West

Lat/Longitude: 15 V 0545897 6963337

Water Depth: 22m

Time of Collection: 12:15

Sieve Mesh Size: ~~500 micron~~ 1mm

Sediment Description

Grain Size (boulder, cobble, gravel, sand, silt, clay; trace, some, -y, and); **Inclusions** (shells, organisms, other non-soil components) **Consistency/Compactness** (v loose, loose, compact, dense, v dense; vsoft, soft, firm, stiff, v stiff, hard); **Moisture Content** (dry, moist, wet, saturated); **Colour; Structure; Contaminants** (staining/odour/sheen); **Other** (wood, debris, organisms).

- unconsolidated light brown silt veneer over light gray dense, firm silt + clay
- some black inclusions - no odour
- Rep 3 clam
- poly chaete burrowing hole ; lots of worms

Approx % Collected in Grab Sample/ Number of Attempts to Obtain Sample :

Chemistry Grab 1		Grab 2	Grab 3
Benthic Grab 1	45% + 35	Grab 2	40 + 30	Grab 3	20 + 60
Attempts	2		4		4

Photograph Reference Number(s) :

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

⊛ see photo in ponar mouth for colour & texture

Sample Control Number (SCN):

Analysis for: ~~☐ Chemistry~~ ~~☐ Toxicity~~ ☒ Benthic Invertebrate Taxonomy

Grabs for Analysis (Chemistry and Toxicology) :

of Jars Per benthic Replicate Sample: Rep 1 1 Rep 2 1 Rep 3 1

Notes:

Reviewed By: