Hope Bay Mining Limited

DORIS NORTH GOLD MINE PROJECT
Roberts Bay Report

A Supporting Document for the Project Certificate and Type A Water Licence Amendment Package

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NORTH AMERICA

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Prepared for:

NEWMONT™ NORTH AMERICA

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Executive Summary

(English)

ᓇᐃᓚᓕᒋᐊᕐᓗᒍ ᐅᓂᒃᑲᖅ

(Inuktitut)

Aulapkaiyiuyup Naittuq

(Inuinnaqtun)

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Executive Summary

This report is intended to provide supporting technical information for the Amendment Package for the Doris North Type A Water Licence 2AM-DOH0713.

Hope Bay Mining Limited (HBML) wishes to discharge treated water from the Tailings Impoundment Area (TIA) to Roberts Bay via a subsea pipeline and diffuser.

The current Water Licence indicates that TIA water is to be discharged to Doris Creek, upstream of the waterfall. However, because of the additional resources that can be accessed via the Doris North Portal, deep groundwater and talik water will be encountered during underground mining. This water is salty, and as such, a more environmentally appropriate receiving environment is the marine (ocean) environment rather than the freshwater environment.

In order to accommodate the additional mine water (which will contain salty groundwater and talik water if the mine life expansion is approved as part of the amendment application), HBML is proposing to discharge the mine water into the TIA, and have a single discharge from the TIA to the marine environment in Roberts Bay. The TIA water would be treated prior to discharge via a subsea pipeline and diffuser in Roberts Bay.

This report provides the details of the proposed discharge system in Roberts Bay. This would include a subsea pipeline that daylights at the 4 m isobath, runs approximately 2.4 km along the bottom of Roberts Bay, and ends in a multiport diffuser located at the 40 m isobath.

In order to avoid disturbing sensitive shoreline fish habitat, the pipeline would be installed along the existing jetty in Roberts Bay, emerging at the toe of the jetty. The pipeline itself would not touch the seafloor; rather the pipe would be supported by concrete ballast weights designed to encourage the colonization of algae and invertebrates and the recruitment of fishes that live on the sea floor. It is expected that the underside of the pipe will provide cover for fish, including Arctic flounder, longhead dab, and starry flounder.

An evaluation of the potential effects of discharging treated TIA water in to Roberts Bay resulted in no expected significant adverse effects on water quality, sediment quality, marine fish, marine fish habitat, marine wildlife, or caribou. The Project has been designed such that the water quality in Roberts Bay will remain below CCME guidelines for the protection of marine and estuarine life for the duration of operation of the TIA.

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ᐅᓇ ᐅᓂᒃᑳᖅ ᐋᖅᑭᒃᓱᖅᑕᐅᓚᐅᖅᑐᖅ ᐃᑲᔪᕆᓐᓇᕐᓂᐊᕐᒪᑕ ᓴᓇᖅᑯᑎᑎᒍᑦ ᖃᐅᔨᒪᔭᐅᕆᐊᓕᖕᓂᒃ ᐋᖅᑭᕆᐊᖅᑕᐅᓚᐅᖅᑎᓪᓗᒍ ᓚᐃᓴᖕ ᓈᓴᐅᑎᓕᒃ 04 ᐃᒪᕐᒥᒃ ᐊᑐᕐᓇᐅᑎ ᓚᐃᓴᖕᓂ ᓇᓗᓇᐃᒃᑯᑕᓕᖕᒥᒃ A ᑐᓴᒃ ᖃᖏᖅᓱᖕᓂ ᐃᒪᕐᒥᒃ ᐊᑐᕐᓇᐅᑎᖕᒪᑕ ᓚᐃᓴᖕ 2AM-DOH0713.

Hᐅᑉ ᐸᐃᒥ ᐅᔭᕋᖕᓂᐊᖅᑎᒃᑯᑦ ᑎᒥᖁᑎᖕ (HBML) ᑯᕕᓯᖅᑦᑕᕆᒪᓕᕐᒪᑕ ᐃᒪᕐᓂᒃ ᐊᑐᖅᑕᐅᓂᑯᓂᒃ ᐊᒃᑕᕐᓂᖕᒪᓂᑦ ᑕᓯᕐᓗᖕᒥᑦ (TIA) ᕿᐳᑦᐸᐃ ᑲᖏᖅᓱᖕᒪᓄᑦ ᓴᐅᓯᒪᔫᒃᑯᑦ ᓱᓪᓗᒃᑯᑦ ᑕᒪᐅᖕ ᓯᐊᒻᒪᖅᑎᑕᐅᓗᓂ.

ᒫᓇ ᐃᒪᕐᒥᒃ ᐊᑐᕐᓇᐅᑎᖕᓂ ᓚᐃᓴᒥ TIA ᐊᑐᖅᑕᐅᓂᖓ ᐃᒪᖅ ᑯᕕᔪᐊᓐᓇᕐᒪᑦ ᑐᓴᒃ ᑰᖕᓄᑦ, ᖁᕐᓗᕐᑐᖕᒪᑕ ᖁᓛᓂ. ᑭᓯᐊᓂᓕ, ᐊᔨᖏᓐᓂ ᓴᓇᒃᑳᓐᓂᕆᒪᖕᒪᑕ ᑕᒫᓂ ᐱᑕᖃᖅᑐᒥ ᑐᓴᒃ ᐊᖅᑯᑎᖕᓂ, ᓄᓇᐅᑉ ᐃᑭᐊᖕᓂ ᐃᒪᖃᕐᒪᑦ ᐊᑖᒍᑦ ᐅᔭᕋᕐᓂᐊᕆᒪᖕᒪᑕ. ᓄᓇᐅᑉ ᐃᑭᐊᖕᓂ ᐅᔭᕋᖕᓂᐊᓕᖅᐸᑕ ᑕᒪᓐᓇ ᐃᒪᖅ ᐊᑐᖅᑕᐅᓂᐊᕐᒪᑦ ᑕᓇᐅᖑᓪᓗᓂ ᑕᒪᑐᒪ ᐊᕙᑎᖕᒪᓄᑦ ᐊᑲᐅᓂᖅᓴᐅᔪᖅ ᑲᖏᖅᓱᖕᒪᓄᑦ ᑯᕕᔭᐅᒃᐸᑦ ᐊᔾᔨᒋᖕᒪᒍ ᑕᔨᐅᑉ ᐃᒪᖕᒪᑎᑑᖏᓪᓚᑦ.

ᑕᐃᒫᒃ ᐱᔪᓐᓇᕐᓂᐊᖅᐸᑕ ᐅᔭᕋᖕᓂᐊᕐᕕᖕᒥ ᐃᒪᖅ ᐊᑐᖅᑕᐅᔪᖅ (ᑕᓇᐅᖑᓗᓂ ᓯᕗᓂᓇᓂᐊᖅᑕᑦᑎᓐᓂ ᐅᔭᕋᖕᓂᐊᕐᕕᒃ ᐊᖏᓕᒋᐊᖅᑕᐅᔪᓐᓇᕐᓂᐊᕐᒪᑦ ᑐᒃᓯᕋᐅᑎᕗᑦ ᐊᖏᖅᑕᐅᒃᐸᑦ ᓇᓴᐅᑎᓕᒃ 04-ᒥᒃ), HBML-ᑯᑦ ᑯᕕᓯᔪᒪᖕᒪᑦ ᑕᓯᕐᓗᖕᒍᑦ TIA-ᒥ, ᑕᐃᑲᖕᖓᑦ ᑯᕕᔭᐅᓂᐊᕐᓗᓂ ᐊᑕᐅᓯᕐᒥᒃ ᑯᕕᕕᖅᑲᕐᓗᑎᒃ ᕿᐳᑦ ᐸᐃ ᑲᖏᖅᓱᖕᒪᓄᑦ ᑕᓇᐅᕐᒧᑦ. ᑖᓐᓇ ᐃᒪᕐᓗᒃ ᓴᓗᒻᒪᖅᓴᖅᑕᐅᖃᑦᑕᓚᖓᔪᖅ ᑯᕕᔭᐅᓚᐅᖄᕐᓇᓂ ᓴᐅᓯᒪᔫᒃᑯᑦ ᓱᓪᓗᒃᑯᑦ ᑕᐅᓄᖕ ᕿᐳᑦ ᐸᐃ ᑲᖏᖅᓱᖕᒪᓄᑦ.

ᐅᓂᒃᑲᐅᓯᓇᕗᑦ ᑕᕝᕙᓂ ᓇᓗᓇᐃᔭᐃᓪᓗᑕ ᖃᓄᖅ ᓴᓇᖅᑯᑕᐅᓂᑯᐃᑦ ᐃᒪᕐᓗᐃᑦ ᑯᕕᔭᐅᖃᑦᑕᕐᓂᐊᕐᒪᖔᑕ ᕿᐳᑦᐸᐃ ᑲᖏᖅᓱᖕᒪᓄᑦ, ᓴᐅᔭᐅᓯᒪᔫᒃᑯᑦ ᓱᓪᓗᒃᑯᑦ ᑕᐅᓄᖕ ᑲᖏᖅᓱᒧᑦ ᓯᓪᔭᐅᑉ ᐊᑖᒍᑦ 4-ᒦᑐᒥᒃ ᐃᑎᓂᖅᑲᖅᑐᒥ, ᐃᖅᑲᖕᒎᕐᓗᓂ ᑕᑭᓂᖅᑲᓚᖓᔪᖅ 2.4 ᑭᓛᒥᑐᒥᒃ ᕿᐳᑦ ᐸᐃ ᑲᖏᖅᓱᖕᒪᑦ ᐃᖅᑲᖕᒪᓄᑦ ᑯᕕᔭᐅᓚᐅᖅᑳᕐᓇᓂ ᐅᐊᕆᑎᔭᐅᖅᑲᑦᑕᓚᖓᔪᖅ ᑕᓇᐅᕐᒧᑦ 40 ᒥᑐᒥ ᐃᑎᓂᖅᑐᒥ.

ᑕᐃᒪᓐᓇ ᐸᒡᕕᓴᐃᔫᖏᓪᒪᑕ ᓯᓪᔭᖓᓅᖅᑦᑕᖅᑐᓂᒃ ᐆᒪᔪᓂᒃ ᐃᖃᓗᖕᓂᓗ, ᓱᓪᓗᓕᐅᖅᐸᑕ ᑲᖏᖅᓲᑉ ᐃᖅᑲᖕᒪᓄᑦ ᑯᕕᔭᐅᖃᑦᑕᓚᖓᔪᖅ ᐊᑐᐊᕐᓗᒍ ᓱᓪᓗᖅ ᕿᐱᑦ ᐸᐃᒍᑦ, ᓱᓪᓗᖕᒐᒍᑦ ᐃᖏᕿᓂᕐᒍᑦ ᐅᐊᕆᑎᓗᒍ. ᑯᕕᔭᐅᖃᑦᑕᓚᖓᔪᖅ ᑕᓇᐅᑉ ᐃᑭᐊᖕᓄᑦ ᐃᖅᑲᖕᓄᑦ ᐊᒃᑐᐊᖏᑦᑐᖅ, ᓱᓪᓗ ᑕᒪᓐᓇ ᓇᑉᐸᖅᑯᑎᓅᓐᓂᓐᓂᐊᕐᒪᑦ ᕿᑯᓂ ᓇᑉᐸᖅᑯᑎᖃᓚᖓᖕᒪᑦ ᑕᓇᐅᑉ ᐃᖅᑲᖕᓂ ᑕᓕᓂ ᑲᖏᖅᓱᒥ ᕿᒃᑯᐊᑦ ᐱᕆᖅᓂᐊᕐᒪᑕ ᖁᕕᕆᑯᓗᐃᓪᓗ ᑕᓇᐅᕐᒥ ᐃᖃᓗᖕᓄᑦ ᐱᒃᑯᒥᕆᔭᐅᓂᖅᓴᐅᓕᕐᓂᐊᕐᒪᑕ. ᓇᓗᓇᖏᓪᒪᑦ ᐊᑖᓂᖅᑕᓕᕐᓂᐊᕐᒪᑕ ᐃᖃᓗᐃᑦ, ᖃᓕᕿᓛᓪᓗ ᐃᒃᑲᓇᐃᑦ, ᑲᓇᔪᐃᓪᓗ ᐊᔨᖏᓪᓗ ᐃᒪᐅᑉ ᐃᖅᑲᖕᓂᒥᐅᑦ ᐅᓪᓗᓇᐊᖑᐊᑦ ᓇᑦᑏᓈᐃᓪᓗ.

ᖃᐅᔨᓴᖅᑕᐅᓚᐅᖅᑐᖅ ᖃᓄᑎᒋ ᓱᕝᕙᓕᐅᑕᐅᓇᔭᕐᒪᖔᑦ ᐅᐊᕆᑎᓯᒪᔪᖅ ᐃᒪᕐᓗᒃ ᑕᒪᐅᖕ ᕿᐳᑉ ᐸᐱ ᑲᖏᖅᓱᖕᒪᓄᑦ TIA-ᒥᑦ ᐊᒃᓲᓗᐊᖏᓐᓂᕿᖅᑕᐅᔪᖅ ᐃᒪᖕᒪᑕ ᐱᖅᑯᓯᑐᖃᖕᓂᒃ ᓱᕆᔪᐃᔫᖏᑦᑐᖅ, ᑲᑦᕐᓂᕐᓗᑯᐃᓪᓗ, ᑕᓇᐅᕐᒥᐅᑕᓄᓪᓗ ᐃᑲᓗᖕᓄᑦ, ᐃᑲᓗᐃᓪᓗ ᓇᔪᖅᐸᒃᑕᖕᓂ ᑕᓇᐅᕐᒥ ᐊᒻᒪᓗ ᑐᒃᑐᐃᑦ ᓇᔪᖅᐸᒃᑕᖕᓂ ᓯᓪᔭᒥ. ᓴᓇᔭᐅᔪᒥᑦ ᐱᔪᑦ ᐋᖅᑭᒃᓱᖅᑕᐅᓯᒪᓂᐊᕐᒪᑕ ᐃᒪᖕᓂᒃ ᓱᕆᔭᐃᑦᑕᐃᓕᒪᓗᑎᒃ ᕿᐳᑦ ᐸᐃ ᑲᖏᖅᓱᖕᓂ ᐊᑐᐊᒐᓂᒃ ᐊᑐᐊᖅᓯᓂᐊᖅᑐᑦ ᓇᓗᓇᐃᔭᖅᑕᐅᓯᒪᔪᓂᑦ CCME-ᒥ ᓴᐳᑎᔭᐅᓯᒪᔪᑎᓂᒃ ᐃᒪᕐᒥᐅᑕᓄᑦ ᐆᒪᔪᓄᑦ ᐊᕙᑎᖕᒪᓄᓪᓗ ᑕᒫᓂ ᓴᓇᕝᕕᐅᓂᖕᓂ ᐊᐅᓚᑕᐅᓂᖕᓂᓗ TIA.

Aulapkaiyiuyup Naittuq

Una taiguagakhaq titiraqhimayuq tunigiami ikayuutikhamk nauaitkutanik Himmautingnanik Makpiraat Nampa 04mut umunnga Doris North Naunaitkutalik A-mik Imaqmut Laisikhaq 2AM-DOH0713.

Hope Bay Uyarakhiuqtut Havakvinga (HBML) kuvipkaiyumayut halummaqtauhimayumik imaqmik iqqakunga ilakunnguqtauyuq piiqtaukmat uyarakmit Ikhinnarvinganit (qablunaatitut taiyauyuq naittumik TIA) Roberts Bay-mut imaqmi turhuakkut hanalrutikkut hiamitirutauyumik.

Tatja Imaqmik Hulinahuarmut Laisikhaa naunaiqtaa TIA imannga kuviyuq Doris Creek-nganut, tatpaunganut kuutirup qurlup. Kihimi, allamit ikayuutikhanganik pittaqqat ukunuuna Doris North Angmauninnganut, itinnaktumik nunami imannga talik imanngalu tautuknaqniaqtuq ataagut ikuutalirumik. Una imaq tariunnginnaq, talvuuna, avatimut ihuatqiyauyumik pigumi avatit una imaqmi avatinga unaunngittumik imaup avatinganik.

Pigiarumi allanik imiqtarvinga (tariuqarniaqtuq nunap imanga talik imangalu uyarakhiuqtut imannga atuqtauninnga angiqtaukpat ilaliutiugumi Nampa 04-mut himmautimut uuktuutinganik), kuvinaqtaat uyaakhiurviuyup imannga TIA-mut, atauhiinarmik kuvilugu TIA-mit imarmut avatinganut Roberts Baymi. Tamna TIA imaa halummaqtauniaqquq kuvitinnagu imaqmi turrhuatigut hanalrutikkut hiamitirutautikkullu Roberts Bay-mi.

Una taiguagakhaq tuniyuq naunaitkutanik kuviumayamiknikkut Roberts Bay-mi, ilaliutiniaqtuq imaqmi turrhuamik qaumayuq uumani 4 m naunaitkutaq naunairhimayuq tariup qanuraaluk itinnauyuq, piyuq 2.4 km ataani Roberts Bay, nutqarhunilu amigaittuni tulakviit hanalrutikkut hiamitirutauyumik ittuq 40 m naunaitkutaq naunairhimayuq tariup qanuraaluk itinnauyuq.

Ihumaaluutinnaittumik hinaani ittut iqalungit, tamna turhuaq iliuraiyauniaqquq atuqtauyuni tulakvinganu Roberts Bay-mi, piyuq aulapkaivinga tulakviup. Tamna turhuaq kahalimaittuq tariup natqanganut; kihimi tamna turhuaq tunngaviqarniaqtuq ahirulaittunik uyaraliuqhimayunik uqumaitkutinik piliurhimayut pipkaigiami tunngavingat nauyut iviit natqami hanguyuittut huratjat qimirluittut natqarmiutat iqaluit. Ihumagiyut ataa turhuap nayugakhaanik iqalumut, nataarnanullu, niaquqtuyut nataarnat, ubluriatitut ittut nataarnanullu.

Qanuriliurninnga naunaitkutamik naunaiyaqtut ayurhautinganik kuvigumi halummaqtitauyumik TIA-mik imaqmik Roberts Bay-mut naunaiqtaat angiyumik nakuungirutauniq imaup qanuriliurninnganik, ilakunnganik qanuritaanganik, imarmiutat Iqaluit, imarmiutat Iqaluit nayugangit, imarmiutat huratjat, tuktulluuniit. Tamna Havauhikhaq piliurhimayuq taimaa imaq qanuritaanganik Roberts Bay-mi inniaqtuq qulaani CCME malirutingani qayagiyumik pigiamikni imarmiutat tariuqmiutat iqaluqariami havaktillugit TIA-mi.

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Glossary

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Glossary

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

ADCP	Acoustic Doppler Current Profiler
AEMP	Aquatic Effects Monitoring Program
Anadromous	Fish that migrate from the sea to spawn in freshwater.
Autotrophic	Organisms that can synthesize their own food from inorganic molecules, usually using light energy (photosynthesis), e.g., plants.
Benthopelagic	Living and feeding near the bottom as well as in midwaters or near the surface
Brackish	Water that is saltier than freshwater but less salty than seawater, as found in estuaries.
$CaCO_3$	Calcium carbonate
CCME	Canadian Council of Ministers of the Environment
Convection	The movement of molecules within fluids.
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPUE	Catch-Per-Unit-Effort
CTD	Oceanographic instrument that measures conductivity, temperature, and depth.
Demersal	Dwelling at or near the bottom of a body of water.
DFO	Department of Fisheries and Oceans Canada
Diffuser	The part of a channel or tube in which deceleration (expansion) of the flow and an increase in pressure take place.
EC	Environment Canada
EEM	Environmental Effects Monitoring
Eutrophic	Nutrient-rich environment that supports high levels of primary production (i.e., plant growth).
GN-DOE	Government of Nunavut, Department of Environment
HADD	Harmful alteration, disruption or destruction of fish habitat.
HBML	Hope Bay Mining Limited
Heterotrophic	Organisms that are unable to synthesise their own food from inorganic molecules, and must consume organic carbon for growth, e.g. animals and fungi.
HTO	Hunters and Trappers Organization
ISQG	Interim Sediment Quality Guideline
KIA	Kitikmeot Inuit Association
NIRB	Nunavut Impact Review Board

NWB	Nunavut Water Board
Oligotrophic	Nutrient-poor environment that supports low levels of primary production (i.e., plant growth).
PEL	Probable Effects Level
Pelagic zone	The open-ocean (as opposed to the nearshore area).
Photosynthesis	The process by which green plants and some other organisms use energy from sunlight to synthesize organic compounds from carbon dioxide and water.
Polynya	A persistent area of open water surrounded by sea ice.
Pycnocline	Vertical zone in the water column in which density changes rapidly with depth. Seawater density is a function of salinity and temperature.
Recruitment	The number of new juvenile fish reaching a size/age where they represent a viable target for the commercial, subsistence or sport fishery for a given species.
Remineralization	The transformation of organic molecules to inorganic forms, typically mediated by biological activity.
ROV	Remote Operated Vehicle
SARA	Species At Risk Act
Sill	A rise at the mouth of a bay or fjord, usually caused by deposition from past glacial events.
Talik	A layer of year-round unfrozen ground in an area of permafrost where temperatures are above freezing, allowing water to remain in liquid form.
TIA	Tailings Impoundment Area
TSS	Total Suspended Solids
WMMP	Wildlife Mitigation and Monitoring Program

1. Introduction

1. Introduction

This report is intended to provide supporting technical information for the Type A Water Licence/ Project Certificate Amendment Package for the Doris North Project.

Hope Bay Mining Limited (HBML) wishes to discharge treated water from the Tailings Impoundment Area (TIA) to Roberts Bay via a subsea pipeline and diffuser.

The current Water Licence indicates that TIA water is to be discharged to Doris Creek, upstream of the waterfall. However, because of the additional resources that can be accessed via the Doris North Portal, deep groundwater and talik water will be encountered during underground mining. This water is saline, and as such, a more environmentally appropriate receiving environment is the marine environment rather than the freshwater environment.

In order to accommodate the additional mine water (which will contain saline groundwater and talik water if the mine life expansion is approved as part of the amendment application), HBML is proposing to discharge the mine water into the TIA, and have a single discharge from the TIA to the marine environment in Roberts Bay. The TIA water would be treated prior to discharge via a subsea pipeline and diffuser in Roberts Bay.

Figure 1-1 shows the location of Roberts Bay relative to the Doris North Project Infrastructure. Roberts Bay is located approximately 4 km north of Doris Camp.

This report provides the details of the proposed discharge system in Roberts Bay, which would include a subsea pipeline that daylights at the 4 m isobath, runs approximately 2.4 km along the bottom of Roberts Bay, and ends in a multiport diffuser located at the 40 m isobath.

This report also presents the existing baseline conditions in Roberts Bay, an environmental assessment of potential effects in Roberts Bay due to the proposed discharge system, mitigation measures that will be in place to reduce or eliminate potential effects, and the proposed monitoring programs that would be in place to monitor the biophysical environment in Roberts Bay. In addition, information on public consultation, alternatives, and reclamation and closure are included.

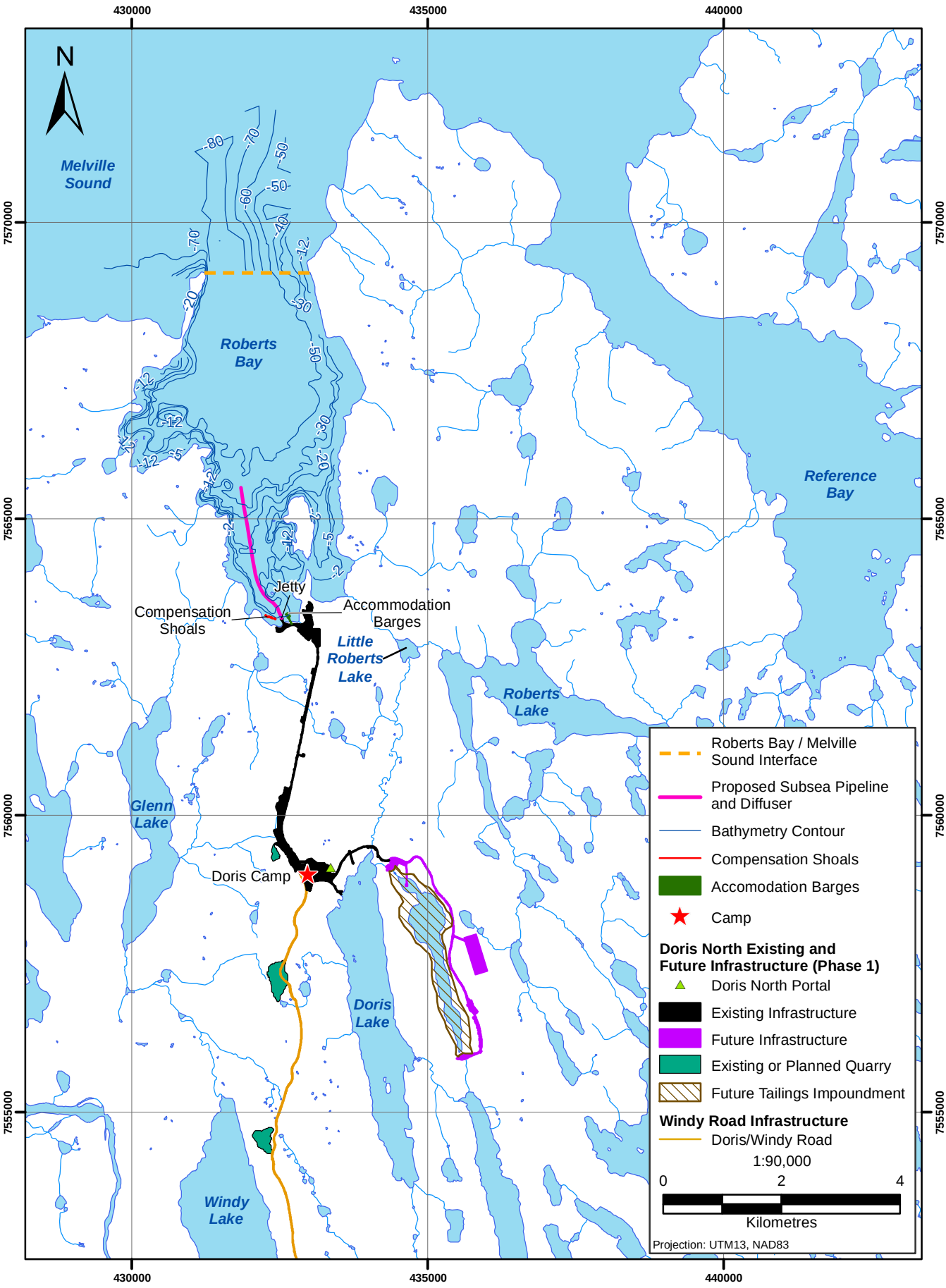

Figure 1-1

Location of Roberts Bay and Doris North Project

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2. Project Description

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2. Project Description

This chapter presents the details of the proposed subsea pipeline and diffuser, and includes other alternatives that were examined, as well as the potential effects of the environment on the proposed infrastructure.

The 'Project' for this report is defined as the installation of a subsea pipeline and diffuser in Roberts Bay, and the discharge of treated water from the Tailings Impoundment Area (TIA) to Roberts Bay through the subsea pipeline and diffuser.

This Project description covers the infrastructure from the shoreline crossing at Roberts Bay to the diffuser located at 40 m depth in Roberts Bay. The on-land portion of the TIA discharge system, including treatment, is described in separate reports (see Hatch 2011).

This Project description also covers the expected behaviour of the treated TIA water once it is discharged into Roberts Bay.

2.1 PURPOSE AND NEED FOR PROJECT

The purpose of the proposed Project is to discharge treated TIA water to the most appropriate receiving environment in order to minimize potential environmental effects.

Accessing the Doris Central and Connector resources via the Doris North Portal will result in the interception of talik water and deep groundwater. This water is saline in nature, and will cause the mine water in the underground mine to have a high salt content. This water could be detrimental to freshwater ecosystems if discharged to the currently permitted discharge site in Doris Creek. However, the saline water could be discharged to the marine environment with no detrimental effects to marine ecosystems, as the salt content will closely match that of seawater.

As mine water will report to the TIA, there is a need to discharge treated TIA water to some location, and the marine environment of Roberts Bay is a more environmentally sound receiving environment location compared to the currently permitted location in Doris Creek.

Other alternatives that were considered for the discharge of TIA water are presented at the end of this chapter (Section 2.3).

2.2 PROJECT DESCRIPTION

2.2.1 Overview

Figure 2.2-1 presents an overview map of the location of the proposed subsea pipeline and diffuser in Roberts Bay, along with the Doris North Project infrastructure.

HBML is proposing to discharge treated TIA water via a 2,400 m long outfall pipeline and a multiport, 95 m long diffuser located at 40 m depth to Roberts Bay.

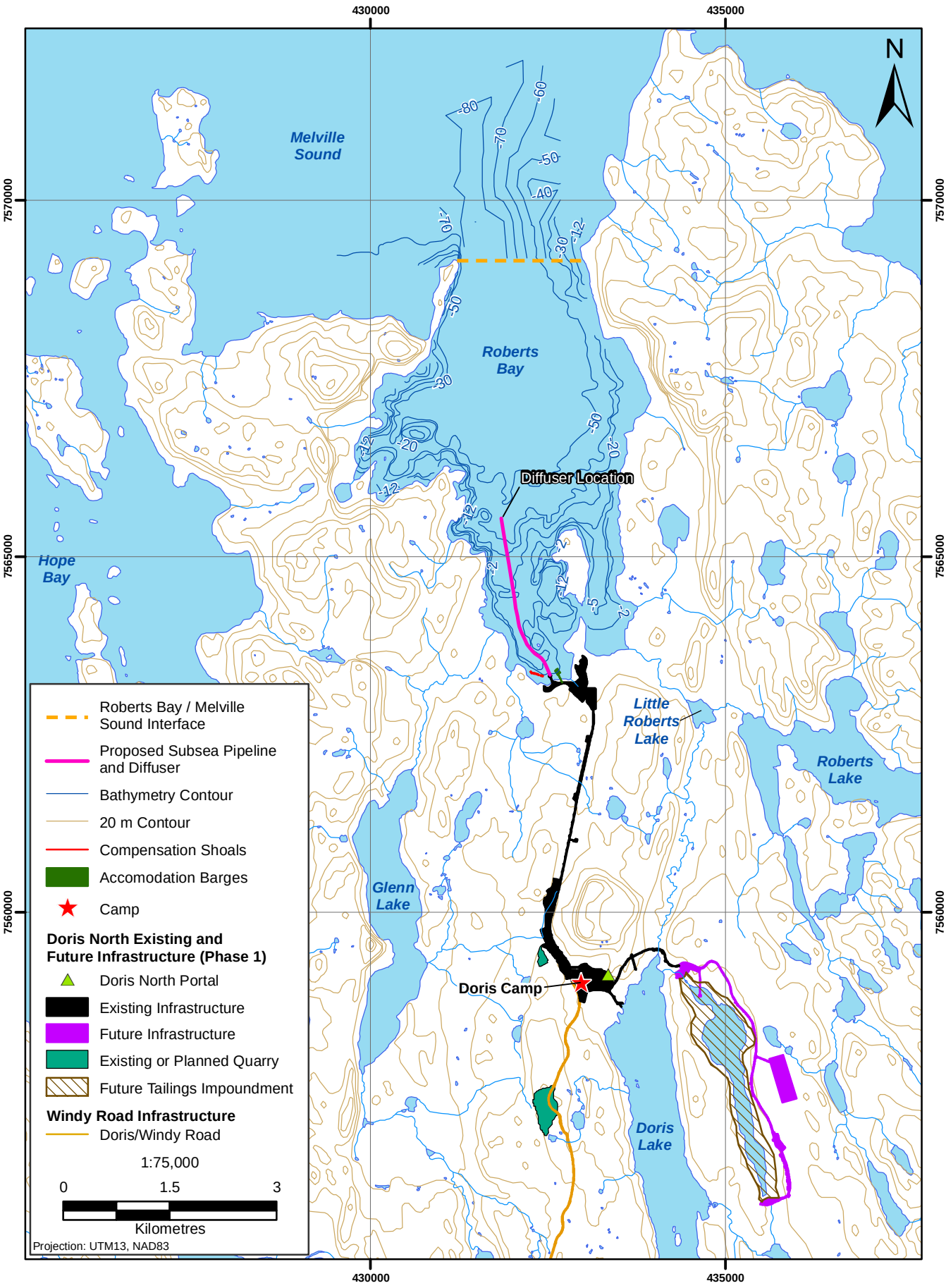

Figure 2.2-1

Location of Proposed Subsea Pipeline and Diffuser

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The advantage over the currently permitted system is that saline water from underground workings would be discharged to the sea. The high concentrations of dissolved solids could be detrimental to freshwater ecosystems if discharged to the currently permitted discharge site in Doris Creek. However, the saline water could be discharged to the marine environment with no detrimental effects to marine ecosystems, as the salt content will closely match that of seawater.

Treated TIA water would be discharged to Roberts Bay year round. The treated TIA water is expected to disperse throughout Roberts Bay in the winter months and flush completely with Melville Sound water during the summer open water season.

The on-land portion of the TIA excess water transfer system is described in Hatch 2011. Inputs to the TIA will include mill effluent, mine water, and natural flows. Decant from the TIA will accommodate all inflows in a manner that will maintain sufficient water cover over deposited tailings solids. Excess water will be pumped from the TIA to a treatment plant located at the Doris Camp site, and then transferred via a pipeline along existing corridors to the subsea pipeline and diffuser system in Roberts Bay.

Please see SRK 2011 for details of estimated flows and inputs into the TIA, and Hatch 2011 for details of proposed treatment of TIA water prior to discharge to Roberts Bay.

After mixing in Roberts Bay, the resulting concentrations of water quality parameters should remain below marine CCME guidelines for the protection of marine and estuarine life.

The proposed treatment of TIA water has been designed so that MMER guidelines will be met within the discharge pipeline, and so that marine CCME guidelines will be met within Roberts Bay.

2.2.2 Shoreline Crossing

In order to avoid sensitive shoreline fish habitat, HBML is proposing to have the excess water pipeline system cross the shoreline in to Roberts Bay at the location of the existing jetty.

It is anticipated that the transition from the overland pipe to the subsea pipe can be achieved within the exiting jetty footprint, and could be installed during the planned sheet pile work currently approved and scheduled for the winter of 2011/2012 (Hatch 2011a).

The plan would be to install a pipe spool during the sheet pile work incorporating the pipe protection into the sheet pile design. The pipe spool would be installed to penetrate the edge of the jetty below the lowest ice level and above the bottom of the bay floor (Hatch 2011a).

The work would be done in compliance with the jetty repair Fisheries Authorization (DFO No. NU-10-0028), and during the winter to minimize potential environmental effects. Both the sedimentation and access issues would be addressed by maintaining the area clear of snow in the early parts of the winter, and removing portions of the ice to promote freezing to full depth. It may then be possible to complete the excavation “in the dry”. By isolating the excavation using ground freezing, any required excavation could be undertaken with limited potential effects to marine habitat (Hatch 2011a).

The following text outlines the mitigation measures that will be followed as specified in the Jetty Expansion Fisheries Authorization (DFO No. NU-10-0028):

> *Conditions that relate to the mitigation of potential harmful alteration, disruption or destruction (“HADD”) of fish habitat.*

The following measures shall be implemented to avoid the unauthorized HADD of fish habitat:

- *No in-water work shall occur between July 15 and August 15 to protect critical spawning and rearing periods for all fish species in Roberts Bay.*
- *A qualified biologist or environmental inspector shall be on site during all in-water construction, compensation and restoration works to ensure implementation of the designs as intended in the Plan and conditions of this Authorization*
- *All materials and equipment used for the purpose of all work phases shall be operated and stored in a manner that prevents any deleterious substance (e.g. petroleum products, silt, debris, etc.) from entering the water.*
  - *Any stockpiled materials shall be stored and stabilized above the ordinary high water mark of any water body.*
  - *Vehicle and equipment re-fuelling and maintenance shall be conducted above the ordinary high water mark of any water body.*
  - *Any part of any equipment entering the water shall be free of fluid leaks and externally cleaned/degreased to prevent any deleterious substance from entering the water.*
- *Only clean, competent, certified non-acid generating rock and material free of fine particulate matter shall be placed in the water.*
- *Material used for habitat compensation features shall not be taken from below the ordinary high water mark or shoreline of any water body.*
- *Sediment and erosion control measures shall be implemented prior to work, and maintained during the work phases, to prevent entry of sediment into the water or the movement of re-suspended sediment.*
- *All disturbed areas shall be stabilized upon completion of work and restored to a pre-disturbed state or better.*
- *Sediment and erosion control measures shall be left in place and maintained until all disturbed areas have been stabilized.*
- *A sediment and erosion control plan shall be submitted to the Iqaluit, NU office of the Department of Fisheries and Oceans, Fish Habitat Management, Eastern Arctic Area, at least 10 days prior to the start of construction.*

2.2.3 Subsea Pipeline

Treated TIA water will be pumped to Roberts Bay via an insulated, heat-traced pipeline, along existing on-land road corridors (Hatch 2011).

In order to avoid disturbing sensitive shoreline fish habitat, the pipeline will be installed along the existing jetty in Roberts Bay, emerging at the toe of the jetty. The pipeline will daylight in Roberts Bay at the 4 m isobath, then continue along the bottom, held by concrete ballast weights at 8 m intervals, for approximately 2.4 km to the 40 m isobath. “Daylighting” of the pipeline at 4 m depth, below low water, is required to protect it from ice damage.

Approximately 300 m north of the jetty is a rocky shoal. The shoal is less than 2 m deep and portions are emergent at low tide. At 2 m depth, based on impacts to shoals, it is known ice will impact the

subsea pipeline; therefore the pipeline route must be diverted to avoid this shoal. It is possible to impart a large radius bend to an HDPE pipe, so the pipeline will curve to the west to avoid the shoal.

The pipeline will end in a 20 port diffuser at the 40 m isobath. The treated TIA water will be de-aerated in a head tank on shore in which bubbles can escape to the atmosphere through the liquid surface. This is necessary to avoid air escaping from the diffuser in the form of bubbles. Many species of marine fish show strong avoidance reactions to bubbles (Sharpe and Dill 1997), particularly smaller schooling species such as Pacific herring and capelin, both of which are common in Roberts Bay. Capelin use the nearshore areas of Roberts Bay as a spawning migration route and bubbles from the diffuser could interfere with their migration. De-aeration of the TIA water will prevent bubbles from forming in the pipeline.

Figure 2.2-2 shows a pictorial view of the overland pipeline entering Roberts Bay and the subsea pipeline and diffuser in Roberts Bay.

2.2.4 Diffuser

Figures 2.2-3, 2.2-4 and 2.2-5 illustrate the layout and operation of the diffuser. The diffuser is configured to optimize the effects of initial jet momentum and effluent buoyancy to achieve the highest dilution as close to the discharge ports as possible.

The diffuser is located in 40 m water depth and has 20 ports spaced at 5 m intervals, staggered on either side of the diffuser at the spring line and so discharging horizontally.

In addition to the obvious benefit of decreasing concentrations of substances of concern, high mixing ratios work to trap the buoyant effluent at a depth below the productive sun-lit zone. A numerical simulation of discharge of 120 L/s yielded a dilution of approximately 300:1 at the trapping depth ~9 m above and within 15 m horizontally of the diffuser.

2.2.5 Construction of Subsea Pipeline and Diffuser

The transition from overland pipeline to subsea outfall pipeline occurs in the shore crossing. It is planned to trench and backfill the overland pipe in the jetty during the approved jetty repairs scheduled for the winter of 2011/2012. The overland pipe will terminate at a flange at 4 m below low tide.

The subsea portion of the pipeline would not be constructed unless the Type A Water Licence/Project Certificate Amendment application is approved.

If approval is granted, the subsea outfall will be fusion-welded on shore in sections of length suitable for handling in the designated fabrication area. Ballast weights will be bolted on and sections will be floated into place over the ultimate pipeline alignment. Temporary blind flanges will maintain the buoyancy of the ballasted pipe by retaining air within it. It may be advantageous to weld or flange all the sections together before sinking, so that a floating pipe string 2.4 km long may be positioned over the alignment. The outfall could be sunk utilizing the S-bend method by metered pumping of water into the shore end.

A spool piece will connect the sunken outfall pipeline with the section installed in the jetty.

The diffuser may be sunk with the outfall pipeline by temporarily sealing the discharge ports or, alternatively, it may be installed as a separate section by flanging onto the outfall pipeline. In either case, there will be a requirement for a few hours of subsea work performed by an ROV or divers (for removal of port covers) or by divers for flanging the diffuser to the outfall pipeline.

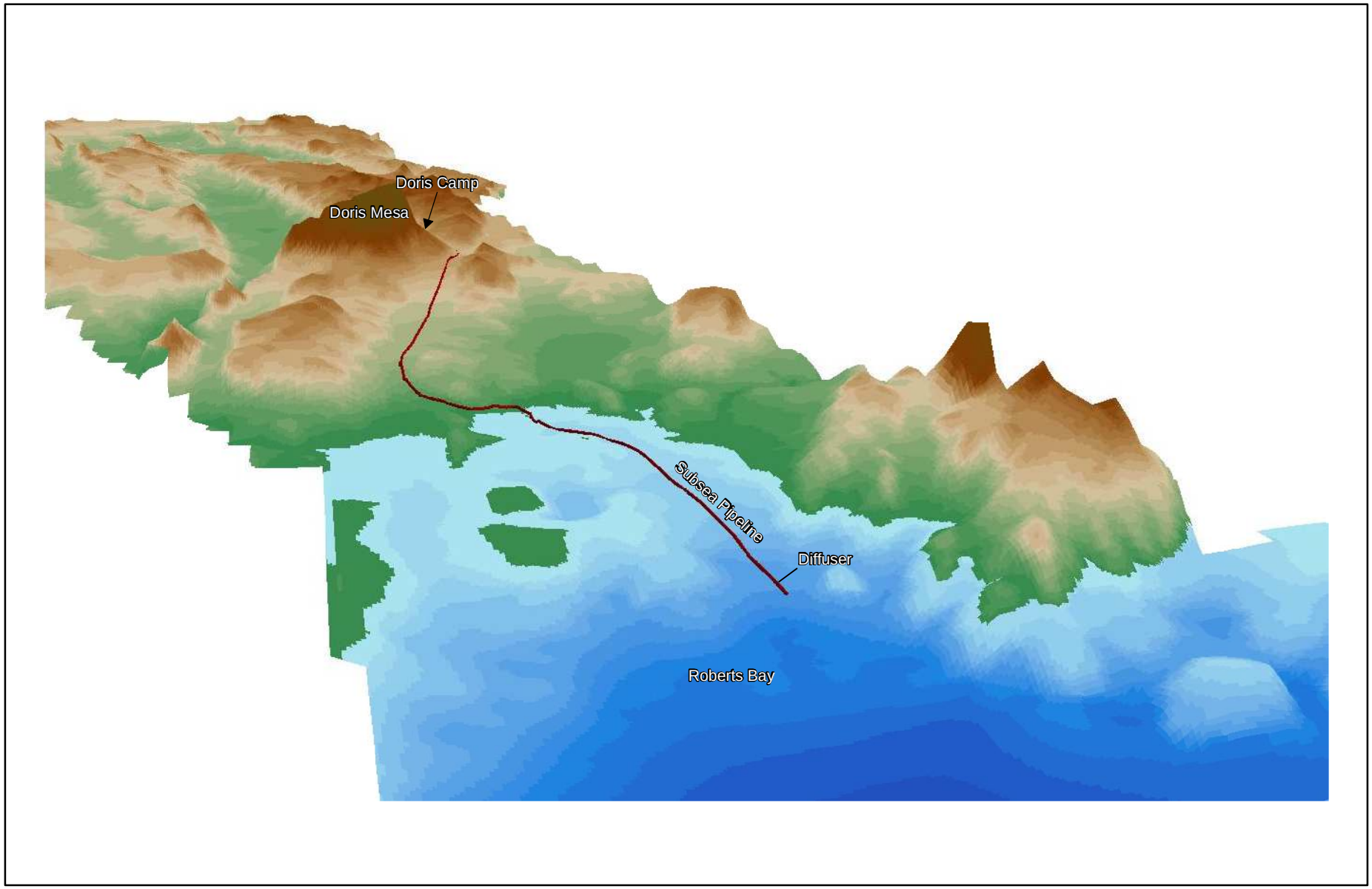

Figure 2.2-2

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3D View of Proposed Subsea Pipeline and Diffuser in Roberts Bay

Figure 2.2-2

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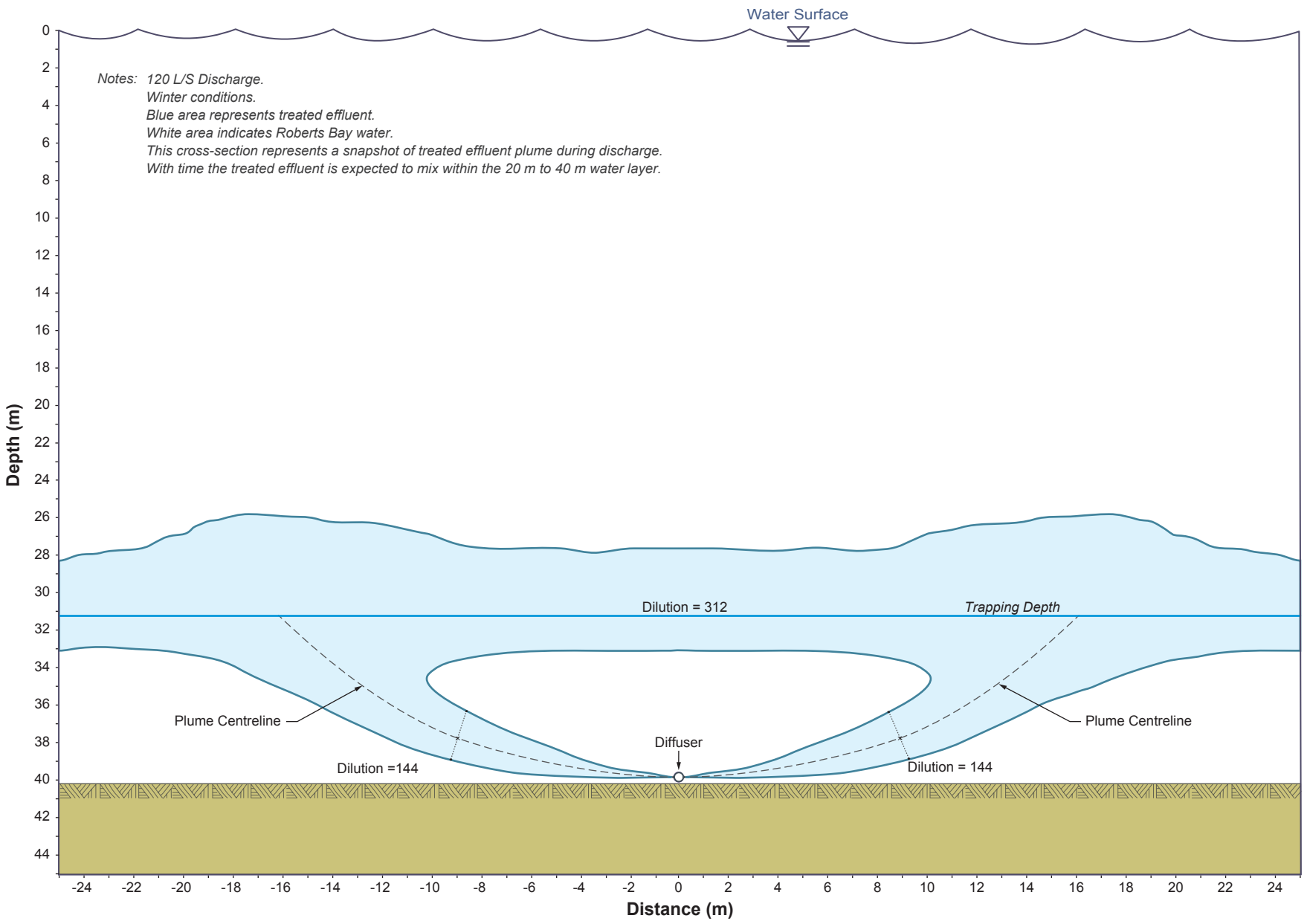

Figure 2.2-3

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Example of Diffuser Plume (End View)

Figure 2.2-3

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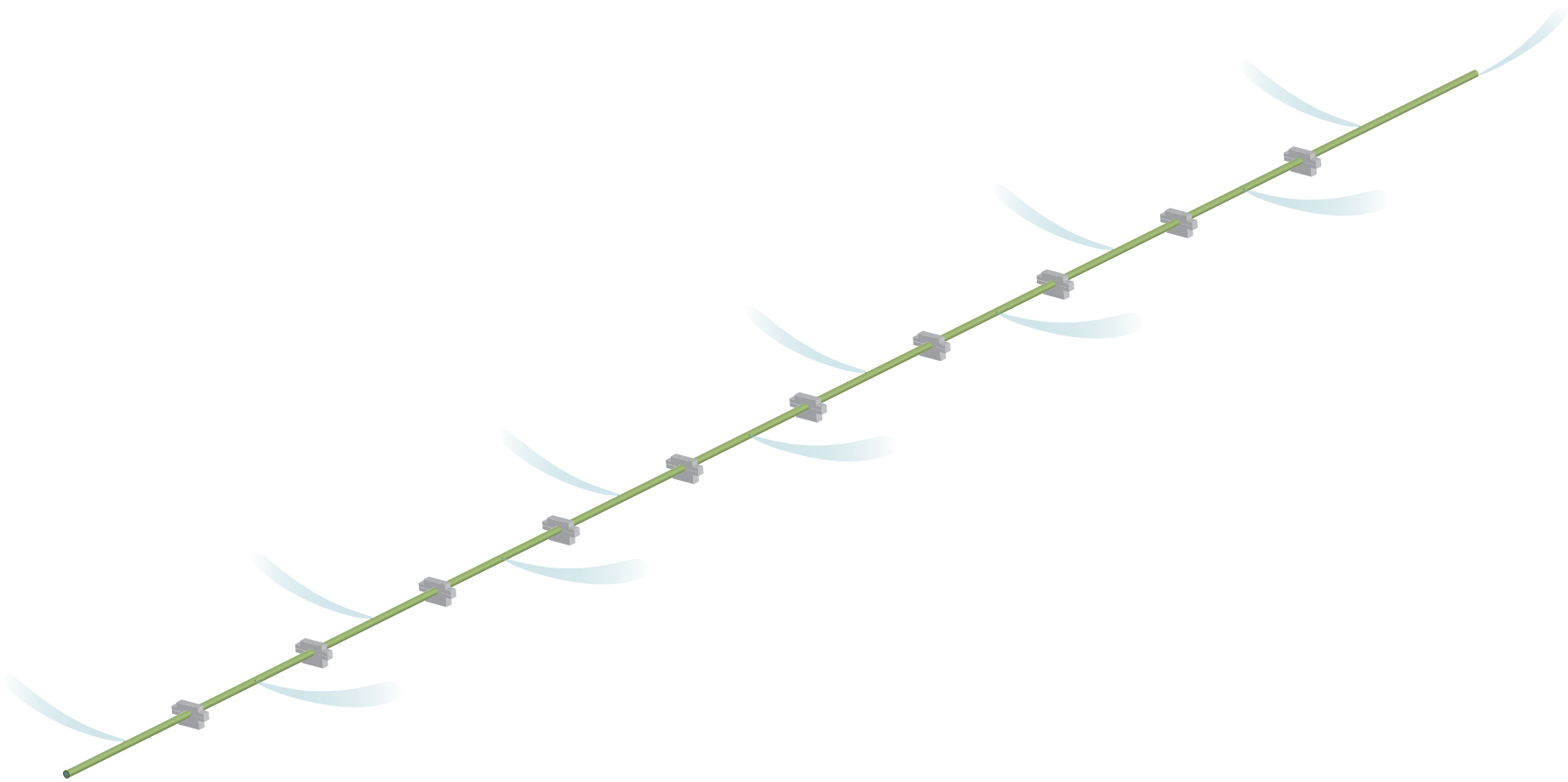

Not to scale

Figure 2.2-4

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Concept Sketch of One Half of Diffuser Showing Discharge Plumes

Figure 2.2-4

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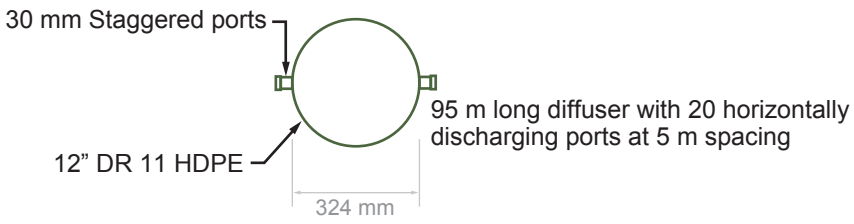
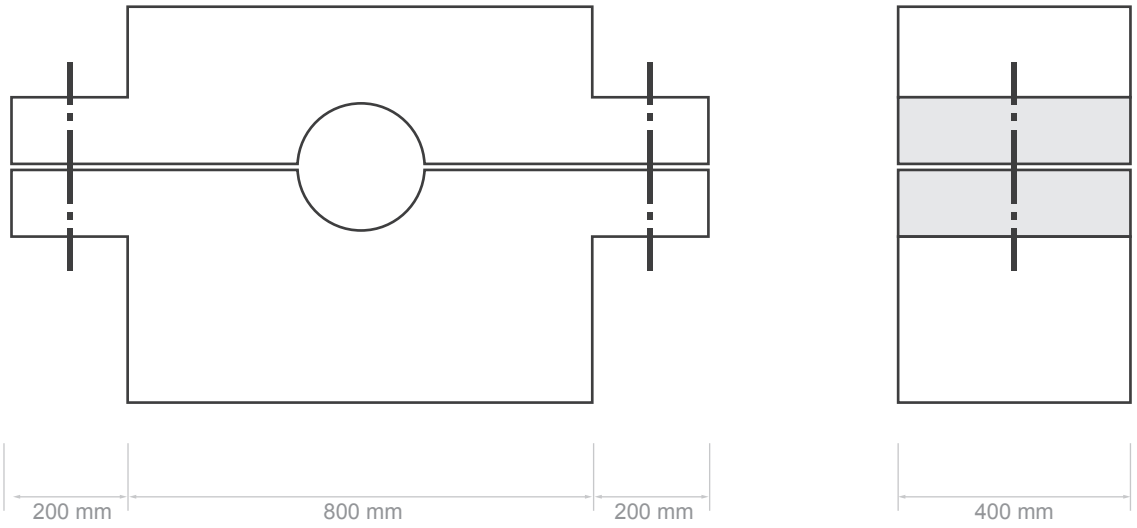
Diffuser



Counter Buoyancy Weight



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Diffuser End View and Counter Buoyancy Weight

Figure 2.2-5

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2.2.6 Potential Effects of the Environment on the Subsea Pipeline and Diffuser

The subsea outfall pipeline is ballasted to resist current and wave forces. The outfall pipeline will be protected against ice impact by burial within the jetty to a water depth of 4 m. Ice thickness in Roberts Bay has been measured to be ≤2 m and rafted ice is confined to water depths less than 4 m.

Treated TIA water temperature will be maintained at a sufficient value by the heat tracing in the overland pipeline to prevent freezing within the subsea outfall of the potentially fresh effluent in seawater at -1.5 degrees.

2.2.7 Accidents and Malfunctions

Accidents that could potentially cause damage to the subsea pipeline or diffuser would be limited to ice and/or vessel anchor impacts. The subsea pipeline and diffuser have been sited to avoid such impacts by ensuring that there is a minimum water cover of 4 m and that the alignment avoids active anchorages.

Ballasting will be used to stabilize the pipeline and diffuser against wave forces projected to occur less frequently than once in one hundred years.

The system will operate at relatively low pressures (a maximum of 4 bar, approximately one third of the pipeline pressure rating). Leakage from normal operating modes is therefore highly unlikely.

In the event that the outfall/diffuser system does sustain damage, subsea repairs can be conducted. In the worst case, these might entail replacement of a pipe section with a pre-measured spool piece fitted into the damaged section and connected to the undamaged section by clamps. Spare pipe sections could be stored on site to expedite such repairs.

2.2.8 Expected Behaviour of Treated TIA Water Discharged to Roberts Bay

The on-land portion of the TIA discharge system, including treatment, is described in a separate report (Hatch 2011). As well, the operation of the TIA is described in a separate report (SRK 2011). The following text describes the anticipated behaviour of the treated TIA water once it is discharged in to Roberts Bay via the subsea pipeline and diffuser.

A sketch of the dilution field achieved by the diffuser is shown in Figure 2.2-3.

After discharge from the diffuser ports, the treated TIA water mixes energetically with ambient seawater and the still slightly buoyant mixture rises through the water column to its depth of buoyant equilibrium (or trapping depth). At this location, approximately 9 metres above the diffuser, momentum has completely dissipated and the mixture is neutrally buoyant. In the absence of current, the diluted treated TIA water field would only spread laterally by gravity as the fluid of a specific density intrudes horizontally into the ambient stratified fluid. Further transport and mixing occurs in response to ambient currents.

Current measurements have been collected under the ice starting in February of 2011. Average currents measured were 5 cm/s at the diffuser location during the ice-covered period. However, numerical modelling of summer conditions based on site wind data has indicated that surface currents as strong as ~20 cm/s could be reached at the entrance of Roberts Bay during ice-free months.

2.2.8.1 Roberts Bay Oceanographic Processes

Circulation is weak in winter when both wind-driven and estuarine circulations are absent due to the ice cover and lack of fresh water input respectively. Ocean current data were collected in February

and March 2011 at a location near the propose diffuser, and in April and May 2011 at the mouth of Roberts Bay with Melville Sound. An acoustic Doppler Current Profiler (ADCP) was mounted below the land-fast ice near the planned diffuser location over a water depth of 30 m, and moved to a location at the mouth of Roberts Bay over a water depth of 80 m.

Results from the measurements near the proposed diffuser location indicated that velocity increases with proximity to the sea bed and the near-bottom flow is directed northward (seaward, down-slope) with a generally southward flow at mid depth. Vertical velocities were downward near the seabed, constant with the concept of down-slope density flow driven by ice growth and concomitant brine drainage. Results from the measurements at the mouth of Roberts Bay indicated that the exchange of Roberts Bay water with Melville Sound is minimal during the ice-covered season. Currents in this region reached 5 cm/s, but were mainly less than 2 cm/s during this period.

The diffuser depth was set at 40 m to prevent treated TIA water from rising through the homogeneous convective layer to the under-ice surface. In the summer, the diluted treated TIA water will be trapped well below the most productive, sunlit upper layers of the water column.

At break-up the sea surface is exposed to wind stress and wind-driven circulation is re-established. At the same time the freshet occurs and fresh water enters Roberts Bay tending to drive an estuarine circulation seaward (to the north) near-surface and southward below. It is these circulation modes that are responsible for renewal of the deep waters (as evidenced by re-oxygenation) within Roberts Bay. Model results using wind data from site indicate that wind-driven currents effectively flush the bay during the summer open water season. Summer renewal is important in ensuring that treated TIA water concentrations do not increase in Roberts Bay.

Roberts Bay is directly connected with Melville Sound, as there is no sill present at the mouth of Roberts Bay. This was verified by depth soundings in April 2011. Roberts Bay communicates with Melville sound through a relatively wide entrance. The maximum depth of Roberts Bay is approximately 80 m near the mouth of the bay.

2.3 SUSTAINABILITY ANALYSIS

The placement of the subsea pipeline and diffuser in Roberts Bay and discharge of treated TIA water is not predicted to adversely affect the sustainability of renewable natural resources. As evaluated in Chapter 5, no significant adverse effects on water quality, marine fish, marine fish habitat, marine wildlife, and caribou are predicted. The Project will meet CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life. A No Net Loss Plan for marine fish habitat has been created that covers the infrastructure from the shore crossing at Roberts Bay to the diffuser at 40 m depth (Section 5.5). In addition, the Project is not located in an area known to be important to current land users for harvesting activities (Section 4.4). For these reasons, it is expected that the local and regional environment (including fish, mammals, and other renewable natural resources) will continue to provide for current and future generations in Nunavut and Canada.

3. Public Consultation

3. Public Consultation

HBML has undertaken a range of consultation and communication activities with local communities, regulators and resource managers over the past several years as part of the Doris North Project, and potential amendments to the Type A Water Licence.

In order to specifically address the proposed Doris North infrastructure changes, including the installation of a subsea pipeline and diffuser in Roberts Bay, a round of community meetings were held in June 2011. The results of the June 2011 consultation are summarized below.

HBML visited four of the five communities in early June 2011: Cambridge Bay, Gjoa Haven, Kugaaruk, Kugluktuk, and Taloyoak. Information pertaining to the proposed subsea pipeline and diffuser in Roberts Bay was presented as well as information about other aspects of the Doris North infrastructure changes application. Table 3-1 summarizes the communities that were visited and the estimated number of attendees.

Table 3-1. Public Meeting Dates and Attendance, June 2011

Date	Community	Attendance*
Monday, June 6, 2011	Kugluktuk	5
Tuesday, June 7, 2011	Cambridge Bay	13
Wednesday, June 8, 2011	Kugaaruk	15
Thursday, June 9, 2011	Taloyoak	19
Friday, June 10, 2011	Gjoa Haven	Postponed due to weather

**Attendance numbers estimated from draw prize entries and visual observations.*

Comments and feedback pertaining to the information presented were documented and where practicable responses were provided by HBML staff that were in attendance. The overall attendance totalled 52 individuals, with the largest attendance being in Taloyoak. Meeting attendance was lower than anticipated in Kuglukuk as many residents were away fishing. Elders were present at the meetings in Kugaaruk and Taloyoak. HBML staff were unable to present information to the Gjoa Haven community as originally planned due to poor weather conditions. It is anticipated that the Gjoa Haven meeting will be rescheduled and information presented to residents for their feedback late in 2011 or early 2012.

Comments, questions, and responses pertaining specifically to the proposed Doris North infrastructure changes were discussed in Cambridge Bay, Kugaaruk, and Taloyoak and have been summarized here.

- Cambridge Bay:
  - A question was asked regarding the limited bed capacity at camp, being approximately 180 beds plus those on the floating barge, and if camp expansion was tied to the Doris North infrastructure changes. This was confirmed by HBML staff. Over 300 beds will be needed to proceed with on-going construction and environmental studies in the coming year or two, and moving forward with the camp expansion will help to ease capacity issues.
- Kugaaruk:
  - Concerns were raised by an Elder about the salt and water being diverted from Tail Lake into Roberts Bay and whether the water would impact fish or fish habitat. An explanation was

given that water would pass through a treatment/filtration system which would remove particulates (such as zinc and copper) from the salty water before being diffused into Roberts Bay.

- Taloyoak:
  - A meeting attendee wanted to know if the tailings and water in Tail Lake were dangerous. An explanation was made by HBML staff explaining that tailings are not dangerous but that they do contain metals and sediment. It is also likely that the water will have some salt content which is expected to be close to that of sea water.
  - A meeting attendee wanted to know if a fence would be erected around Tail Lake to keep wildlife out. No fence is currently planned; however, the lake will be ringed by a road so the pond can be patrolled.
  - An Elder wanted to know if the Water Board did routine inspections. It was explained that the Water Board does not have inspectors but inspections are conducted by Aboriginal Affairs and Northern Development Canada (previously INAC) EC, DFO and the KIA. The Water Board presents all inspection results in their annual reports and all water monitoring and testing records are filed with NIRB and are available through their website or at their regional offices.
  - An Elder asked if fish in the area were regularly inspected and tested. Fisheries work is conducted each year as well as sampling and testing of small aquatic organisms.

Other general comments and questions discussed at the meetings pertained to employment opportunities, training, mine production timelines, Inuit benefits, environmental testing, and potential effects on human health and social issues. This feedback will be incorporated into future discussions and considered during on-going project planning.

Previous consultation efforts were carried out in August 2010 when HBML conducted a community tour, in which the proposed amendments included in the Type A Water License Amendment Package No. 2 were presented and discussed with meeting attendees. Environmental baseline studies conducted in the Doris North area and southern belt were also presented and discussed. Communities visited during the August 2010 meetings included Cambridge Bay, Gjoa Haven, Kugaaruk, Kugluktuk, and Taloyoak, with the overall attendance totalling approximately 121 attendees and the largest attendance being in Gjoa Haven. Community Elders were in attendance at Gjoa Haven, Taloyaok, and Kugaaruk. A detailed summary of the topics discussed during the 2010 meetings can be found in the Amendment Package No. 2 application.

In addition to community tours, a community newsletter, the *Hope Bay Belt Quarterly Newsletter,* was published and distributed in October 2010. The newsletter presented information pertaining to the 2010 sealift, summer field work, and employment information. It is hoped that this quarterly publication, once its production resumes, will reach a larger audience, including those who may not be able to attend the community meetings or site visits.

4. Existing Baseline Conditions in Roberts Bay

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4. Existing Baseline Conditions in Roberts Bay

4.1 REGIONAL SETTING

The Doris North Gold Mine Project (the Project) is located approximately 125 km southwest of Cambridge Bay, Nunavut, on the southern shore of Melville Sound. The proposed subsea pipeline and diffuser will be constructed in Roberts Bay, the marine receiving environment to the north of the Project area (Figure 4.1-1). Roberts Bay is an inlet in Melville Sound located at 68º 12' N, 106º 38' W.

Baseline information on the physical water column structure, dissolved oxygen levels, water quality, sediment quality, and biological communities (phytoplankton, zooplankton, benthic invertebrates, fish, seabirds, and marine mammals) have been collected in Roberts Bay since 1996. Some baseline data are also available for the adjacent embayments to the east (Reference Bay) and southwest (Hope Bay) of Roberts Bay. The following sections provide an overview of the baseline physical, chemical, and biological conditions within Roberts Bay, as well as a socio-economic overview of the region. The data presented in the following sections are mainly from 2009 and/or 2010 because intensive marine baseline sampling programs were conducted during these years.

Roberts Bay is typically ice covered from October to June, most of that time with land-fast ice. Roberts Bay is a wide embayment that is exposed to strong winds, which drive circulation in summer. In winter, the waters of the bay are isolated from wind stress by the land-fast ice cover. Water exchange between Roberts Bay and Melville Sound occurs primarily during the summer months when winds drive the upper freshwater layer towards the shoreline of Roberts Bay, and deeper waters move into Melville Sound.

Freshwater enters Roberts Bay from Little Roberts Outflow, Glenn Outflow, and smaller tributaries (Figure 4.1-2). The total volume of Roberts Bay is approximately 512,000,000 m^3, with a maximum depth of 88 m at the mouth between Roberts Bay and Melville Sound (see Figure 4.2-7).

Roberts Bay and the surrounding embayments are generally well oxygenated, low in metals and nutrients, and have very low phytoplankton biomass levels. The marine fish community of Roberts Bay is representative of an Arctic marine ecosystem, and 14 species have been found in Roberts Bay to date.

4.2 PHYSICAL ENVIRONMENT

4.2.1 Proximity to Designated Environmental Areas

Roberts Bay is located along the coastline of Melville Sound, in the West Kitikmeot region of Nunavut.

The Nunavut Planning Commission (NPC) is currently developing a land use plan for all of Nunavut, including the West Kitikmeot region. A publicly available draft of this plan is expected to be available in the fall of 2011. Melville Sound and Northern Bathurst Inlet are not currently designated environmental areas; however, they are being considered for inclusion in the land use plan as "important wildlife areas." Environment Canada has indicated that these areas are important habitat for Pacific common eiders and Thayer's gulls, and also provide habitat to grizzly bears and wolverine (species proposed as "special concern" under the Species At Risk Act (SARA)).

There are currently no designated marine environmental areas around Roberts Bay. The closest area, by water, would be the proposed Huikitak River Cultural Area which is located in the southern part of Bathurst Inlet (Figure 4.2-1). The Queen Maud Gulf Bird Sanctuary encompasses a marine area along the shoreline

and extending off land up to ~50 km distance. However, Roberts Bay is over 300 km away from this area by water, as Melville Sound is isolated from the Queen Maud Gulf by the Kent Peninsula (Figure 4.2-1).

4.2.2 Tidal Processes

In order to measure the local tides in Roberts Bay, a tide gauge has been installed and operated along the southern shore of Roberts Bay since 2009.

Results from the tide gauge have shown that there are the two main tidal cycles in Roberts Bay: 1) the fortnightly spring-neap cycle and 2) the daily diurnal high-low tidal cycle.

Overall, the tides in Roberts Bay are small and are generally diurnal with one daily high tide and low tide. There are only small differences between the daily tidal ranges of the spring and neap cycles as the spring tidal (new and full moon period) range can exceed 0.4 m while neap tidal ranges (1st and 3rd quarter moons) are typically between 0.2 and 0.3 m. Tidal ranges at regional stations monitored by the Canadian Hydrographic Service (Cambridge Bay, Omingmaktok, Kugluktuk) are similar to those measured in Roberts Bay.

Figure 4.2-2 shows the time series of measured water levels in Roberts Bay for 2010. A tidal eliminator filter has been applied to the measured levels to yield the residual, non-tidal signal, which represents water level fluctuations occurring in response to wind stress or other meteorological factors. Water levels responding to meteorological forcing, probably direct wind stress, account for changes in water level up to 0.5 m in this record. This data shows that water levels in Roberts Bay can be influenced more by winds than by tides.

Because of the weak tides in Roberts Bay, tidal currents will also be weak. For a 0.2 m change in water level during a flood tide, approximately 2,000,000 m^3 of water will enter Roberts Bay. The vertical section area of the bay entrance is approximately 75,000 m^2 (50 m deep $\times$ 1,500 m wide). Thus, a horizontal displacement at the entrance of approximately 27 m over the 12 hour period of flood would occur resulting in average currents of approximately 0.06 cm/s.

Under-ice current measurements made in early 2011 showed generally weaker tidal currents than the steady currents associated with down-slope density flows originating from brine rejection by growing sea ice.

4.2.3 Basin Circulation

The overall circulation of water in Roberts Bay will depend on the season (ice-covered vs. ice-free), as well as other factors, such as freshwater runoff and winds.

Winds and freshwater runoff volume can vary on an annual basis. The dates of freeze-up and break-up can also vary year by year so that the period over which wind stress can affect the waters of Roberts Bay varies. Therefore, annual variability in water column structure, circulation, and flushing are expected.

4.2.3.1 Summer

Figure 4.2-3 presents a diagram of the general circulation of water in Roberts Bay during the summer (ice-free) months. During the summer, water circulation is dominated by wind-driven flows, rather than freshwater discharge. The strong, generally northerly winds drive the surface layer southward into Roberts Bay, which results in a return, outward, northerly flow below at depth. Thus, Roberts Bay circulation, in general, is contrary to that in most estuaries: the mean flow is inward near the surface and outward at depth.

PROJECT #1009-007-02 GIS # HB-15-055 May 25 2011

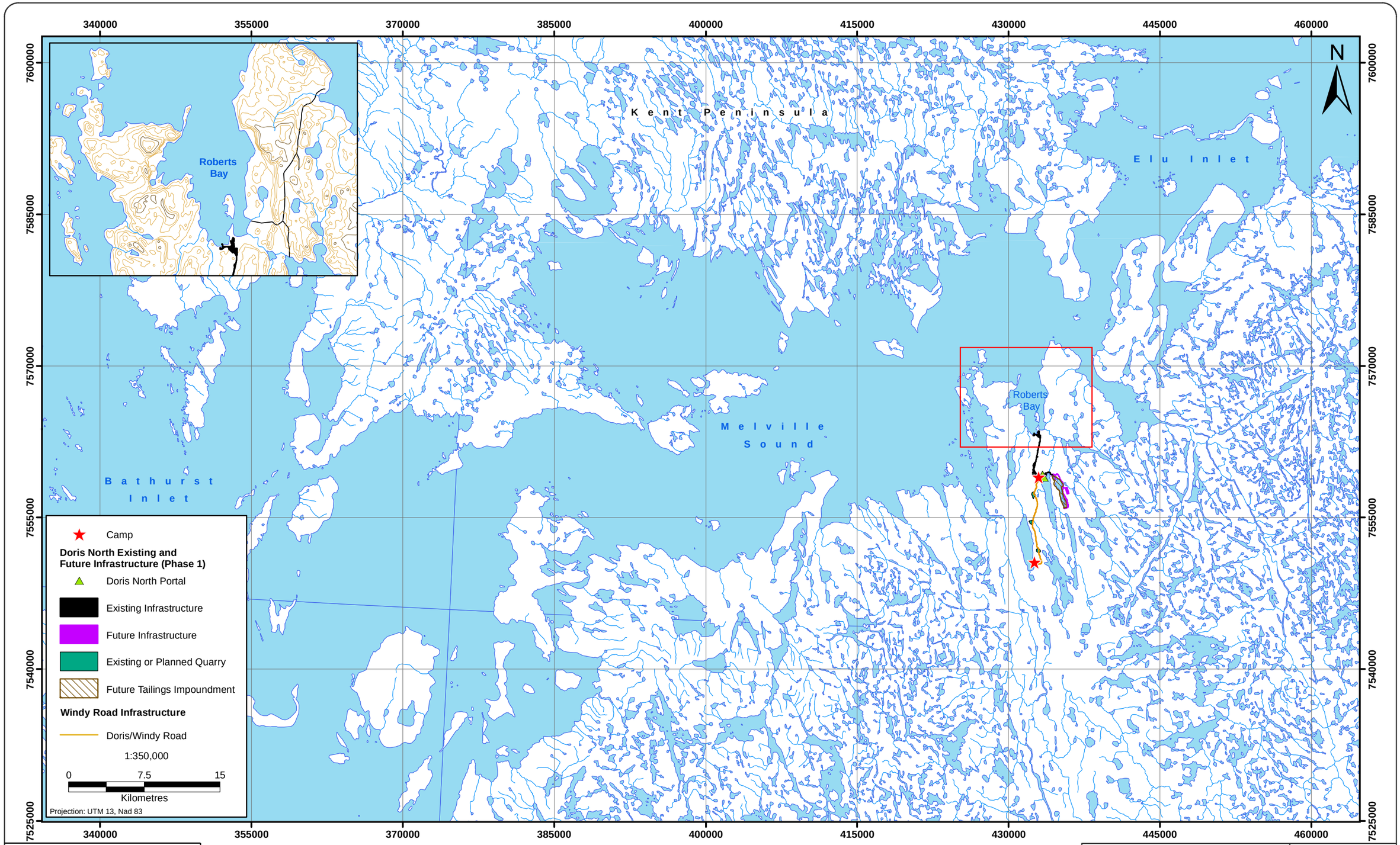

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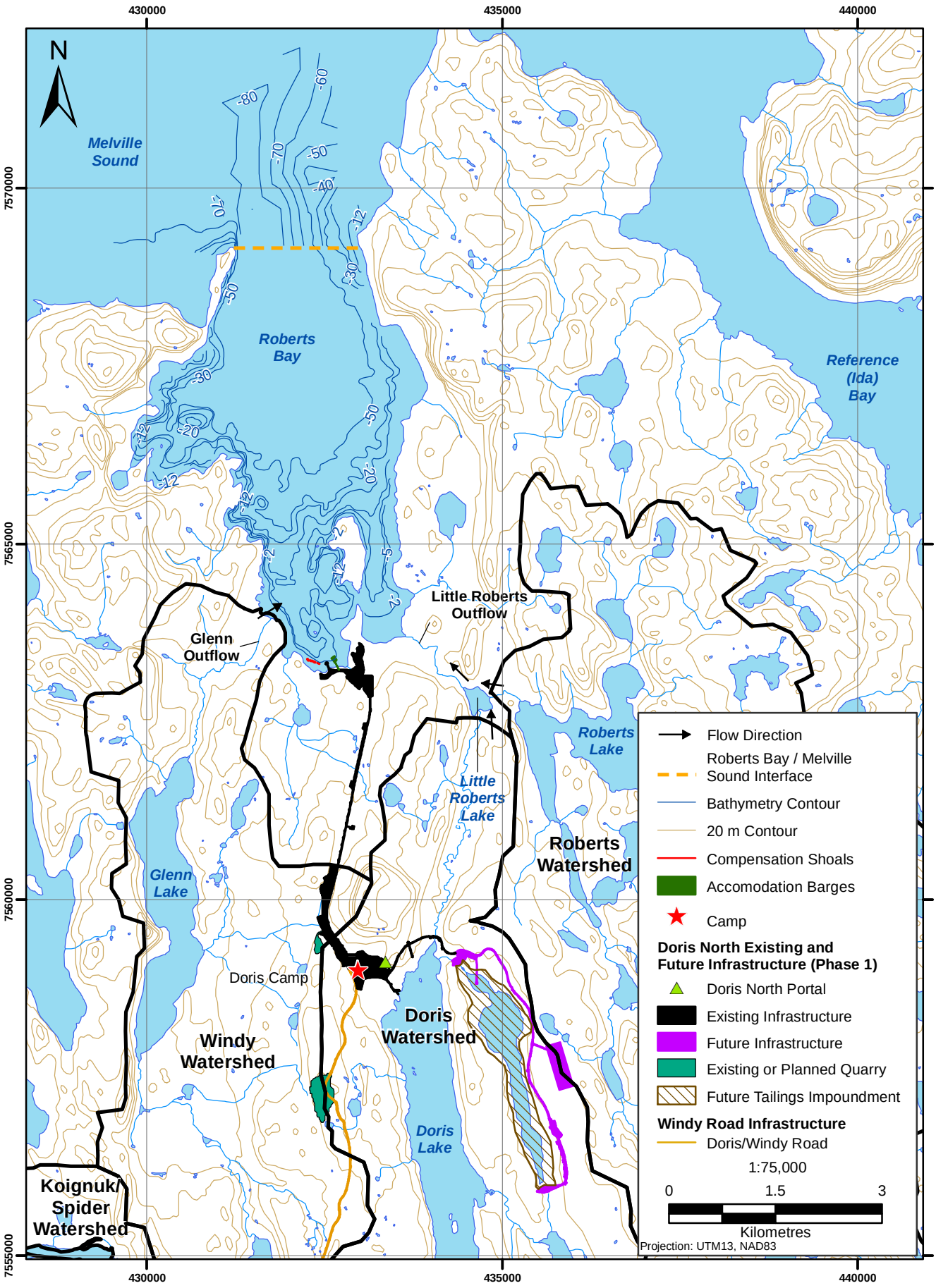
Figure 4.1-1

Roberts Bay and Regional Marine Setting



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Roberts Bay and Surrounding Freshwater Catchments

Figure 4.1-2

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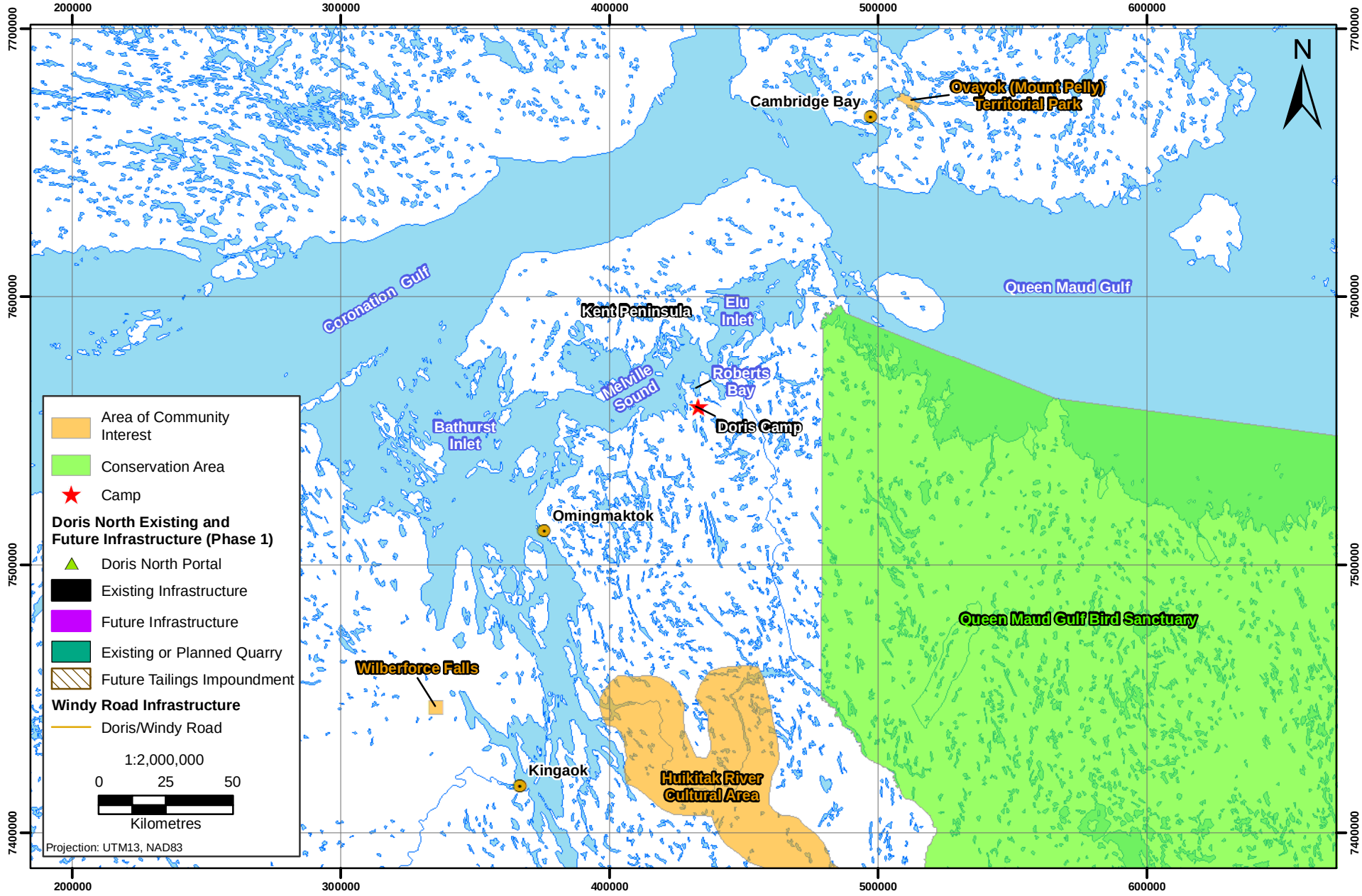

Figure 4.2-1

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Proximity of Roberts Bay to Designated Environmental Areas

Figure 4.2-1

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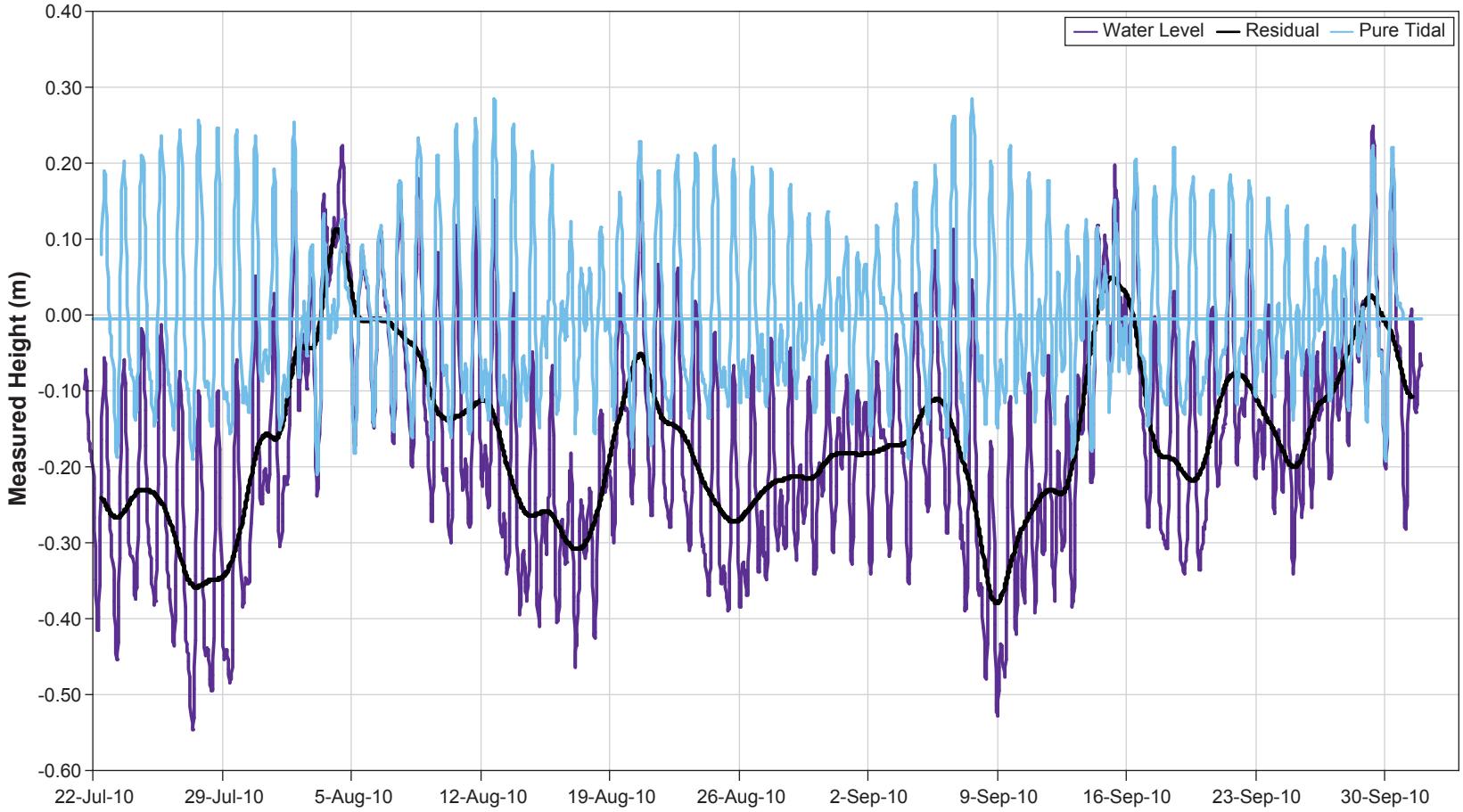

Figure 4.2-2

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Water Level Measurements in Roberts Bay Showing Tidal and Non-tidal Oscillations

Figure 4.2-2

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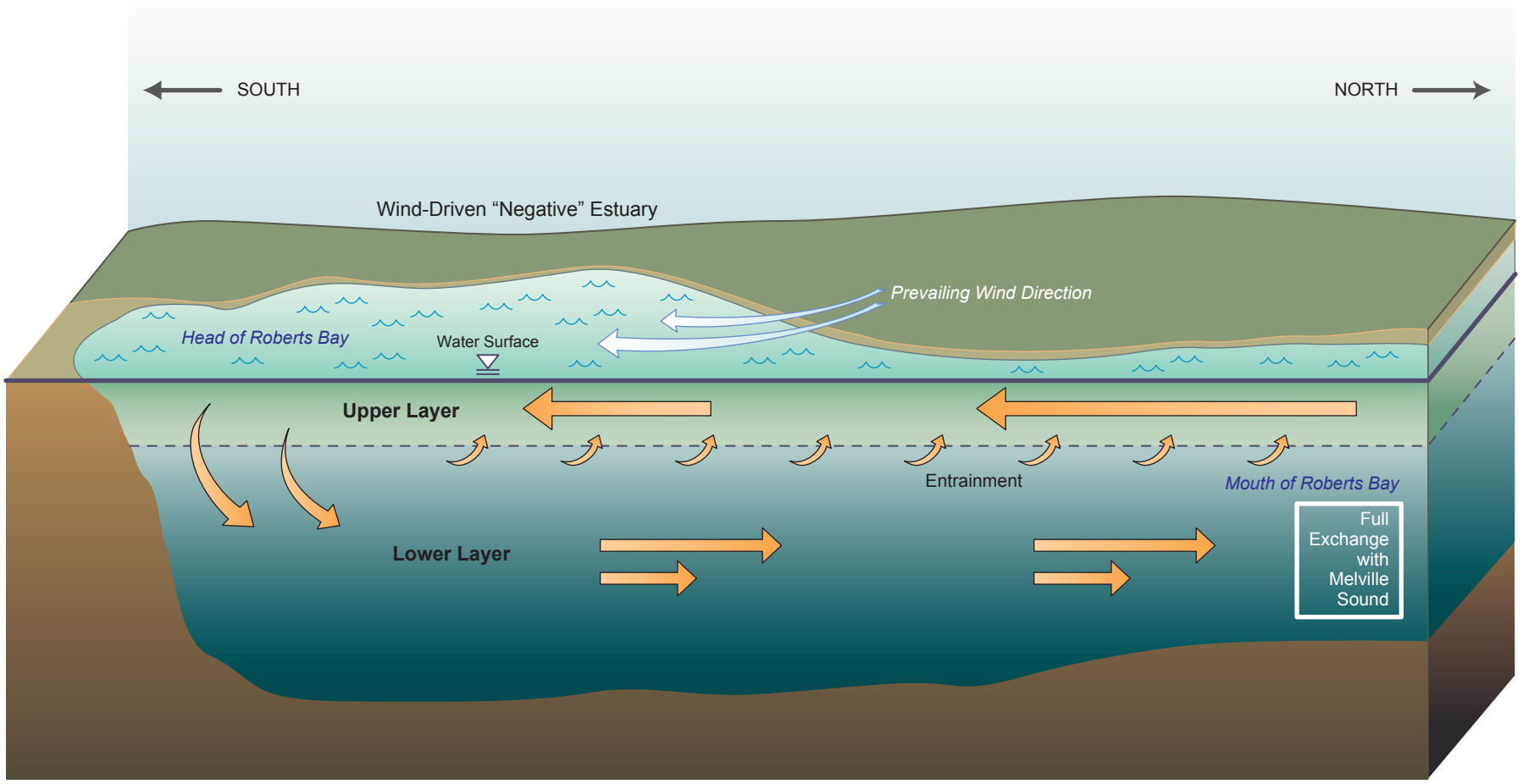

Figure 4.2-3

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Example of Roberts Bay Circulation during the Summer

Figure 4.2-3

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Site-specific wind data was used to model the summer circulation of Roberts Bay water. The bathymetry data and wind data used in the summer circulation three dimensional modelling are provided in Appendix 4.2-1. Figures 4.2-4 and 4.2-5 show the resulting numerically simulated current fields. The numerical simulation shows that all of the deeper waters of Roberts Bay were exchanged with those of Melville Sound over one year. That is, the bay flushed fully over the model year.

4.2.3.2 Winter

Figure 4.2-6 presents a diagram of the general circulation of water in Roberts Bay during the winter (ice-covered) months. During the winter, sea ice starts to form in October. Growing sea ice extrudes brine, which is denser than under-ice seawater and tends to sink. If exchange between Roberts Bay and Melville Sound has been relatively weak in the ice-free summer season, the surface layer will be relatively fresh. If the surface salinity at the onset of freeze-up in October is less than about 25 ppt, then water under the ice decreases in density when cooling (similar to the situation in a freshwater lake). Thermal convection under this condition is absent until the surface layer salinity is increased above 25 ppt by brine rejection. If the surface salinity is higher, as it was in 2010, approaching 27 ppt, then cooling under ice water will result in thermal convection and the development of a deeper under-ice mixed layer. In both cases, brine rejection from growing sea ice will tend to drive convection. Therefore, winter conditions under the ice vary from year to year.

Tidal flows are weak and likely have little effect on exchange between Roberts Bay and Melville Sound. However the convectively driven flow and the weak tidal flows would combine to gently stir Roberts Bay during the winter ice-covered season, tending to laterally homogenize the density-stratified bay.

4.2.4 Roberts Bay Bathymetry

Roberts Bay is included on a Canadian Hydrographic Service map (chart 7790) that shows the bathymetry along the southern coast of Melville Sound. However, soundings are sparse at the mouth of Roberts Bay where the depth is indicated as greater than 50 m and where a single sounding of 83 m is shown in the centre.

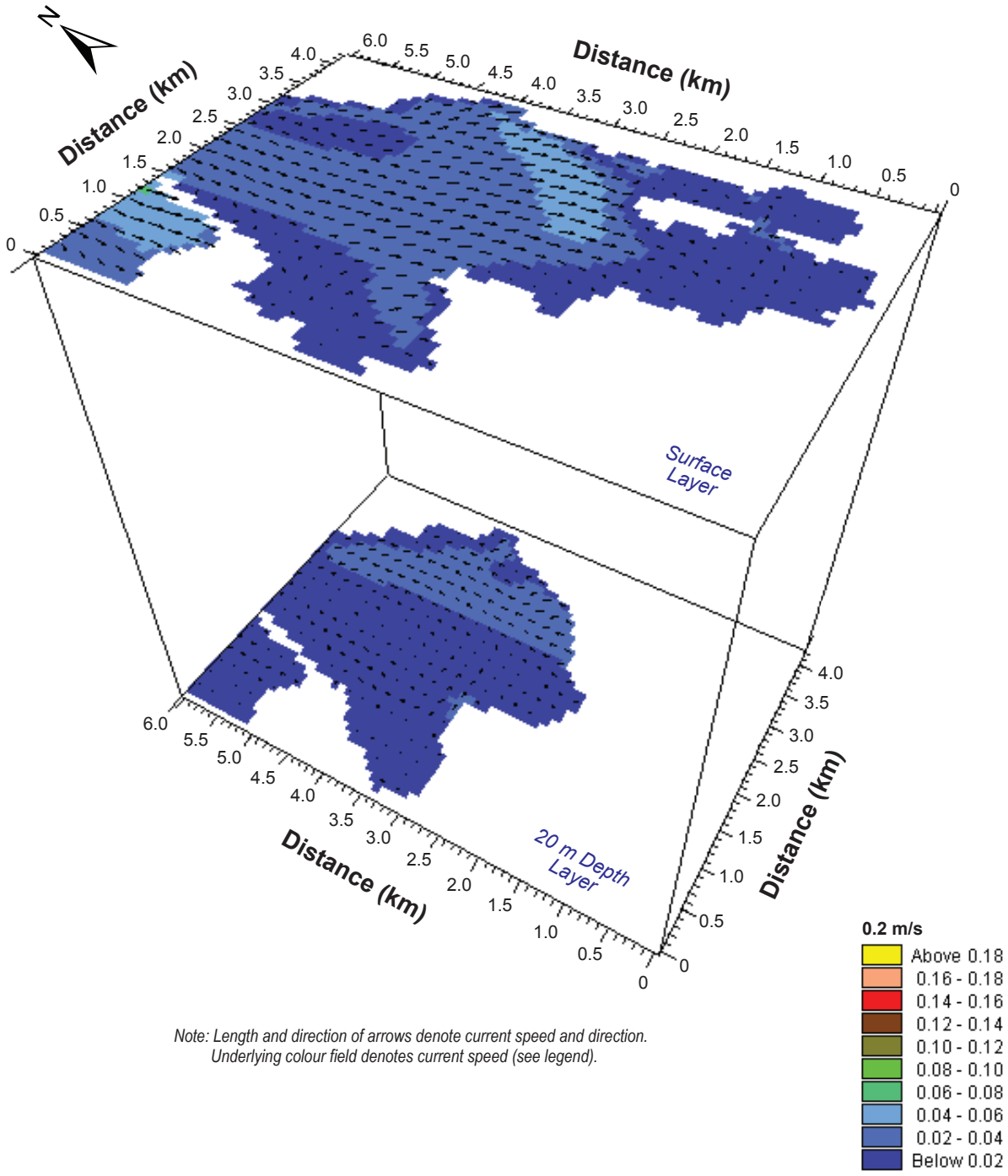
The presence or absence of a sill in a bay is important, as the presence of a sill can result in deep water remaining within a bay.

In order to determine if a sill was present at the mouth of Roberts Bay, a bathymetric field survey was conducted in April of 2011. Results of the field survey indicated that no sill is present at the mouth of Roberts Bay, and that there is a channel approximately 80 m in depth that connects Roberts Bay to Melville Sound (Figure 4.2-7).

Numerous bathymetric surveys have been conducted in the nearshore areas of Roberts Bay over the years as part of baseline monitoring and fish habitat compensation monitoring (around the jetty and the compensation shoals). All site-specific bathymetric information is included in Figure 4.2-7.

4.2.5 Water Column Structure and Dissolved Oxygen

Water column structure and dissolved oxygen concentrations have been measured in Roberts Bay during the winters and summers of 2009, 2010, and 2011. Figure 4.2-8 shows the sampling locations along a north-south transect where these measurements have been collected. Raw physical data collected in April (under-ice) and August from 2009 to 2011 at the sites shown in Figure 4.2-8 are provided in Appendix 4.2-2. Because of inter-annual variability in wind strength, climate, and freshwater inputs, some natural variability in the water column structure of Roberts Bay is to be expected.



Note: Length and direction of arrows denote current speed and direction. Underlying colour field denotes current speed (see legend).

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August Mean Currents at the Surface and 20 m Depth in Roberts Bay

Figure 4.2-4

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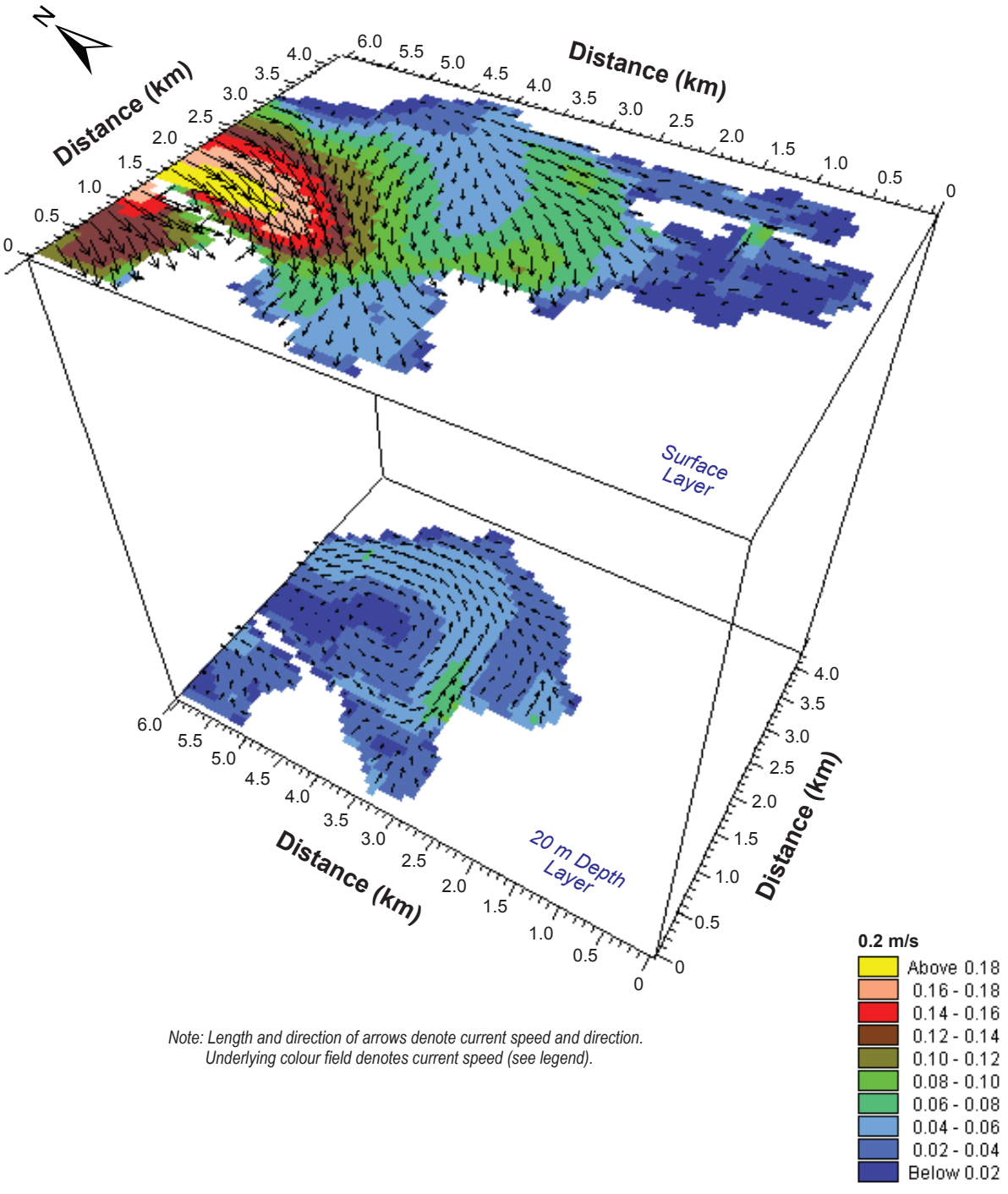

Note: Length and direction of arrows denote current speed and direction. Underlying colour field denotes current speed (see legend).

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September Mean Currents at the Surface and 20 m Depth in Roberts Bay

Figure 4.2-5

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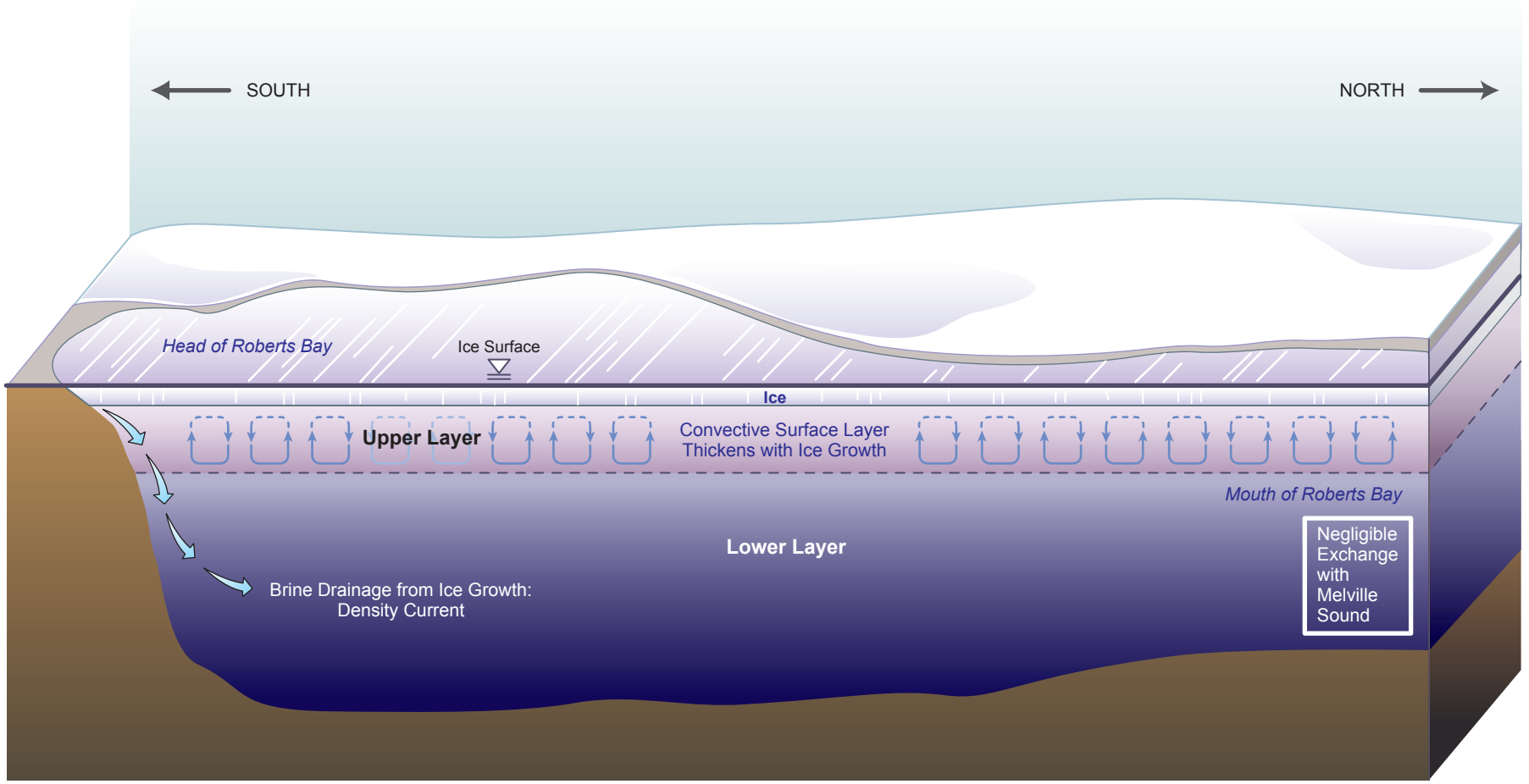

Figure 4.2-6

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Example of Roberts Bay Circulation during the Winter

Figure 4.2-6

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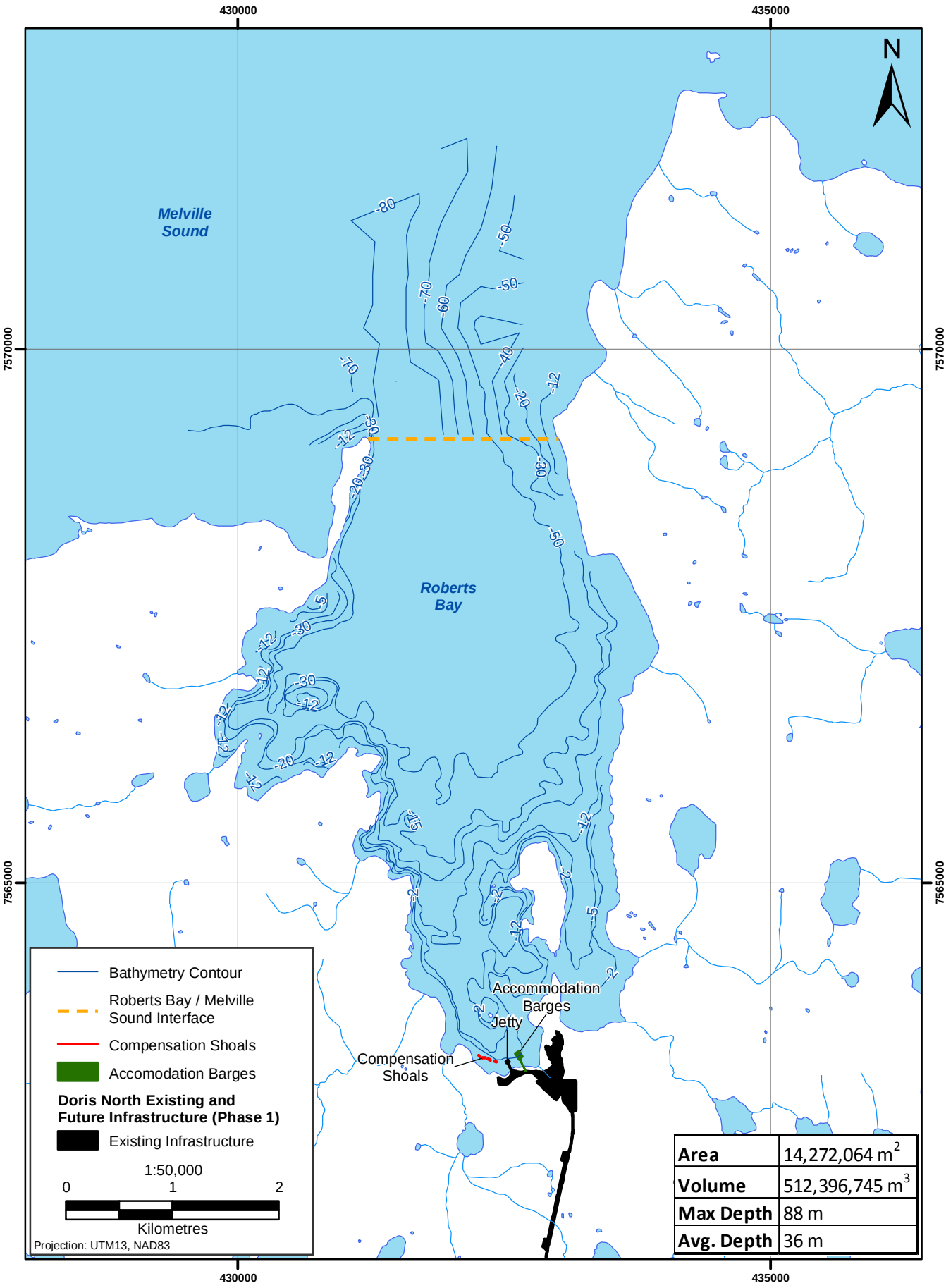

Figure 4.2-7

Roberts Bay Bathymetry

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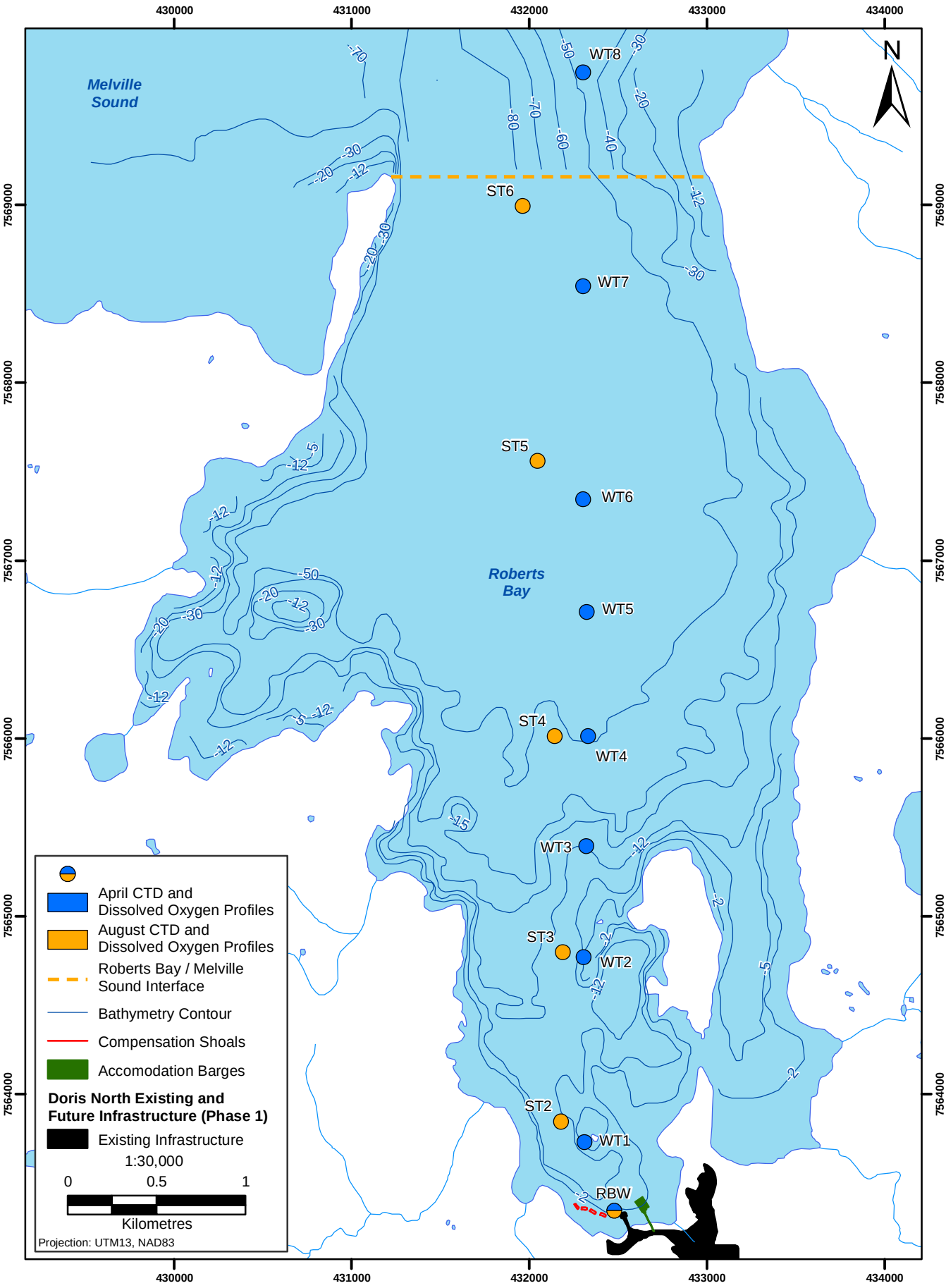

Roberts Bay CTD and Dissolved Oxygen Profile Stations, 2009-2011

Figure 4.2-8

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Figure 4.2-9 shows the water column temperature and salinity over a cross-section of Roberts Bay in April 2010. The winter water column structure in Roberts Bay consists of two distinct layers. In April 2010, the upper mixed layer depth was approximately 10 m, surface temperature was approximately -1.5ºC, and salinity ranged from 23.9 ppt at the nearshore site WT2 to 26.5 ppt at the more seaward sites. At depth, water temperature and salinity approached -0.5ºC and 27.3 ppt. Similar to April 2010, the pycnocline depth in April 2009 was at approximately 10 m depth; however, in April 2011, the pycnocline was considerably deeper at 30 m.

Figure 4.2-10 shows a cross-section of the temperature and salinity in Roberts during August 2010. The water column in Roberts Bay in the summer of 2010 was strongly stratified, with a pycnocline at approximately 10 m. Surface temperature ranged from 10 to 13ºC and salinity ranged from 20 to 24 ppt. At 60 m depth, temperature and salinity approached -0.7ºC and 27.4 ppt. In August 2009, the depth of the pycnocline and the deep water conditions were similar to 2010; however, the upper layer was less well-mixed and less saline in August 2009 than in August 2010.

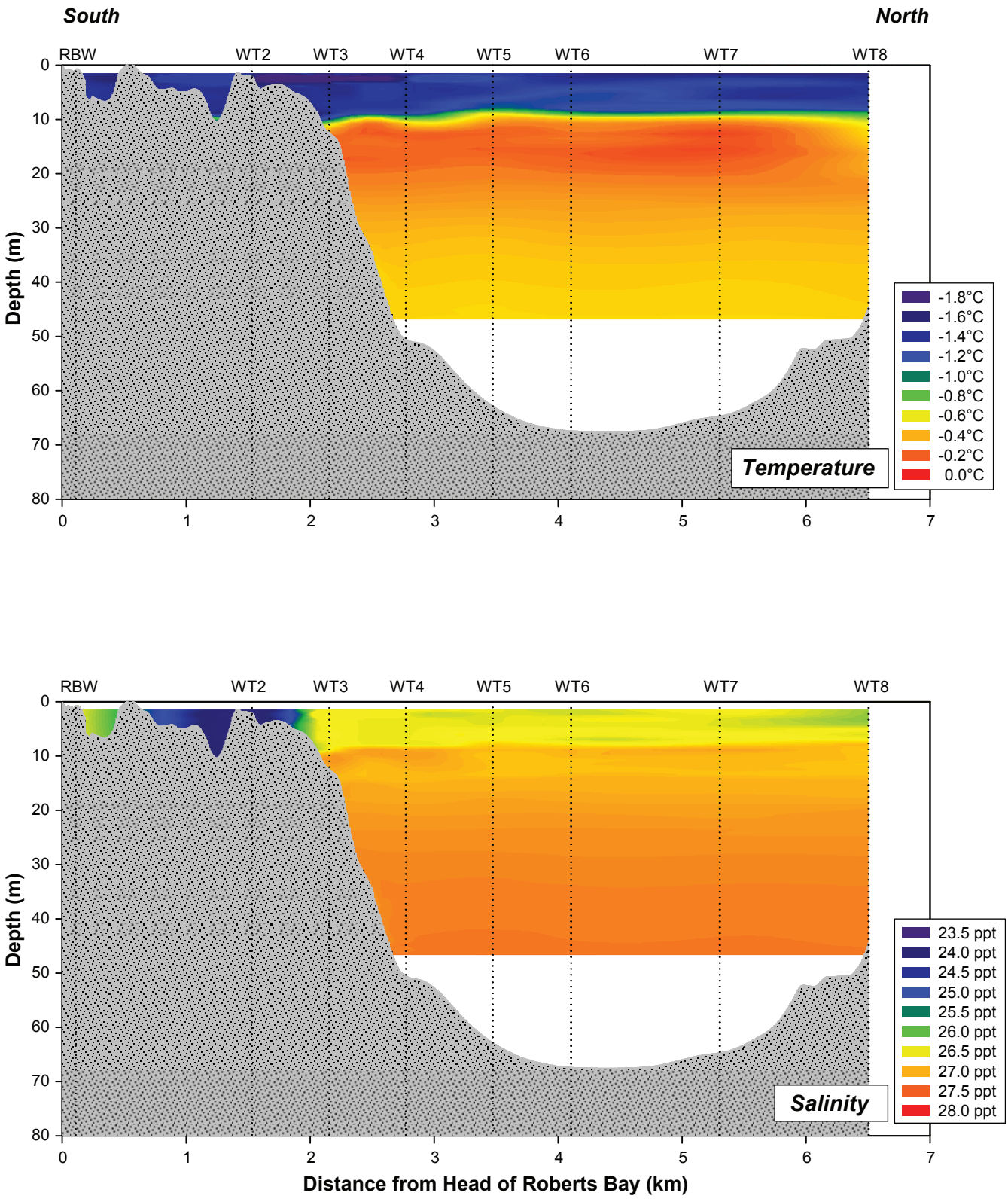
Figure 4.2-11 shows the April and August concentrations of dissolved oxygen at several sites in Roberts Bay from 2009 to 2011. In winter, dissolved oxygen concentrations generally decreased with depth, with the largest decline in dissolved oxygen occurring at the pycnocline. Deep water dissolved oxygen concentrations approached the Canadian Council of Ministers of the Environment (CCME) recommended minimum dissolved oxygen concentration for the protection of marine and estuarine aquatic life of 8.0 mg/L (CCME 2011b) in April 2009, and dropped below 8.0 mg/L in April 2010 (reaching a minimum of 7.0 mg/L). In April 2011, dissolved oxygen concentrations throughout the water column were higher than in either April 2009 or April 2010, and reached a minimum of 9.2 mg/L in the deepest waters profiled.

In the uppermost 30 m of the water column, August dissolved oxygen concentrations were highest near the pycnocline, and lowest at the surface. In 2009, August dissolved oxygen concentrations ranged between 10.2 and 11.0 mg/L at the surface, and increased to a maximum of 14.5 mg/L at 15 m depth. In 2010, August concentrations ranged from 9.1 mg/L at the surface to 12.6 mg/L at 16 m depth.

4.2.6 Marine Water Quality

Intensive water quality sampling programs were conducted in Roberts Bay in 2009 and 2010. Water quality samples were collected from 15 sites located throughout Roberts Bay from the shallow nearshore area at the head of the bay to the deeper area at the mouth of the bay near the entrance to Melville Sound (Figure 4.2-12). Samples were collected throughout the water column (both above and below the pycnocline) during both the ice-covered and open-water seasons. Under-ice samples were collected using an adapted 2.5 L “skinny” Niskin bottle, and open-water season samples were collected using an acid-washed 5 L GO-FLO sampling device. Water quality samples were analyzed by ALS Laboratory Group in Burnaby, BC.

Table 4.2-1 presents a summary of key water quality parameters in Roberts Bay. The complete dataset is provided in Appendix 4.2-3. The CCME water quality guidelines for the protection of marine aquatic life are also included in Table 4.2-1 and Appendix 4.2-3 (CCME 2011b). All water quality parameters in Roberts Bay were below CCME guidelines, with the exception of total mercury concentrations at some sites during the 2009 ice-covered season (which exceeded the interim CCME guideline for inorganic mercury of 0.000016 mg/L).



Note: Vertical exaggeration is 44:1

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Temperature and Salinity Contours in Roberts Bay, Doris North Project, April 2010

Figure 4.2-9

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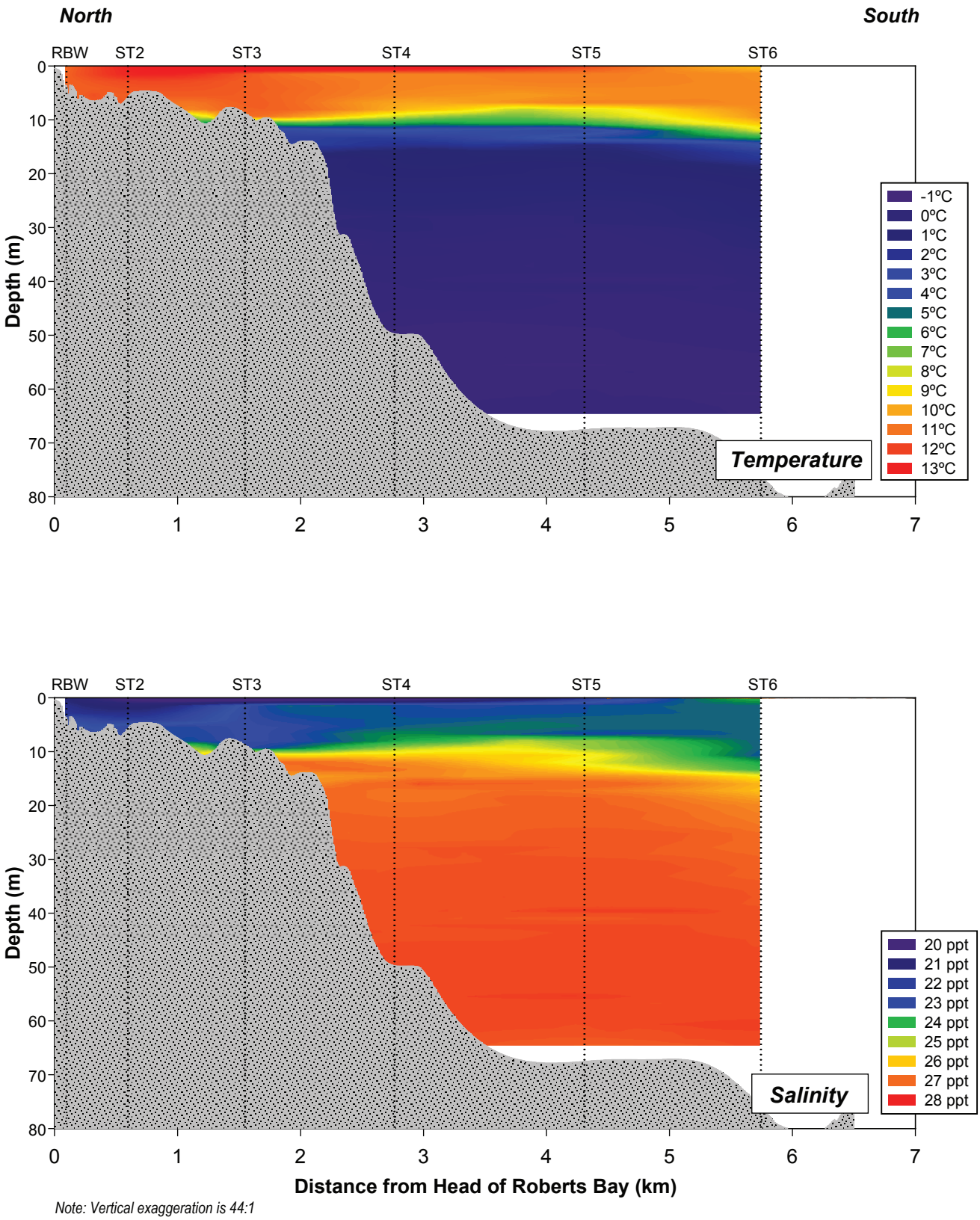

Note: Vertical exaggeration is 44:1

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Temperature and Salinity Contours in Roberts Bay, Doris North Project, August 2010

Figure 4.2-10

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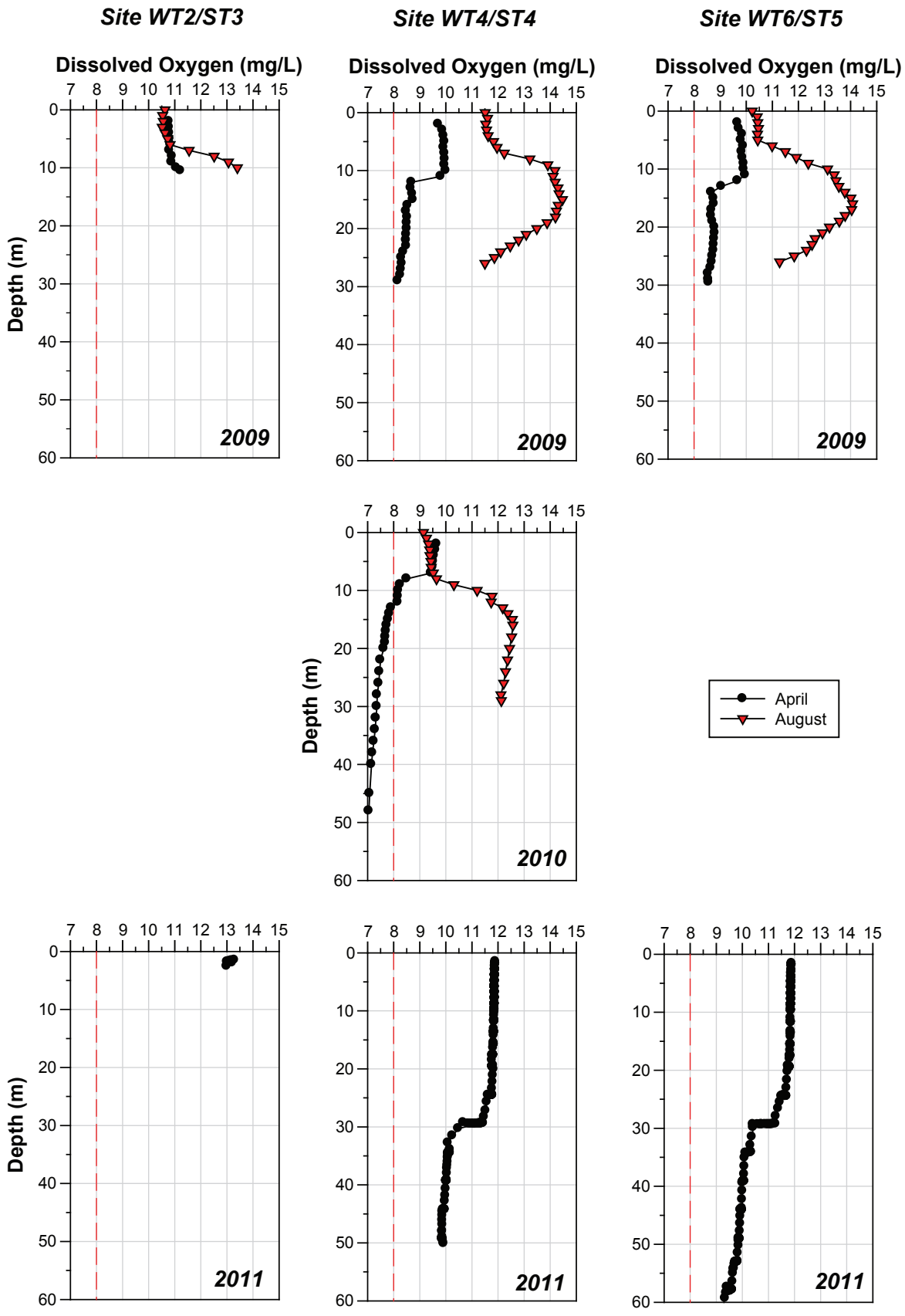

Note: Dashed lines represent CCME water quality guideline for dissolved oxygen in marine and estuarine waters (8.0 mg/L).

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Dissolved Oxygen Concentration Profiles in Roberts Bay, Doris North Project, 2009-2011

Figure 4.2-11

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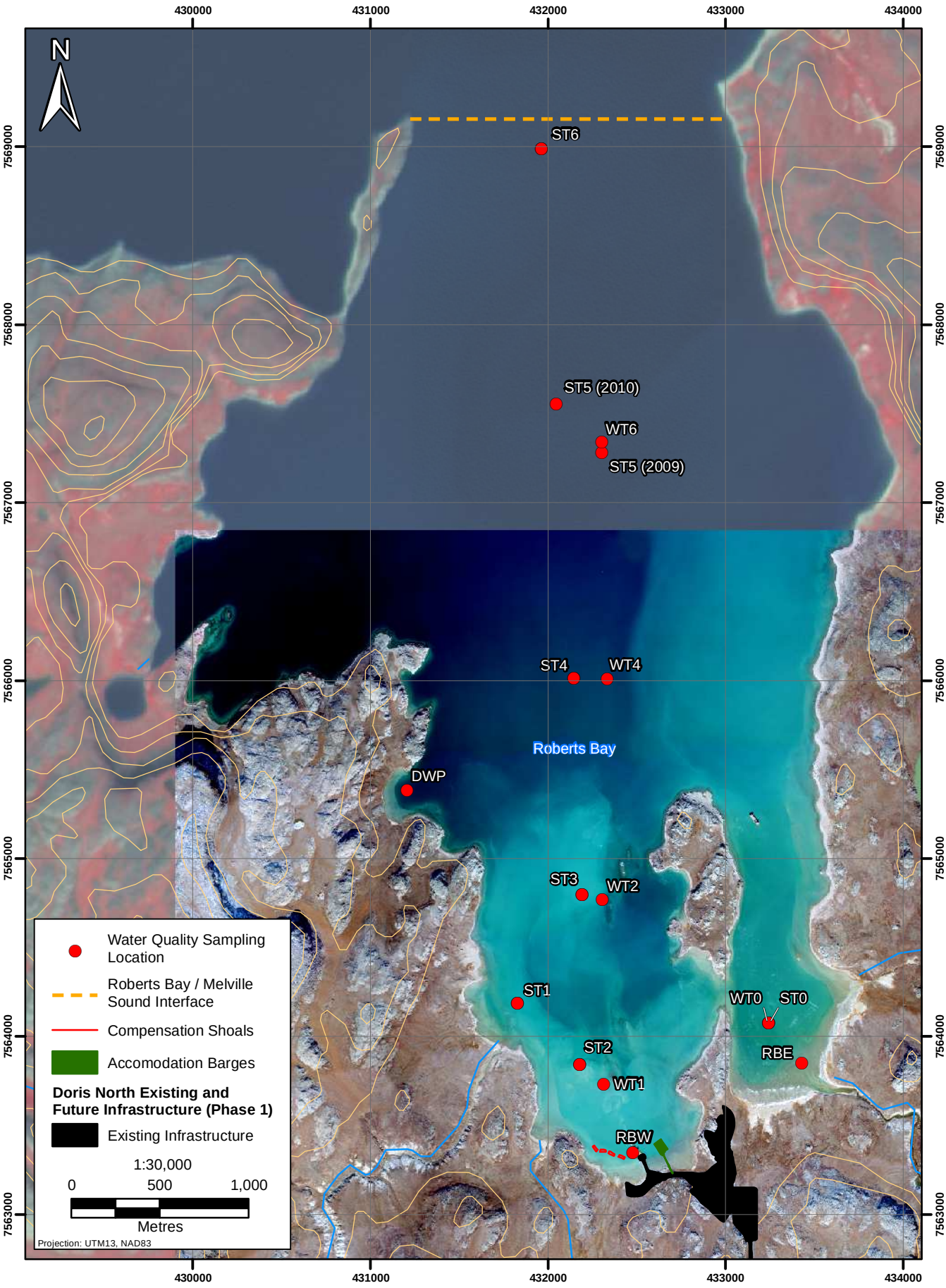

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Roberts Bay Water Quality Sampling Locations, 2009-2010

Figure 4.2-12

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Table 4.2-1. Roberts Bay Water Quality, 2009-2010

Parameter	CCME Guideline for the Protection of Marine Aquatic Life[a]	Concentration (mg/L, unless otherwise noted)		
		Min	Median	Max
Physical Tests				
Temperature (ºC)[b]	narrative[c,d]	-1.7	-0.7	12.9
Salinity (ppt)[b]	narrative[e,d]	15.4	26.9	27.6
Hardness (as $CaCO_3$)		727	4,990	5,410
pH (pH units)	7.0–8.7	7.46	7.80	7.90
Total Suspended Solids	dependent on background levels[f]	<3.0	7.0	25
Turbidity (NTU)	dependent on background levels[f]	0.13	0.30	15.7
Anions and Nutrients				
Alkalinity, Total (as $CaCO_3$)		35.8	105	120
Ammonia as N		<0.0050	<0.0050	0.155
Bromide (Br)		5.0	39.9	63.9
Chloride (Cl)		2,280	13,650	16,500
Fluoride (F)		<0.40	<1.0	0.97
Nitrate (as N)	3.612[b]	<0.0060	<0.0060	0.0919
Nitrite (as N)		<0.0020	<0.0020	0.0034
Ortho Phosphate (as P)		0.0150	0.0255	0.0462
Total Phosphorus		0.0151	0.0308	0.0545
Silicate (as SiO_2)		0.519	0.836	2.11
Sulphate (SO_4)		295	1,900	2,250
Organic / Inorganic Carbon				
Total Organic Carbon		0.68	1.14	4.98
Total Metals				
Aluminum (Al)		<0.0050	0.0051	0.562
Arsenic (As)	0.0125[b]	0.00050	<0.0020	0.00137
Boron (B)		0.56	3.35	4.11
Cadmium (Cd)	0.00012	0.000020	0.000067	0.000068
Calcium (Ca)		49.8	301	353
Chromium (Cr)	Cr(VI): 0.0015; Cr(III): 0.056[b]	<0.0010	<0.0010	0.0012
Cobalt (Co)		<0.000050	0.000066	0.000070
Copper (Cu)		0.00028	<0.0010	0.00474
Iron (Fe)		<0.005	<0.050	0.649
Lead (Pb)		<0.000050	0.00014	0.00015
Magnesium (Mg)		146	921	1,090
Manganese (Mn)		0.00087	0.00144	0.0166
Mercury (Hg)	Inorganic Hg: 0.000016[b]	<0.00001	<0.00001	0.000096
Molybdenum (Mo)		<0.0020	0.0078	0.0115
Nickel (Ni)		0.00031	0.00042	0.00129
Phosphorus (P)		<1.0	<1.0	<3.0

(continued)

Table 4.2-1. Roberts Bay Water Quality, 2009-2010 (completed)

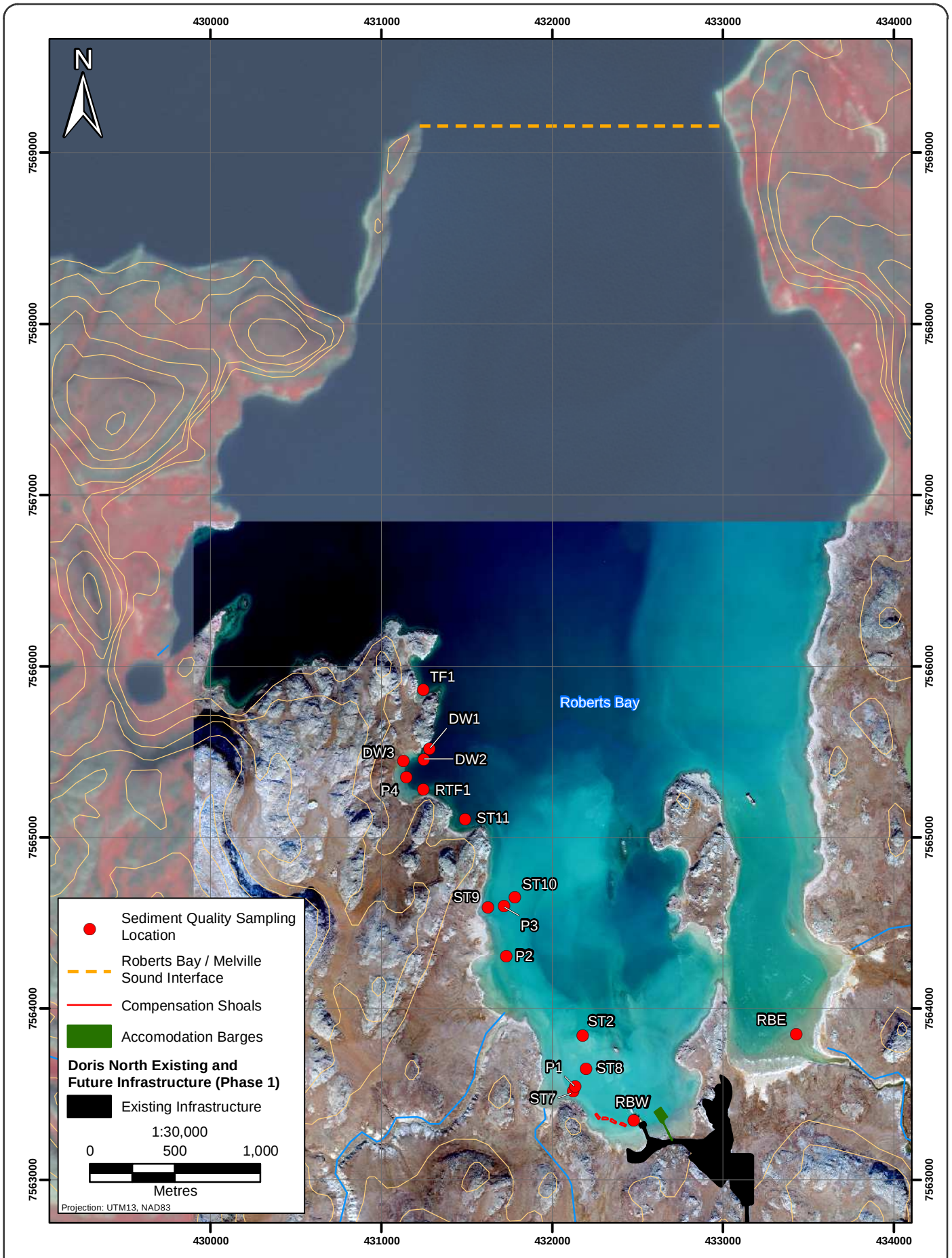
Parameter	CCME Guideline for the Protection of Marine Aquatic Life[a]	Concentration (mg/L, unless otherwise noted)		
		Min	Median	Max
Total Metals *(continued)*				
Potassium (K)		45.9	278	355
Selenium (Se)		<0.00040	0.00078	0.00078
Silver (Ag)		<0.00020	<0.00020	<0.0010
Sodium (Na)		1,180	7,735	9,350
Tin (Sn)		<0.001	<0.001	<0.010
Uranium (U)		<0.00050	0.00198	0.00263
Zinc (Zn)		<0.00050	0.0016	0.0110

Notes:
Units are mg/L unless otherwise indicated.
Half the detection limit was substituted for values below the detection limit for the calculation of the median.
Maximum values represent maximum detectable values. If no concentrations were detectable, the maximum detection limit is reported.
a) Canadian water quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.
b) Used all available CTD data collected between 2009 and 2011 from sites shown in Figure 4.2-11 for calculation of summary statistics for salinity and temperature.
c) Human activities should not cause change in ambient temperature of more than ± 1ºC, nor alter the natural temperature cycle characteristics, nor cause a rate of change of more than 0.5ºC per hour.
d) Interim guideline
e) Human activities should not cause the salinity to fluctuate by more than 10% of the natural level expected for that time and depth.
f) For clear-flow waters with background TSS levels less than 25 mg/L and turbidity levels less than 8 NTU, CCME guideline is a maximum increase of 25 mg/L TSS or 8 NTU turbidity for any short-term exposure (e.g., 24-h period), or a maximum increase of 5 mg/L TSS or 2 NTU turbidity for any longer-term exposure (e.g., 24 h to 30 d). For high flow or turbid waters with background TSS levels of 25 to 250 mg/L and turbidity levels of 8 to 80 NTU, CCME guideline is a maximum increase of 25 mg/L TSS or 8 NTU at any time.

4.2.7 Marine Sediment Quality

Between 2009 and 2010, sediment quality samples were collected from 17 sampling locations near the southern and southwestern shores of Roberts Bay (Figure 4.2-13). Triplicate samples were collected at each site using a Ponar grab sampler, and sampling depths ranged from 2 to 13 m. Sediment quality samples were analyzed by ALS Laboratory Group in Burnaby, BC.

Table 4.2-2 presents a summary of key sediment quality parameters in Roberts Bay. The complete dataset is provided in Appendix 4.2-4. CCME sediment quality guidelines for the protection of marine aquatic life, including the interim marine sediment quality guidelines (ISQGs) and probable effects levels (PELs), are also provided in Table 4.2-2 and Appendix 4.2-3 (CCME 2011a). Roberts Bay sediments were composed mainly of sand, with some silt and clay. Concentrations of several parameters co-varied with the fine particle composition of the sediment. Sites with higher proportions of fine sediments (silts and clays) tended to contain the highest concentrations of organic carbon, nutrients, and metals. All sediment parameters were below CCME guidelines, with the exception of copper and chromium concentrations measured in some sediments along the southwestern shore of Roberts Bay in 2009 (which slightly exceeded the more conservative ISQGs but remained below the PELs for copper and chromium). Concentrations of polycyclic aromatic hydrocarbons were always below analytical detection limits and CCME guidelines.



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Roberts Bay Sediment Quality Sampling Locations, 2009-2010

Figure 4.2-13

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Table 4.2-2. Roberts Bay Sediment Quality, 2009-2010

Parameters	CCME Guidelines for the Protection of Aquatic Life[a]		Concentration (mg/kg dry wt, unless otherwise noted)		
	ISQG[b]	PEL[c]	Min	Median	Max
Physical Tests					
Moisture (%)			17.1	26.2	44.9
pH (pH units)			6.95	7.63	8.40
Particle Size					
Gravel (>2mm) (%)			<0.10	<1.0	10.0
Sand (2.0mm - 0.063mm) (%)			5.0	73.0	99.0
Silt (0.063mm - 4µm) (%)			<1.0	18.0	98.8
Clay (<4µm) (%)			0.45	4.8	46.0
Leachable Anions & Nutrients					
Total Nitrogen by LECO (%)			<0.020	0.042	0.141
Organic / Inorganic Carbon					
Total Organic Carbon (%)			<0.10	0.24	0.83
Plant Available Nutrients					
Available Ammonium (as N)			<0.80	2.9	42.5
Available Nitrate (as N)			<2.0	<2.0	<6.0
Nitrite (as N)			<0.40	<0.40	<1.2
Available Phosphate (as P)			2.5	16.1	41.9
Metals					
Aluminum (Al)			3,580	7,010	22,300
Arsenic (As)	7.24	41.6	0.59	2.49	4.67
Cadmium (Cd)	0.7	4.2	<0.10	<0.10	0.23
Calcium (Ca)			1710	3,030	7340
Chromium (Cr)	52.3	160	11.2	23.7	59.3
Cobalt (Co)			2.8	5.4	12.2
Copper (Cu)	18.7	108	4.7	11.7	28.5
Iron (Fe)			6,670	14,800	30,600
Lead (Pb)	30.2	112	<2.0	2.8	9.7
Magnesium (Mg)			2,660	5,880	16,900
Manganese (Mn)			72.8	127	348
Mercury (Hg)	0.13	0.70	<0.0050	<0.0050	0.0116
Molybdenum (Mo)			<0.20	0.66	2.54
Nickel (Ni)			6.6	12.1	28.9
Phosphorus (P)			253	465	736
Potassium (K)			480	1,770	7,320
Selenium (Se)			<0.50	<0.50	<0.50
Silver (Ag)			<0.10	<0.10	0.15
Sodium (Na)			970	3,080	9,980
Sulphur (S)			400	680	1570

(continued)

Table 4.2-2. Roberts Bay Sediment Quality, 2009-2010 (completed)

Parameters	CCME Guidelines for the Protection of Aquatic Life[a]		Concentration (mg/kg dry wt, unless otherwise noted)		
	ISQG[b]	PEL[c]	Min	Median	Max
Metals *(continued)*					
Tin (Sn)			<5.0	<5.0	<5.0
Uranium (U)			0.433	0.560	0.949
Zinc (Zn)	124	271	10.1	22.6	64.6
Hydrocarbons					
EPH10-19			<40	<200	<200
EPH19-32			<40	<200	91.5
LEPH			<40	<200	<200
HEPH			<40	<200	92.0
Polycyclic Aromatic Hydrocarbons					
Acenaphthene	0.00671	0.0889	<0.0050	<0.0050	<0.0050
Acenaphthylene	0.00587	0.128	<0.0050	<0.0050	<0.0050
Anthracene	0.0469	0.245	<0.0040	<0.0040	<0.0040
Benz(a)anthracene	0.0748	0.693	<0.010	<0.010	<0.010
Benzo(a)pyrene	0.0888	0.763	<0.010	<0.010	<0.010
Benzo(b)fluoranthene			<0.010	<0.010	<0.010
Benzo(g,h,i)perylene			<0.010	<0.010	<0.010
Benzo(k)fluoranthene			<0.010	<0.010	<0.010
Chrysene	0.108	0.846	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	0.00622	0.135	<0.0050	<0.0050	<0.0050
Fluoranthene	0.113	1.494	<0.010	<0.010	<0.010
Fluorene	0.0212	0.144	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene			<0.010	<0.010	<0.010
2-Methylnaphthalene	0.0202	0.201	<0.010	0.015	0.015
Naphthalene	0.0346	0.391	<0.010	<0.010	<0.010
Phenanthrene	0.0867	0.544	<0.010	<0.010	<0.010
Pyrene	0.153	1.398	<0.010	<0.010	<0.010
Total PAHs			<0.040	<0.040	<0.040

Notes:
Units are mg/kg unless otherwise indicated.
Half the detection limit was substituted for values below the detection limit for the calculation of the median.
Maximum values represent maximum detectable values. If no concentrations were detectable, the maximum detection limit is reported.
a) Canadian sediment quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011
b) ISQG = Interim Sediment Quality Guideline
c) PEL = Probable Effects Level

4.3 BIOLOGICAL ENVIRONMENT

4.3.1 Marine Aquatic Life

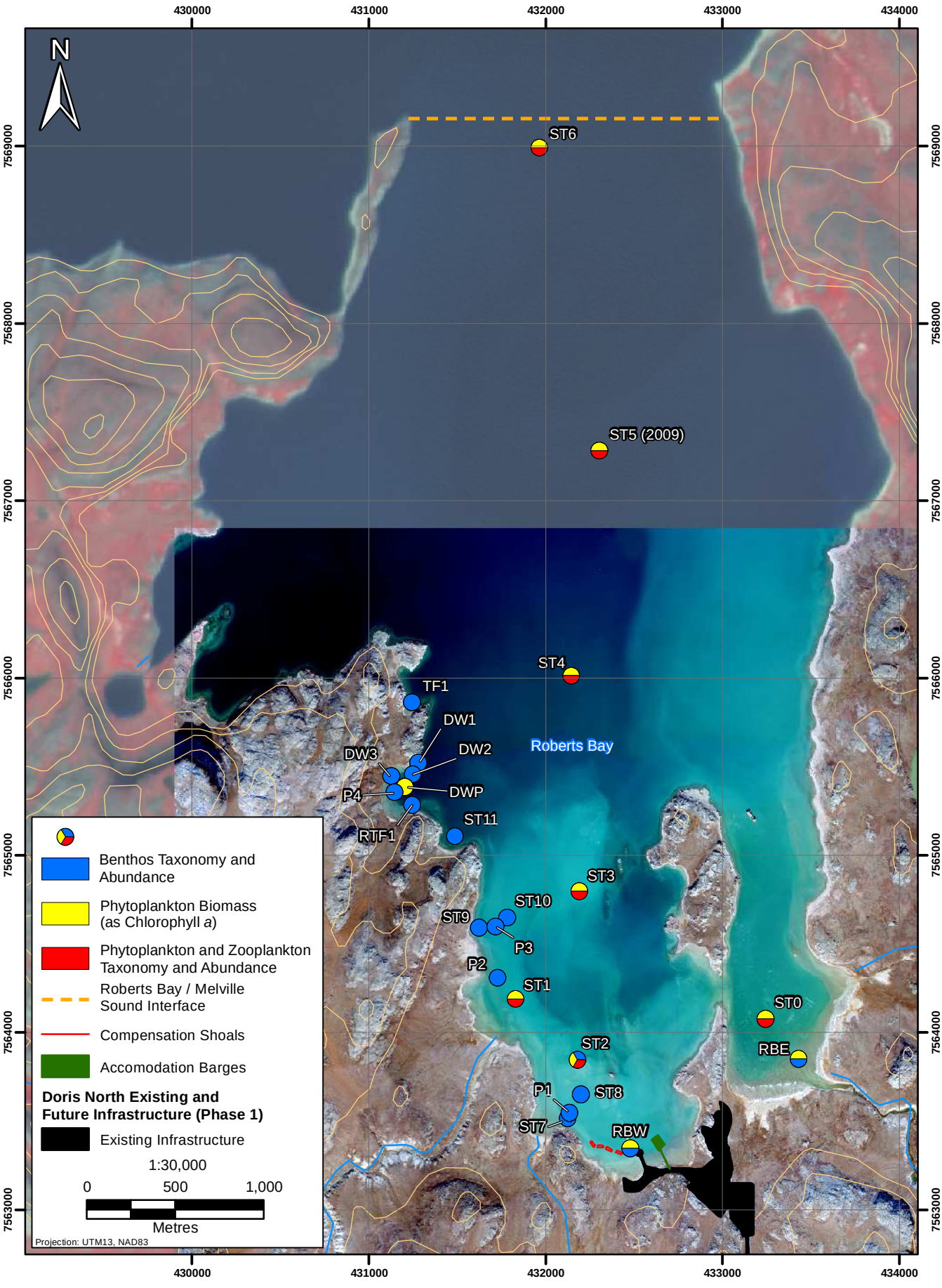
Phytoplankton, zooplankton, and benthic invertebrate communities were sampled in Roberts Bay between 2009 and 2010 at the sampling locations shown in Figure 4.3-1. Phytoplankton and zooplankton sampling covered the entire bay, while benthos sampling was conducted near the southern and southwestern shores of Roberts Bay. Table 4.3-1 presents a summary of the phytoplankton, zooplankton, and benthic invertebrate communities in Roberts Bay, and the complete datasets from 2009 and 2010 are provided in Appendices 4.3-1 to 4.3-5.

Table 4.3-1. Summary of Roberts Bay Marine Aquatic Life, 2009-2010

Parameter (units)	Min	Median	Max	Predominant Taxa
Phytoplankton				
Biomass (µg chl *a*/L)	<0.040	0.045	10.0	most abundant by carbon biomass: *Leptocylindrus danicus* (diatom) *Dinobryon balticum* (chrysophyte) *Ebria tripartita* (silicoflagellate) most abundant numerically: *Dinobryon balticum* (chrysophyte) unidentified small Cryptomonads *Leptocylindrus danicus* (diatom)
Biomass (µg C/L)	4.08	9.17	52.5	
Abundance (cells/L)	91,679	187,956	429,059	
Zooplankton				
Abundance (organisms/m^3)	6,527	12,624	17,734	most abundant numerically: *Acartia longiremis* (calanoid copepod) Pseudocalanidae (calanoid copepod) *Evadne nordmanni* (cladoceran)
Benthic Invertebrates				
Density (organisms/m^2)	79	9,434	66,667	most abundant numerically: Nematodes* Harpacticoid copepods *Nephtys sp.* (polychaete worm)

Notes:
Values represent compiled 2009 and 2010 dataset, except for zooplankton which was only sampled in 2009.
Predominant taxa are the three most abundant groups (in descending order) in the pooled total of all samples.
** Nematodes were excluded from total density estimates because nematodes belong to the meiobenthos size category and would be expected to pass through the sieve used to collect macrobenthos, precluding accurate estimates of density.*

Phytoplankton biomass (as chlorophyll *a*) was generally very low in Roberts Bay, with a median biomass of 0.045 µg chl *a*/L between 2009 and 2010. Biomass levels were unusually high at the shallow, nearshore site RBE in August 2010 (ranging from 5.3 to 10 µg chl *a*/L), which may be attributable to the resuspension of benthic primary producers. The median phytoplankton abundance in Roberts Bay was 187,956 cells/L, and the median phytoplankton biomass (as carbon) was 9.17 µg C/L. The diatom *Leptocylindrus danicus* and the chrysophyte *Dinobryon balticum* were abundant numerically, and were also major contributors to phytoplankton biomass (as carbon). The large silicoflagellate *Ebria tripartita* was an important contributor to phytoplankton biomass, but was not present in high numbers. Conversely, cryptomonads were very abundant, but these relatively small organisms contributed little to total phytoplankton biomass.



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Roberts Bay Marine Aquatic Life Sampling Locations, 2009-2010

Figure 4.3-1

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The median zooplankton abundance in Roberts Bay in 2009 was 12,624 organisms/m^3 (zooplankton was not sampled in 2010 in Roberts Bay). The calanoid copepod species *Acartia longiremis* and family Pseudocalanidae were the most abundant zooplankton taxa in Roberts Bay, followed by the cladoceran *Evadne nordmanni*.

Benthic invertebrate density in Roberts Bay was highly spatially variable, ranging from 79 to 66,667 organisms/m^2, with a median density of 9,434 organisms/m^2. Nematodes were the most numerous benthic organism observed in benthos samples; however, nematodes were excluded from total density estimates because nematodes cannot be accurately quantified (nematodes belong to the meiobenthos size category and would be expected to pass through the sieve used to collect macrobenthos). Aside from nematodes, harpacticoid copepods, the polychaete worm genus *Nephtys*, and the clam *Macoma balthica* were also very abundant.

4.3.2 Marine Fisheries

Marine fish information is available for Roberts Bay from 2002 to 2007 and 2009 to 2010. Comprehensive fish community surveys were conducted in 2009 and 2010 for marine fish and fish habitat in Roberts Bay, along with a reference bay to the east. A total of 18 species have been found in Roberts Bay, including anadromous populations of lake trout (Swanson et al. 2010). None of the fish species in Roberts Bay are currently considered threatened or endangered (COSEWIC 2010).

4.3.2.1 Marine Fish Community

From the 2009 and 2010 fish community work, 14 fish species have been captured in Roberts Bay (Table 4.3-2). The majority of the 14 fish species found in Roberts Bay are marine in habitat preference, but some, like the Arctic flounder and starry flounder, are known to enter low-salinity habitats (Walters 1955). Others, which are known to be strictly marine fish species have been captured in freshwater systems, likely a result of the fish remaining in areas of tidal influence (i.e., in the salt wedge underneath the surface freshwater layer). Three species are exceptions to this rule. Arctic char and some local populations of lake trout are anadromous, meaning they spawn and rear in freshwater but migrate to the sea to forage (Scott and Crossman 1973). Ninespine stickleback have three life-history types: freshwater, brackish, and anadromous (Arai and Goto 2005). The sticklebacks captured in this study followed either an anadromous or brackish water life history.

Table 4.3-2. Fish Species Captured in Roberts Bay, 2009 and 2010

Common Name	Scientific Name	Primary Habitat	Depth Range
Arctic Char	*Salvelinus alpinus*	Anadromous	Benthopelagic
Arctic Flounder	*Liopsetta glacialis*	Marine	Demersal
Arctic Shanny	*Stichaeus punctatus*	Marine	Demersal
Banded Gunnel	*Pholis fasciata*	Marine	Demersal
Capelin	*Mallotus villosus*	Marine	Pelagic
Fourhorn Sculpin	*Triglopsis quadricornis*	Marine/Brackish	Demersal
Greenland Cod	*Gadus ogac*	Marine	Demersal
Lake Trout	*Salvelinus namaycush*	Anadromous	Benthopelagic
Longhead Dab	*Limanda proboscidea*	Marine	Demersal
Ninespine Stickleback	*Pungitius pungitius*	Brackish/Anadromous	Benthopelagic
Pacific Herring	*Clupea pallasii*	Marine	Pelagic
Saffron Cod	*Eleginus gracilis*	Marine/Brackish	Demersal
Starry Flounder	*Platichthys stellatus*	Marine/Brackish	Demersal
Shorthorn Sculpin	*Myoxocephalus scorpius*	Marine/Brackish	Demersal

Note: Dashes indicate species not present.

A total of 18 species of fish have been captured over the last decade; the additional species captured prior to 2009 included Arctic cisco, least cisco, lake whitefish and an unknown species of flounder (Golder 2007). Saffron cod was the most abundant species in most years. Relatively high numbers of capelin and Pacific herring were caught in 2003 and 2007 due to a focus in those two years on intercepting along-shore fish migrations. Sampling in 2009 caught more pelagic and bentho-pelagic species because more sampling effort was expended with gillnets in offshore areas than in previous years.

4.3.2.2 Marine Fish Habitat

Roberts Bay is dominated by cliffs up to 50 m in height at the northern and western areas of the bay. The eastern and southern areas of Roberts Bay are more gradually sloped and contain numerous lake drainages. While the cliff areas are generally devoid of terrestrial vegetation, the gently sloped valleys have lush growths of reeds, grasses, and other vegetation. The shoreline substrate consists mainly of bedrock in the northwest and south portions of Roberts Bay; however, gravel and sand are present in bays and at stream outlets. The eastern portion of the bay is dominated by boulder, gravel, and sand substrate. The shoreline habitat quality of Roberts Bay ranges from fair (bedrock dominated northern areas) to excellent (Glenn and Little Roberts outflows in the southern area).

Shoreline habitat of Roberts Bay was assessed along the southern and western shores of Roberts Bay in 2000 (Figure 4.3-2; Rescan 2001), 2009, and 2010. In 2009, a total of 686 m of shoreline littoral habitat was surveyed in the southwestern area of Roberts Bay (Appendix 4.3-6). Of this distance, 51% was composed of cobble, 15% of boulder, 15% of gravel, 14% of fines and 5% of bedrock. An outlet to a stream was present within the western section of the surveyed area. The dominant substrate around the stream outlet was sand and gravel, likely carried down by the stream. In the eastern section of the bay, cobble and boulder dominated the shoreline. Substrate offshore of the littoral zone was dominated by fines with small patches of cobble and/or boulder. Water depths in this area ranged from 0.2 m (near shore) to 10.0 m in open water.

A total of 985 m of shoreline habitat was surveyed in the northwestern area of Roberts Bay in 2009 (Appendix 4.3-7). Of this distance, 46% was composed of bedrock, 27% of cobble, 12% of gravel, 12% of fines and 2% of boulder. Offshore substrate was dominated by fines, similar to the proposed barge site. Water depths at the site ranged from 0.4 m near shore to 26.0 m in open water.

In 2010, a total of 67,953 m^2 of nearshore habitat was surveyed along the western shore of Roberts Bay (Appendix 4.3-8). Of this area, 52.7% was composed of fines (primarily in areas farther from shore), 15.1% of gravel, 13.5% of cobble, 9.2% of bedrock, 7.4% of boulders and 2.1% of organic sediments.

4.3.2.3 Roberts Bay Fish Habitat Compensation Monitoring

As part of the Doris North Mine infrastructure, a rock jetty was constructed in early July 2007 at the south end of Roberts Bay for barge loading and off-loading. The jetty was constructed perpendicular to shore and measured 95 m in length, varying in width from 5.3 to 35 m (Rescan 2010b).

The construction of the jetty resulted in the alteration and/or loss of 0.176 ha of fish habitat. To compensate, four underwater rock reefs (or shoals), each measuring 31.25 m long by 12 m wide and spaced approximately 19 m apart, were constructed west of the jetty in 2008. The four compensation shoals were equivalent to 0.150 ha of fish habitat. In combination with the below high-water side-slope area of the jetty (0.164 ha) which would provide additional habitat for fish and invertebrates, the net gain of fish habitat was equivalent to 0.138 ha.

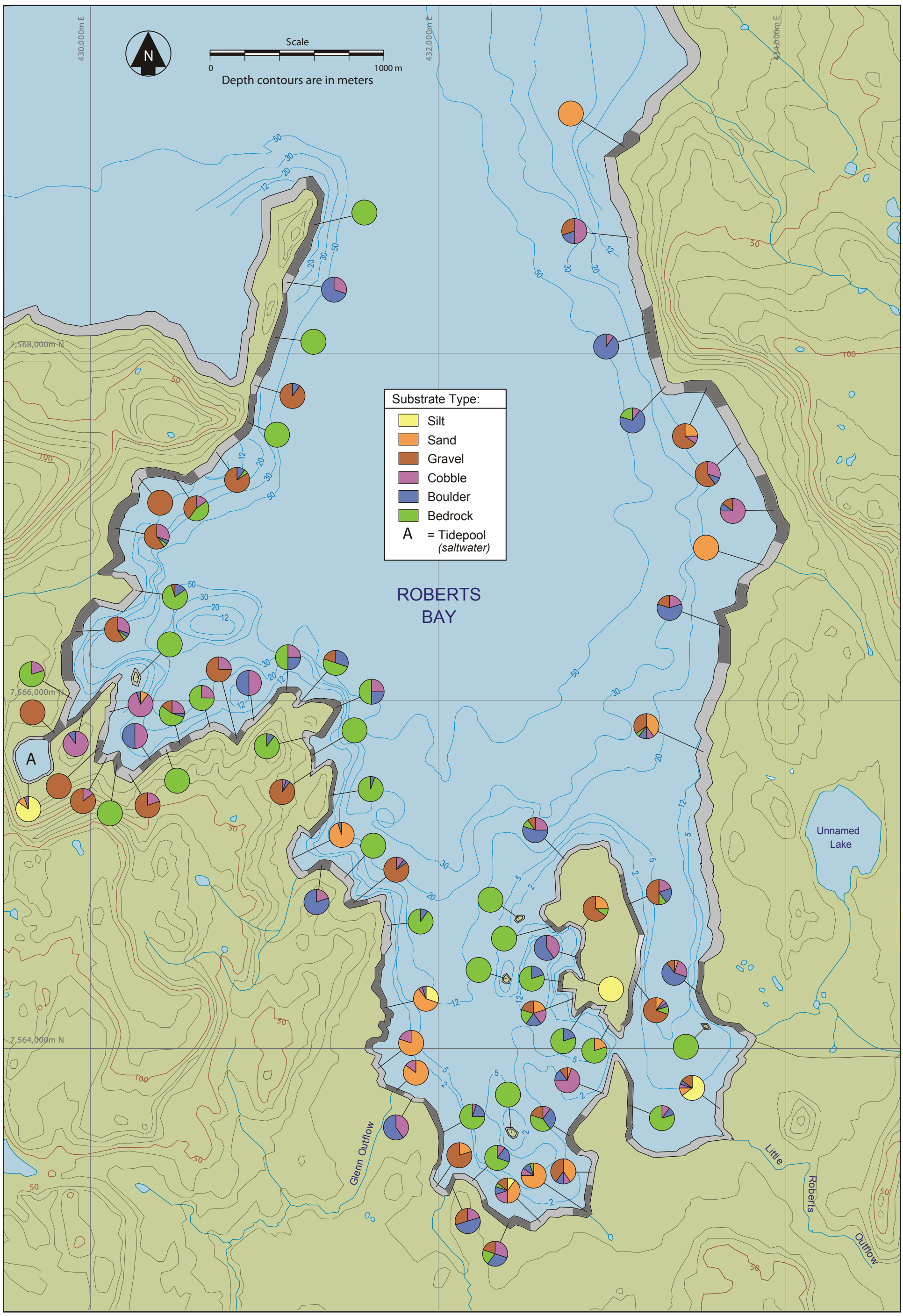

Figure 4.3-2

NEWMONT NORTH AMERICA

Roberts Bay Shoreline Fish Habitat

Figure 4.3-2

Rescan Engineers & Scientists

Authorization for the construction of the jetty in Roberts Bay was granted from Transport Canada and Fisheries and Oceans Canada (DFO) in June 2007. The Fisheries Authorization (DFO File No: NU-02-0117) granted for the construction of the jetty addresses the following conditions for monitoring in Roberts Bay:

- The implementation of a sediment transportation and deposition monitoring program;
- A photographic record of construction activities (*completed in 2008*); and
- Implementation of a fish habitat monitoring program.

For the sediment transportation and deposition monitoring program, bathymetric comparisons of Roberts Bay pre-construction and Year-3 post-jetty construction showed similar patterns to what was observed during Year-1 and Year-2 post-jetty comparisons (Rescan 2010b, 2010c). Changes in bed elevation in Roberts Bay were observed to the north and east of the jetty. Other observations with respect to change in bed elevation may be related to variability of detailed data for that area or steepness of slope.

The fish habitat monitoring program was developed to monitor the stability and successful use of fish habitat compensation structures, specifically the jetty and shoals in Roberts Bay. As part of this program, the following components were sampled at the jetty and compensation shoals in Roberts Bay: periphyton biomass (as chlorophyll *a*), cell density and taxonomic composition; benthic invertebrate density and taxonomic composition; fish community composition and Catch-Per-Unit-Effort (CPUE); and macroalgae community composition and percent cover (Rescan 2010b, 2010c).

Results of the first year of monitoring (Rescan 2010b) indicated that periphyton and benthic invertebrate communities had established themselves on the compensation shoals in Roberts Bay. Periphyton assemblages were numerically dominated by blue-green algae and diatoms. The benthic invertebrate community composition on both the jetty and compensation shoals was dominated by amphipods, followed by polychaetes.

Year-2 monitoring results confirmed that periphyton and benthic invertebrate communities had established themselves on the compensation shoals in Roberts Bay (Rescan 2010c). Periphyton assemblages were again numerically dominated by cyanobacteria and diatoms. The filamentous cyanobacterium, *Anabaena cylindrica*, was the most abundant species on Roberts Bay shoals. The benthic invertebrate community composition was dominated by amphipods. *Lagunogammarus setosus* and *Ischyrocerus anguipes* were the most abundant species on the compensation shoals.

From minnow trap and crab trap efforts, a total of 19 fish from two species were captured at the Roberts Bay shoals (Rescan 2010c). The jetty, which was only sampled during the July sampling period, yielded a total of 16 fish from two species. Overall, saffron cod and fourhorn sculpin were the dominant species by number for the shoal habitat and side-slopes of the jetty in Roberts Bay.

Visual snorkel surveys indicated that various genera of algae, invertebrates and fish were inhabiting and/or utilizing the compensation structures. Macro-algae were not visually plentiful on the shoals or the jetty in Year 1. This is to be expected given that the compensation structures in Roberts Bay are new habitat and the natural succession of the algal communities is expected to take several years.

Euphausiids (krill, of the order Euphausiacea) were the most abundant invertebrate observed throughout the visual surveys conducted in Roberts Bay. This shrimp-like crustacean plays a key role in marine food webs as it is known to be a main prey item to many marine vertebrates.

Various species of adult, juvenile and young-of-the-year fish were observed during snorkel surveys in Roberts Bay (Rescan 2010b, 2010c). Young-of-the-year fish (probably gadids) were the most common fish observed on the shoals. Their abundance shows that the jetty and shoal structures provide shelter and/or a food source for fish.

In summary, monitoring of the compensation structures in Roberts Bay showed enhancement success as defined in the Fisheries Authorization. Primary and secondary producers have established themselves on the rock shoals and the side-slopes of the jetty of Roberts Bay. In addition, the monitoring program has documented the use of the shoals and rip-rap slopes of the jetty by fish prey and fish of multiple age classes.

The jetty monitoring program will be implemented in the following years as indicated in the Fisheries Authorization: 2009, the year prior to mine construction (2009), Year of mine construction (conducted in 2010), Year-2 of mine operation, Year-2 of active mine post-closure (i.e., year prior to jetty lowering to below high water level), Year-1 post lowering of jetty, and Year-2 post lowering of jetty.

4.3.3 Marine Birds

Marine birds surveys have been conducted in Roberts Bay from 2006 to 2010. Aerial surveys as well as ground-based nesting surveys have been conducted for some or all of the survey years. In addition, a ship-based survey was conducted in the late summer of 2010 in order to document the distribution of seabirds in Roberts Bay and Melville Sound.

Table 4.3-3 presents the seabirds that have been recorded in Roberts Bay. Twelve species of seabirds have been found to use Roberts Bay for foraging, travel, or staging. This list does not include shorebirds that nest near the shore and use the terrestrial areas surrounding the bay, such as sandpipers and plovers.

Table 4.3-3. Seabirds Present in Roberts Bay

Common Birds	Species Name	Occasional/ Incidental	Species Name
Common Eider	(*Somateria mollissima*)	King Eider	(*Somateria spectabilis*)
Red-breasted Merganser	(*Mergus serrator*)	Yellow-billed Loon	(*Gavia adamsii)*
Pacific Loon	(*Gavia pacifica*)	Common Loon	(*Gavia immer*)
Long-tailed Duck	(*Clangula hyemalis*)	Tundra Swan	(*Cygnus columbianus*)
Canada Goose	(*Branta canadensis*)		
Red-throated Loon	(*Gavia stellata*)		
Herring Gull	(*Larus argentatus*)		
Glaucous Gull	(*Larus hyperboreus*)		

4.3.3.1 Aerial Surveys

Aerial surveys for marine birds have been conducted from 2006 to 2010. In 2009 and 2010, the survey area was increased from 225 km^2 to 475 km^2, and included Roberts Bay, Hope Bay, and Reference Bay. Surveys were timed to coincide with two important periods: the northern migration/establishment of nesting territories and the brood rearing/fall staging period.

During 2009, one aerial survey was conducted in July and five surveys were conducted in August. Surveys were conducted along 11 parallel survey transects spaced 2 km apart and covering the coastal area of Hope Bay, and both Roberts Bay and Reference Bay. The total numbers of birds ranged from 3 to 133 in Roberts Bay, 9 to 72 in Hope Bay and 3 to 90 in Reference Bay. The results for Roberts Bay were increased by a single group of 85 long-tailed ducks. Without that one group, Roberts Bay consistently contained the lowest number of seabirds.

During 2010, three aerial surveys were conducted in July and four in August. Roberts Bay had the lowest number of birds: from three to 28 in July and from two to 15 in August. Also, more birds were observed in August than in July in all inlets. The total number of birds in Hope Bay ranged from 39 to 97 in July, and from 72 to 146 in August. In Reference Bay, the number of individual birds ranged from 18 to 30 in July and from 12 to 79 in August.

In 2010, the five most abundant species were: herring gull, red-breasted merganser, glaucous gull, common eider, and Pacific loon. Long-tailed ducks were absent from all surveys in 2010, but the number of both glaucous and herring gulls were higher in 2010 than in 2009.

Seabird densities calculated during periods of low marine traffic (i.e., August 2009 and July 2010) were not statistically different than those calculated during periods of high marine traffic (i.e., August 2010). These results suggest that the increase in marine traffic did not have a detectable effect on seabird densities in Roberts Bay.

4.3.3.2 Barge Survey

A barge survey was conducted aboard the "Sea Commander" vessel from August 10 to 12, 2010. During the survey, one observer scanned for seabirds and marine mammals from either the port or starboard side of the vessel; the observer selected the side that had the least wind and glare to minimize error in species identification. The observer scanned from the bow of the vessel to a bearing of 270° (port side) or 90° (starboard side) from the bow. Survey speed varied from 4 to 7 knots (7 to 13 km per hour). The survey involved the vessel travelling from the Roberts Bay jetty to Cambridge Bay and back.

The seabirds identified on the survey included three common murres and four pacific loons. In addition, two unknown loons and one unknown gull were observed. These unknown birds likely belong to the several gull and loon species known to occur in the area (Table 4.3-3). None of the identified species are of conservation concern in Nunavut. The common murres were observed near the narrow entrance into Melville Sound. Three of the pacific loons were observed in the same area as the common murres. The fourth pacific loon was observed in upper Bathurst Inlet, along with the unknown loons and gull.

4.3.3.3 Nesting Surveys

Ground-based searches for nesting seabirds were conducted during July in 2006, 2009, and 2010 on islands smaller than 20 ha in Roberts Bay, Hope Bay, and/or Reference Bay. Thirteen islands were surveyed in 2006 in Hope Bay (12 islands) and Roberts Bay (one island). In 2009 and 2010, all three inlets were surveyed. During 2009, 41 islands were surveyed and 3 nests were observed, although none of them were seabirds (2 in Roberts Bay). 2009 was a poor year for surveying due to a very late spring and poor summer weather conditions. During 2010, 87 islands were surveyed and 28 active nests were recorded, four of which were located in Roberts Bay. In each of these surveys, Roberts Bay contained the least available island habitat for seabird nesting and consequently the lowest numbers of nesting birds.

In July 2006, searches of 13 islands in Hope Bay and Roberts Bay yielded three common eider nests (one depredated) an one red-breasted merganser nest. All nests were located in Hope Bay. Two eider nests had clutch sizes of six and three, while the red-breasted merganser had a clutch size of seven. Common eiders were often seen in the area while red-breasted merganser sightings were less frequent (Miramar 2007).

In 2009, only three nests were found, none belonging to seabirds. Mixed groups of common eiders and red-breasted mergansers were often noted on island beaches. The lack of nesting activity was attributed to poor weather, a late spring, and high ice coverage in mid-July.

In 2010, 28 active nests were found, five belonging to seabirds: four common eider and one red-breasted merganser nests. Twenty-two glaucous gull nests were found and one herring gull nest. In addition, one semipalmated plover pair with a young chick was observed.

4.3.4 Marine Mammals

Three species of marine mammals, the beluga whale (*Delphinapterus leucas*), ringed seal (*Pusa hispida*), and bearded seal (*Erignathus barbatus*), have been observed in marine environments surrounding the Doris North Project. Beluga whale are infrequent summer visitors to Bathurst Inlet based on historical evidence (Stewart and Burton 1994; Priest and Usher 2004; NPC 2008). Both seal species have a holarctic distribution and frequent the Bathurst Inlet and Coronation Gulf area throughout the year. Ringed seals are the more abundant of the two species (Priest and Usher 2004). This species is common throughout the Arctic, making it difficult to identify important areas of critical habitat. However, higher populations are known to occur in the eastern Arctic, including Lancaster Sound, Barrow Strait, and Baffin Island (NPC 2008).

The range of narwhals is predominantly thought to occur in the eastern Arctic, with two populations; the Baffin Bay and Hudson's Bay populations. The area of narwhal habitat closest to the Project site is approximately 500 km east near Gjoa Haven (NPC 2008). Narwhals have not traditionally been observed as far west as Bathurst Inlet. However, in 2001 a pod of narwhals was observed for the first time in recorded memory in Cambridge Bay (Alex Buchan, 2011 Pers Comm).

Two survey methods were implemented for the documentation of marine wildlife in the regional study area. An aerial survey was flown in the early spring of 2010 to document the presence and distribution of seals on the pack ice in Melville Sound and the northern portion of Bathurst Inlet. Incidental observations of seals and seal holes were also recorded during aerial surveys for caribou during May of 2011. A ship-based survey was also conducted in late summer of 2010 between Cambridge Bay and Roberts Bay to document the presence of larger marine mammals, such as belugas, that may frequent the greater area in the summer.

4.3.4.1 Aerial Survey

Aerial surveys conducted during the spring of 2010 indicate that seals are quite common in Bathurst Inlet and Melville Sound. The spring seal survey was conducted concurrently with the Dolphin and Union caribou ice crossing study (refer to Section 4.3.5). During the aerial surveys on June 3, 4, and 5, 2010, seal and breathing hole observations within 500 m from either side of the helicopter were recorded. In addition, incidental observations of seals or breathing holes (i.e., observations greater than 500 m from the helicopter or during ferry flights to and from Doris Camp) were also recorded.

A total of 777 seals were observed during aerial surveys on June 3 to 5, 2010, comprised of 87 bearded seals, 386 ringed seals, and 322 unknown seals (Table 4.3-4). In addition, there were 129 observations of open breathing holes on the sea ice. Of the seals that were observed, a total of 48 bearded, 210 ringed, and 41 unknown seals were observed on transect. Of the breathing holes that were observed, 79 were observed on transect. The remaining observations were recorded incidentally.

Seals and breathing holes were more frequently observed in upper Bathurst Inlet and in the Coronation Gulf in comparison to areas within Melville Sound. The highest number of bearded and ringed seals per km was recorded on in the Coronation Gulf.

The relatively large number of unknown seals recorded during the spring seal survey results from seals frequently diving before positive species identification could be made. In addition, many seals were too far from the helicopter to enable positive species identification.

Table 4.3-4. Results of the Spring Seal Survey, 2010

		Species									
		Bearded Seal		Ringed Seal		Unknown Seal		Total Seal Observations		Breathing Hole	
Survey Area	Transect	On[1]	Inc.[1]	On[1]	Inc.[1]	On[1]	Inc.[1]	On[1]	Inc.[1]	On[1]	Inc.[1]
Melville Sound	MS1	2	2	4			2	6	4	7	
	MS2	4	4	16		1	8	21	12	7	
	MS3	3	3	18	9	1	8	22	20	6	
	MS4	4	2	19	1	1	10	24	13	11	1
	MS5			4	4	1	2	5	6	7	
	MS6	7		8	6	4	4	19	10	7	1
	MS7	5		11		2	8	18	8	6	
	MS8	3		13	1		14	16	15	3	1
Coronation Gulf	CG1	2		57	4	5	65	64	69	12	1
	CG2	4	1	40	5	21	41	65	47	6	
	CG3	14	5	20	6	5	7	39	18	7	1
Transit to/from Doris Camp	-		22		122		112		256		45
Survey Total		**48**	**39**	**210**	**158**	**41**	**281**	**299**	**478**	**79**	**50**
Grand Total Observations		**87**		**386**		**322**		**777**		**129**	

[1] *On = Observed on transect, Inc. = incidental observation (more than 500 m from the helicopter or during ferry flights)*

Incidental observations of seals and breathing holes were also collected on May 22, 2011, during a caribou survey. A total of 25 seals at breathing holes were observed, with one each in Roberts Bay and Reference Bay and the remainder (92%) in Hope Bay. Seal holes were more prevalent at a greater distance (i.e. 3-4 km) from shore, presumably to avoid predation from land-based predators such as wolverine. A wolverine was observed stalking a seal at an ice hole approximately 0.5 km from shore in Hope Bay. Due to the low numbers of seals and seal holes observed in Roberts Bay, this area is not considered an important area for seals during the winter.

4.3.4.2 Barge Survey

A barge survey was conducted aboard the "Sea Commander" vessel from August 10 to 12, 2010. During the survey, one observer scanned for seabirds and marine mammals from either the port or starboard side of the vessel; the observer selected the side that had the least wind and glare to minimize error in species identification. The observer scanned from the bow of the vessel to a bearing of 270° (port side) or 90° (starboard side) from the bow. Survey speed varied from 4 to 7 knots (7 to 13 km per hour). The survey involved the vessel travelling from the Roberts Bay jetty to Cambridge Bay and back.

Few marine wildlife species were recorded during the barge surveys from August 10 to 12, 2010. A total of two ringed seals, one bearded seal, and one unknown seal were observed. One ringed seal was recorded at the entrance of Roberts Bay while the other was recorded midway through Melville Sound. The bearded seal and the unknown seal were both observed at the entrance of Melville Sound.

4.3.5 Caribou

Caribou have been monitored as part of the Doris North Wildlife Monitoring and Mitigation Program (WMMP) on a yearly basis from 2005 until the present (2011). Prior to that, baseline information was collected each year from 1996 to 2004.

Two caribou herds have historically occurred in the area; the Ahiak and the Dolphin and Union herds. The Ahiak winters near the treeline in the Northwest Territories and northern Saskatchewan and calves in Nunavut. During the 1990s, this herd calved to the south of the Doris North area with the Bathurst herd. Since then, however, the Ahiak herd has moved its calving range progressively east into the Queen Maud Gulf Bird Sanctuary and outside of the Doris North area. This herd is not currently considered to interact with the Doris North Project.

The second herd, the Dolphin and Union herd, winters on the mainland on both the east and west sides of Bathurst Inlet, sometimes in the Doris North area. Small groups of caribou were observed during winter baseline studies in the regional study area. During spring, this herd crosses to Victoria Island, where they calve and spend the summer, returning after Coronation Gulf freezes in the fall. Of those animals who winter to the east of Bathurst Inlet, some animals cross Melville Sound to the Kent Peninsula before crossing Dease Strait to Victoria Island.

Caribou use in the Doris North area during migration has been recorded through several studies which examined the use of the study area from a very large scale, down to the small scale around Roberts Bay. The GN-DOE conducted a collaring study on the herd between 1986 and 2006. Poole et al. (2010) used these data to describe the large-scale locations and timing of collared caribou crossing Melville Sound, Coronation Gulf and Dease Strait. At a medium-scale, an aerial survey was conducted in May 2010 of Melville Sound and Bathurst Inlet to examine crossing locations of migrating Dolphin and Union caribou. At the local-scale, incidental observations of caribou trails were also recorded in May 2011, centred on Roberts Bay, Hope Bay and Reference Bay. In the early 1900s, the Dolphin and Union caribou herd was estimated at 100,000 animals (COSEWIC 2004). Overhunting and harsh winter conditions are reported to have caused a population crash between 1900 and 1920 to the point where caribou were not observed migrating between Victoria Island and the mainland (Gunn 2005; Poole et al. 2010). In the late 1980s and early 1990s, the Dolphin and Union herd had recovered to the point where they resumed their historic migrations between Victoria Island and the mainland (Gunn et al. 1997; Poole et al. 2010). Approximately 7,200 Dolphin and Union caribou were counted prior to migration in spring 1993 (Gunn et al. 1997). In 1997, the Dolphin and Union herd was estimated at 28,000 ± 3,350 animals (Nishi and Gunn 2004), which is approximately one third of its historical size.

Dolphin and Union caribou have recently been recognized as a genetically distinct population from the Peary caribou and barren-ground caribou (COSEWIC 2004). The Dolphin and Union herd is designated as a sub-population of Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) due to high harvests without recent population estimates (COSEWIC 2004). Potential threats to this herd's long term viability are climate warming and shipping activity across the herd's migration route (COSEWIC 2004). Climate warming may shorten the amount of time caribou have to cross between the mainland and Victoria Island during the spring and fall migrations, since this movement is dependent on ice formation. Shipping and icebreaking make Dolphin and Union caribou vulnerable to die-offs, such as those that have affected the Peary caribou (COSEWIC 2004). The herd is pending addition to Schedule 1 of the Species at Risk Act (SARA). Resupply of Hope Bay does not require breaking ice.

At the large-scale, Poole et al. (2010) report that Dolphin and Union caribou wintering to the east of Bathurst Inlet will follow two routes north, either crossing Melville Sound to the Kent Peninsula or travelling directly along the Kent Peninsula where it joins the mainland just east of Melbourne Island. These animals then cross Dease Strait to Victoria Island in May and early June.

To examine the use of Melville Sound and Bathurst Inlet, an aerial survey was flown during May 2010 across Melville Sound and Bathurst Inlet. Surveys were conducted along pre-determined transect lines in Melville Sound and upper Bathurst Inlet within the regional study area. Transect lines were parallel at a distance of 8 km apart. Eight transect lines were oriented in an east-west orientation in Melville

Sound. Three transect lines were oriented in an approximately north-south orientation in upper Bathurst Inlet and Coronation Gulf.

A total of 18 caribou and 114 caribou tracks were observed during aerial surveys from June 3 to 5, 2010. One group of 13 bull caribou were observed off-transect. Five bull caribou were incidentally observed during travel to and from Doris Camp. Of the 114 separate caribou tracks observed, the majority were documented along the shoreline of northern Melville Sound. In several areas, caribou tracks were grouped together, suggesting that larger groups of caribou (~5 to 10 individuals) were travelling together. Generally, caribou tracks were oriented in a northerly direction and followed shorelines of the Kent Peninsula.

At the local scale, incidental observations of caribou trails were recorded during a caribou survey in May, 2011. This survey included Roberts Bay, Hope Bay and Reference Bay and noted the location of all caribou trails across the sea ice, recorded along a series of six parallel east-west transects. 45 caribou trails were observed, which were generally focused at the ends of peninsulas and points and where islands provided a shorter route across the sea ice to the Kent Peninsula. Concentrations of tracks followed the eastern shoreline of Hope Bay, led from the points of land east and west of Roberts Bay and along the eastern shoreline of Reference Bay. No trails were observed in Roberts Bay itself, however what appeared to be a grizzly bear kill or scavenge of a caribou was located at the eastern entrance to Roberts Bay. This suggests that Roberts Bay is used infrequently by caribou in comparison to the regional landscape.

4.4 SOCIO-ECONOMIC ENVIRONMENT

4.4.1 Proximity to Communities

Roberts Bay lies within the West Kitikmeot Region of Nunavut. The entire Kitikmeot Region is the most western of the three administrative regions within Nunavut. The region incorporates the southern and eastern parts of Victoria Island and the adjacent part of the mainland up to the Boothia Peninsula, along with King William Island and the southern portion of Prince of Wales Island (Figure 4.4-1). There are a total of seven communities within the Kitikmeot Region.

Omingmaktok (also known as Bay Chimo), Cambridge Bay, and Bathurst Inlet are the closest communities to Roberts Bay and the Doris mine site (Figure 4.4-1). Omingmaktok is approximately 75 km away from the mine site, while Cambridge Bay and Bathurst Inlet are approximately 125 km and 160 km away, respectively. Other Kitikmeot communities are at a greater distance from Roberts Bay and the mine site, including Kugluktuk (~360 km), Gjoa Haven (~445 km), Taloyoak (~550 km), and Kugaaruk (~690 km).

Omingmaktok is located on Bay Chimo Harbour and was established around an abandoned post on the eastern shore of Bathurst Inlet. The community is now primarily a seasonal hunting and fishing camp, which may be accessed by chartered flights from Yellowknife and Cambridge Bay or by boat during the ice free period. Travel by snowmobile is also common, and is a main mode of travel to the community in the spring. Although occupation is now mainly seasonal, a small population of five to ten residents do typically remain year-round. Census statistics suggest that the population has significantly decreased in recent years. Between 1991 and 1996, Omingmaktok hosted a stable population of approximately 50 people, which declined in 2001 to a reported five persons (Statistics Canada 2007).

Figure 4.4-1

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Kitikmeot Communities

Figure 4.4-1

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Bathurst Inlet is a seasonal community found on a deep inlet of Bathurst Inlet which drains the Burnside and Western Rivers. Bathurst Inlet is one of the smallest communities in the Kitikmeot Region. As with Omingmaktok, access can be gained by air from Yellowknife and Cambridge Bay by chartered flights. Access by snowmobile is common during the ice period. The community of Bathurst Inlet is currently only occupied during the spring and summer, especially driven by the open season of the Bathurst Inlet Lodge which runs from June through July. The residents, which consist of a few families, over-winter in larger communities such as Cambridge Bay and Yellowknife.

Cambridge Bay is the largest community in the Kitikmeot Region, with a current population of approximately 1,700 (Nunavut Bureau of Statistics 2011). It serves as a regional hub for transportation and business. The public sector is a prominent component of the local economy. Cambridge Bay is a traditional hunting and fishing location that expanded due to missionary and trading activity in the early 20th Century and beginning in the 1940s and 1950s with the DEW line. Residents participate in traditional land use activities, but are increasingly reliant on the market economy (Statistics Canada 2008). There are a number of businesses operating in Cambridge Bay, which offer a range of goods and services many of which are supported by the mining industry. Tourism and transportation are also important industries within the community.

4.4.2 Marine Archaeological Potential

An assessment of the potential for archaeological resources in the Roberts Bay marine environment involves two facets. It is a well recorded ethnographic observation that the Copper Inuit typically camped on sea ice in communal groups for extended periods of time in winter (e.g., Jenness 1922). It is certainly possible that tools and other items may have been lost or left behind when people moved on in the spring. When the ice melted, those items would have fallen to the ocean floor. Consequently, it is conceivable that there may be archaeological artefacts on the Roberts Bay sea bottom; however, finding them would be like searching for the proverbial “needle in a haystack” since they would be isolated items covered by varying thickness of sediments. Furthermore, their interpretative value would be limited to the specific item since all the important context information would be lost.

The other factor is rising sea levels. Archaeological resources originally on the Arctic shoreline could be covered by water as melting polar ice caps increase the ocean water levels. In the case of Roberts Bay, much of the surrounding terrain is elevated so this is a possible occurrence only in the lower elevation areas where the ground slopes gradually into the water. Furthermore, the fact that the land has been rising gradually since the end of the last ice age approximately 9,000 years ago may balance any possible effects of this very recent rising sea level phenomenon.

It is possible that there are isolated artefacts on the sea floor of Roberts Bay, but locating them would be exceedingly difficult and their scientific significance would be low. It is considered highly unlikely that entire sites or site features would be present under the waters of Roberts Bay. No specific surveys for archaeological resources have been conducted of the Roberts Bay shallows or underwater since the low potential for recovery of archaeological resources does not justify the effort required. However, any underwater video footage that may be collected in Roberts Bay can be made available to the Project archaeologist to review for potential archaeological remains.

4.4.3 Land and Resource Use

Figure 4.4-2 presents a map of the current understanding of land and resource use in the regional area around Roberts Bay. There is currently no prominent fishing or hunting resource use in Roberts Bay.

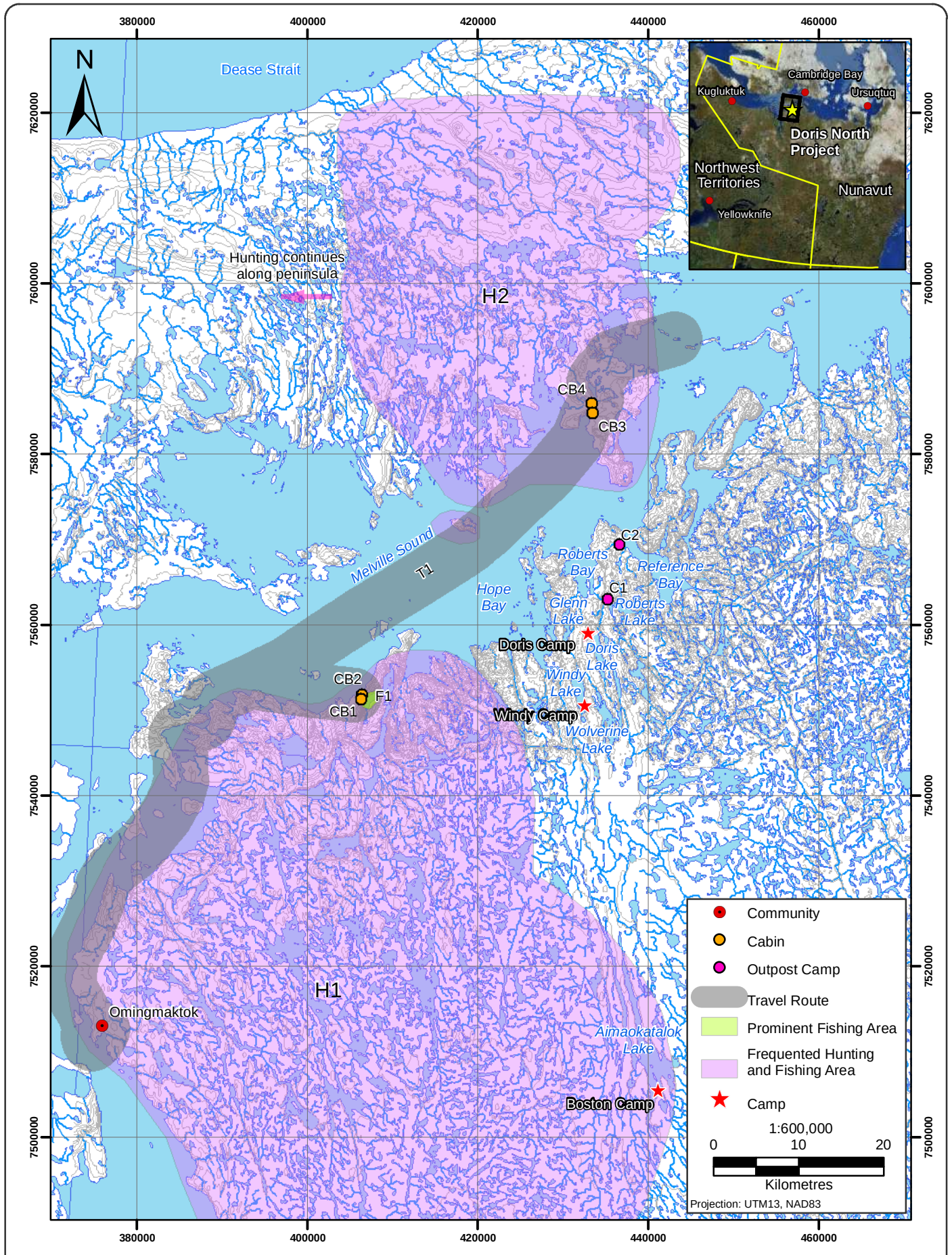

Figure 4.4-2

Land and Resource Use, Doris North Project

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The closest prominent fishing area is located well away from Roberts Bay, approximately 30 km to the southwest of Roberts Bay along the coastline of Melville Sound (F1 in Figure 4.4-2; Anonymous, pers. comm.; B. Setatak, pers. comm.). Arctic char is the main species fished at this location. This site is reported to typically be used near the end of May for ice fishing. In the fall, nets are also set through the ice (Anonymous, pers. comm.; B. Setatak, pers. comm.). There are currently no known unique or important fishing areas located within Roberts Bay, although Little Roberts Outflow has been fished for char by Inuit in the recent past.

Hunting also occurs throughout the region. However, there are more regularly used and prominent hunting areas southwest of Roberts Bay and to the north along the Kent Peninsula (Anonymous, pers. comm.; J. Avalak, pers. comm.; B. Setatak, pers. comm.).

Elders have shared that in the past, traditional camps were located along the shores of Roberts Bay, around Hope Bay, and at river mouths and confluences (Golder 2003). Currently, an outpost camp is located north of Roberts Lake and east of Roberts Bay (C1 in Figure 4.4-2). Active local hunter J. Avalak previously lived there for approximately seven years with his family (parents and ten children) and still stays at the camp for three to seven days annually (J. Avalak, pers. comm.). Another outpost camp is located on the peninsula between Roberts Bay and Reference Bay (Ida Bay) and used primarily in spring and summer (C2 in Figure 4.4-2; J. Avalak, pers. comm.). Cabins belonging to the Omingmaktok HTO are also located within the region, two near the popular fishing area west of Hope Bay and another two well north of Roberts Bay, on the south side of Kent Peninsula (CB1, CB2, CB3 and CB4 in Figure 4.4-2; J. Avalak, pers. comm.). Both camps and cabins are used during hunting expeditions and during travel through the area (e.g., when travelling from Cambridge Bay to Omingmaktok).

People travelling between Bathurst Inlet, Omingmaktok, and Cambridge Bay generally follow a route along the coast and across waterways towards Kent Peninsula (Figure 4.4-2). This route is travelled by people from Bathurst Inlet and Omingmaktok from freeze up until April (Anonymous, pers. comm.; J. Avalak, pers. comm.). Travel may occur through Roberts Bay, although it has not been identified as being on an important travel route.

4.4.4 Local and Regional Traffic Patterns

Kitikmeot communities receive barge service from the Northern Transportation Company Ltd. (NTCL) or Nunavut Sealift and Supply Inc. (NSSI) each year. The western Kitikmeot communities are usually serviced by NTCL, and eastern communities by NSSI. In the last several years, ships from both east and west have serviced Cambridge Bay and Roberts Bay. NTCL uses recently developed shipping routes that have decreased transportation cost and increased shipping capacity (C. Dimitruk, pers. comm.). Since 2009, the NTCL shipping route for the Western Arctic travels north along the coast from Delta, BC, around Point Barrow and east to the Kitikmeot communities of Kugluktuk, Cambridge Bay, Gjoa Haven, and Taloyoak (Figure 4.4-3). This route was not used in 2011. The NTCL route map also indicates travel to Omingmaktok and Bathurst Inlet (NTCL 2011). NSSI ships to Cambridge Bay, Gjoa Haven, Kugluktuk, and Taloyoak from the east, starting at the Port of Montreal (NSSI 2011).

The general route for shipping supplies for the Doris North Project heads south and east from the Coronation Gulf into Melville Sound and Roberts Bay (Figure 4.4-3). Sea barges deliver annual supplies to the project during the ice free period, which usually lasts approximately six to eight weeks. The sealift includes food, fuel, equipment, and construction and other supplies. A large sealift operation took place in 2010, carrying fuel, supplies and construction materials for the Doris North Project. Other than to support current Doris North Project activities, there is no other routine local marine traffic within Roberts Bay.

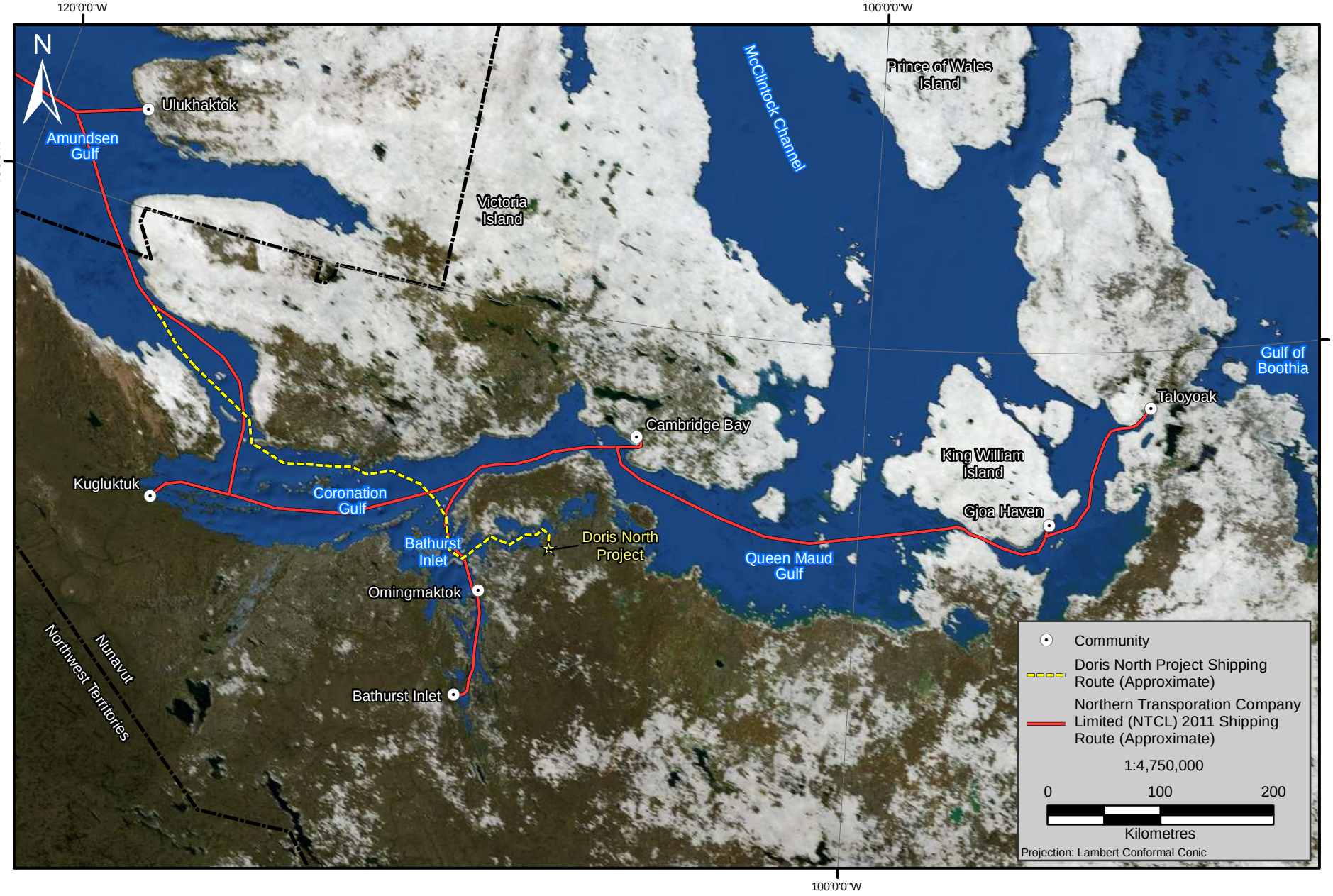

Figure 4.4-3

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Marine Shipping Routes

Figure 4.4-3

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5. Potential Environmental Effects

5. Potential Environmental Effects

This chapter presents the potential interactions of the proposed Project (installation of subsea pipeline and diffuser in Roberts Bay) with the Roberts Bay environment, and evaluates the potential effects of the Project on environmental components within Roberts Bay. Mitigation measures are presented that would reduce or eliminate potential effects. The potential for cumulative effects is also addressed for any environmental components that could possibly be affected by both the proposed Project and existing Doris North activities.

This chapter is organized by environmental component. For each environmental component that has the potential to interact with the proposed Project, the potential effect of the Project on that component is evaluated, mitigation measures are highlighted, and cumulative effects are addressed if applicable.

5.1 POTENTIAL INTERACTIONS

The discharge of treated TIA water into Roberts Bay has the potential to interact with the following environmental components of Roberts Bay:

- Water quality;
- Sediment quality;
- Ice thickness;
- Marine fish and fish habitat;
- Marine wildlife (marine mammals and seabirds); and
- Caribou.

The discharge of treated TIA water to Roberts Bay has the potential to influence the water quality of Roberts Bay, as the concentrations of non-salt parameters in the treated TIA water could be different than existing background concentrations in Roberts Bay. The TIA Discharge Project has been designed to meet all discharge standards, as described in more detail below.

Sediment quality could potentially be influenced by the discharge of treated TIA water to Roberts Bay. However, the subsea pipeline will end in a multiport diffuser, which will cause the treated TIA water to rise, thereby reducing or eliminating the potential contact with the seabed sediments. Further details are described below.

The temperature of the treated TIA water may not be identical to the temperature of Roberts Bay water at all times of the year. In order to address any concerns about the potential for the proposed Project to influence the timing or thickness of ice in Roberts Bay, the potential for changes in ice thickness are described below.

The installation of the subsea pipeline and diffuser system has the potential to influence marine fish habitat in Roberts Bay. A No Net Loss Plan has been prepared describing how the DFO Policy of No Net Loss will be achieved as part of the proposed Project.

As the discharge of treated TIA water to Roberts Bay has the potential to influence the water quality of Roberts Bay, there is the potential to influence the food sources for marine fish and wildlife

(e.g. seabirds, mammals) in Roberts Bay. These potential interactions are dependent on the potential water quality changes and habitat changes. The proposed Project is being designed such that marine CCME guidelines for the protection of marine life will be met in Roberts Bay during the entire period of treated TIA water discharge. Marine CCME guidelines are Canadian Federal guidelines that are meant to be protective of all marine life, and by designing the Project to ensure that these threshold guidelines will be met, food sources of marine fish and wildlife should be protected.

Finally, because of the importance of Caribou in Nunavut, the use of the Roberts Bay area for caribou crossings during the ice-covered months is included. The proposed Project is not expected to influence the ice thickness of Roberts Bay ice, nor the timing of freeze up. The Project has been designed to include a multiport diffuser at 40 m depth which will keep the treated TIA water in the deep waters of Roberts Bay, and prevent interaction with the upper water layers and ice.

5.2 WATER QUALITY

The discharge of treated TIA water to Roberts Bay has the potential to influence the water quality of Roberts Bay, as the concentrations of non-salt parameters in the treated TIA water could be different than existing background concentrations in Roberts Bay.

During construction, limited activity such as the 'daylighting' of the pipeline and securing the pipe anchors to the sediment surface will cause localized, very temporary increases in suspended solids and their related constituents (e.g., total metals). This material will be quickly dispersed throughout Roberts Bay and conditions would quickly return to baseline levels within days after the activity ceased.

The following text focuses on when there is active discharge of treated TIA water into Roberts Bay.

5.2.1 Mitigation by Design

The treated TIA water will meet the legally-required MMER guidelines within the pipeline, as specified in the Type A Water Licence, prior to discharge via the multiport diffuser in the marine environment.

In addition, the Project has been designed such that CCME guidelines for the protection of marine life will be met within Roberts Bay during the entire time of discharge of treated TIA water. CCME guidelines are conservative, often employing order of magnitude safety factors based on toxicological tests, and are designed to be protective "of *all* forms of aquatic life and all aspects of aquatic life cycles, … including the most sensitive life stage of the most sensitive life species over the long term" (CCME 1999).

The predicted quality of the excess TIA water is described in SRK 2011. The proposed treatment measures to ensure that the MMER guidelines are met within the pipeline, and that the marine CCME guidelines are met within Roberts Bay are described in Hatch 2011.

In order to achieve this Project design, the baseline chemistry of Roberts Bay, along with the water circulation dynamics of Roberts Bay were used to provide threshold levels that the treated TIA water must meet in order to maintain Roberts Bay water quality concentrations below marine CCME guidelines for the duration of planned treated TIA water discharge.

Treatment methods were then determined that would allow the treated TIA water to meet these thresholds.

5.2.2 Predicting Treated TIA Discharge Targets

Treated TIA water discharge targets were calculated and used to identify appropriate treatment such that marine CCME guidelines for the protection of marine life would be met for the duration of treated TIA discharge to Roberts Bay.

The following information was used to calculate the treated TIA water discharge targets:

- Background Roberts Bay water chemistry;
- Water circulation within Roberts Bay;
- Exchange rate of Roberts Bay water with Melville Sound;
- Performance of the proposed multi-port diffuser;
- Anticipated discharge volume of treated TIA water; and
- Marine CCME guidelines.

Results from the treated TIA water discharge targets were used to determine appropriate treatment methods as described in Hatch 2011.

The treated TIA water discharge targets were calculated using a simple mass-balance model with monthly time steps that had the constraint that marine CCME guidelines would be met during the active discharge of treated TIA water to Roberts Bay. The following data/assumptions were used for the time-stepped model:

- Background water quality concentrations in the deep water (below the pycnocline) of Roberts Bay based on 2009–2011 data (since the discharge will be at 40 m);
- The treated TIA water would be discharged year round at a constant rate of 120 L/s;
- During the winter months, treated TIA would pool within Roberts Bay between 20 m and 40 m depth; and
- During the summer months, 33% of Roberts Bay water between 20 and 40 m would move in to Melville Sound in July, August, and September. This assumption allows for nearly 100% of deep Roberts Bay water to move into Melville Sound each summer.

Treated TIA water quality target concentrations were developed for all parameters with marine CCME guidelines with a few exceptions. Dissolved oxygen was not modelled; rather the marine CCME guideline was used as the treated TIA water target concentration (DO: ≥8.0 mg/L). pH was also not modelled, and the marine CCME guideline range was used for the treated TIA water target concentrations (pH: 7.0–8.7).

5.2.2.1 CCME Marine Water Quality Guidelines used for Treated TIA Discharge Targets

Table 5.2-1 presents the CCME water quality guidelines for the protection of marine aquatic life. These concentrations were used as upper limits that could be reached in Roberts Bay during treated TIA water discharge, and were used to generate the estimated TIA water quality concentrations that ensure these guideline levels will not be surpassed in Roberts Bay.

Table 5.2-1. Marine CCME Guidelines along with Assumed Concentrations for Target Roberts Bay Water Quality

Parameter	Units	CCME Guideline Concentration	Assumed Parameter for Modelling	Assumed Target Concentration for Modelling
pH[1]	pH units	7.0-8.7	pH	7.0 to 8.7*
Nitrate-N	mg/L	3.6	Nitrate-N	3.6
Dissolved Oxygen[1]	mg/L	8	Dissolved Oxygen	8*
Salinity	‰	<10% change of natural salinity	Salinity	<10% change of natural salinity
Temperature[2]	°C	<1°C variation compared to natural temperature	Temperature	Not included
Total Arsenic	mg/L	0.0125	Total Arsenic	0.0125
Total Cadmium	mg/L	0.00012	Total Cadmium	0.00012
Chromium (Cr^{3+}) Chromium (Cr^{6+})	mg/L	0.056 (III) 0.0015 (VI)	Total Chromium	0.0015
Mercury (inorganic)	mg/L	0.000016	Total Mercury	0.000016

[1] pH and dissolved oxygen were not modelled. Rather, the CCME guidelines for the protection of marine life were used as the target treated TIA water concentrations. The CCME guideline for dissolved oxygen is for a minimum of 8 mg/L for coastal and estuarine environments. If natural concentrations are greater than 8 mg/L, then the guideline specifies that human activities should not result in a decrease of more than 10% of the natural concentration at any one time. If natural concentrations are below 8 mg/L, as they can be during the under-ice season in Roberts Bay, then the natural concentration becomes the interim dissolved oxygen guideline.

[2] based on an estimated 40:1 dilution of treated TIA water within 10 m of the diffuser during the ice-covered period, treated TIA water would have to be discharged at 40°C to increase surrounding ambient water by 1°C. This is highly unlikely and therefore temperature was not modelled.

Chromium (trivalent and hexavalent) and mercury (inorganic) each have specific, non-total metal CCME criteria. However, commercial analytical laboratories typically measure the total or dissolved fractions of metals, not individual species such as trivalent and hexavalent chromium. Using total values is the most conservative approach. As a result, some assumptions were made regarding what total metal concentrations would become target concentrations for Roberts Bay. For chromium, it was assumed that setting the target guideline at 0.0015 mg/L would ensure that both trivalent and hexavalent species would remain below potentially toxic levels. The same rationale was used for the assumption that the total mercury guideline was the same as the CCME guideline for inorganic mercury (0.000016 mg/L).

Nitrate

The marine CCME guideline for nitrate is intended to protect marine organisms from toxic levels of nitrate. However, nitrate can also act as a nutrient in marine waters, and there is the potential for changes in Roberts Bay due to nitrate as a nutrient rather than causing toxicity.

Roberts Bay is an oligotrophic system (i.e., low nutrient concentrations, low primary productivity), with phytoplankton growth controlled by light during the ice-covered season and by nitrogen availability during the summer.

The introduction of nitrate at marine CCME guideline levels has the potential to cause classic eutrophication changes in Roberts Bay, by potentially increasing phytoplankton growth during the summer, which could result in increased organic matter sinking to depth, where it would be decomposed by bacteria and use up oxygen in the bottom waters, thereby potentially decreasing dissolved oxygen.

However, by having the diffuser at 40 m depth, below the upper sun lit portion of the water column, nitrate in the treated TIA water will not be readily available to phytoplankton, which will be photosynthetically active in the upper water layers. Phytoplankton, being single-celled plants, require sunlight to survive. During the summer months, all of the nitrate is used up in the upper water column (above the pycnocline), but higher nitrate concentrations remain below the pycnocline throughout the summer, and phytoplankton are not photosynthetically active at deep depths.

Hence, by discharging treated TIA water at a deep depth of 40 m, it is not anticipated that the introduction of nitrate at marine CCME guideline levels will cause any eutrophication effects in Roberts Bay.

5.2.2.2 Roberts Bay Background Water Quality Concentrations

Detailed marine water quality sampling has been conducted in Roberts Bay in 2009, 2010, and 2011 (see Chapter 4 for details).

As the multiport diffuser will be located at 40 m depth, only water quality from similar depths, and most importantly below the pycnocline (the pycnocline serves as a barrier between water above and below it), were used to model TIA water quality target concentrations.

Data were used from two sampling depths below the pycnocline (14–18 m; 30–40 m) and included data from both the ice-covered (April) and open-water seasons (August). The sampling site used was located approximately 500 m seaward of the proposed multiport diffuser, and unless indicated, the background concentrations were the median value of two winter and two summer concentrations. If a concentration was below detection, the detection limit value was used rather than 1/2 of the detection limit. Table 5.2-2 presents the background water quality concentrations that were used.

Table 5.2-2. Roberts Bay Background Water Quality used for Calculating Treated TIA Water Discharge Targets

Parameter	Units	Detection Limit	Concentration Used as Roberts Bay Background for Modelling
pH[1]	pH units	0.01	7.72
Nitrate-N	mg/L	0.006	0.040
Dissolved Oxygen[1]	mg/L	0.1	11.9 (summer)[2] 7.8 (winter)[2]
Salinity	‰	0.002	27.2[2]
Temperature	°C	0.002	-0.4[2]
Total Arsenic	mg/L	0.0002	0.00094
Total Cadmium	mg/L	0.00002	0.000045
Total Chromium	mg/L	0.0001	0.0001
Total Mercury	mg/L	0.00001	0.000005[3]

Note: All data and detection limits are from 2009, except total chromium (2010 data and analytic detection limit). All other data selection criteria were identical (same sampling sites, sampling depths, months of sampling).
[1]pH and dissolved oxygen were not modelled. Rather the CCME guidelines for the protection of marine life were used as the targeted TIA concentrations.
[2] Salinity, temperature, and dissolved oxygen values are an average of all measurements collected between 20 m and 40 m depth at a mid Roberts Bay (WT4/ST4) station in April and August of 2009 and 2010 (see Chapter 4).
[3] The background total Hg value used was half way between the ultra low level detection limit used for April 2011 samples and the low detection limit used for 2009 samples (0.0000005 mg/L and 0.00001 mg/L)

5.2.2.3 Model Assumptions

The goal of the modelling exercise was to calculate treated TIA water target concentrations to ensure that the water quality of Roberts Bay remains below marine CCME guideline concentrations for the duration of treated TIA discharge to Roberts Bay.

A monthly time-stepped model was run for each parameter, so that the concentration of that parameter in Roberts Bay remained just below the respective marine CCME guideline.

The model was run for a hypothetical scenario where treated TIA water was discharged over a 6-year period to Roberts Bay, after which there was no longer any discharge (Appendix 5.2-1). This period of discharge was longer than the proposed operational period of the TIA for the Doris North Project, including the proposed amendment activities.

One of the key factors influencing the water quality dynamics in Roberts Bay is the exchange between Roberts Bay and Melville Sound. Based on field measurements of under-ice currents, the absence of a sill at the mouth of Roberts Bay, and numerical modelling based on wind data (see Chapter 4 of this report for more information), the following assumptions were made, which reflect the current understanding of water circulation in Roberts Bay:

- During the winter months, there is very little exchange of water between Roberts Bay and Melville Sound;
- During the summer months, wind drives the circulation of Roberts Bay, and surface water from Melville Sound enters Roberts Bay, while deeper water exits Roberts Bay to Melville Sound; and
- Roberts Bay water is flushed completely with Melville Sound water during the open-water season.

During the winter, exchange between Roberts Bay and Melville Sound is extremely low and treated TIA water is expected to 'pool' during this period. During the summer, treated TIA water discharged into the deep layer (below the pycnocline depth of 10–12 m) is expected to be flushed completely into Melville Sound. This was addressed in the model by assuming that 33% of deep water exits Roberts Bay during each of the months of July, August, and September.

Additional assumptions used for the model include:

- Roberts Bay water quality concentrations must remain below marine CCME guideline concentrations for the duration of treated TIA discharge (see Table 5.2-1);
- Treated TIA water would be discharged to Roberts Bay year round at a flow rate of 120 L/s at the proposed diffuser location (40 m depth, ~2.4 km from shoreline);
- The treated TIA water would be trapped in a 20 m thick layer (from 20 to 40 m depth), and would be mixed laterally throughout this layer on a monthly basis;
- Roberts Bay – Melville Sound exchange is 33% for each month during the open-water season (July, August, September) and 0% during the ice-covered season (tides are weak); and
- All parameters act conservatively. No biological or geochemical processes were considered.

5.2.3 Treated TIA Discharge Targets Results

Table 5.2-3 presents the calculated treated TIA water discharge targets that would ensure that Roberts Bay water quality remains below CCME guidelines for the duration of treated TIA discharge to Roberts Bay.

Table 5.2-3. Calculated Treated TIA Discharge Water Quality Targets to Ensure that Roberts Bay Water Quality Remains Below Marine CCME Guidelines

Parameter	Units	Allowable Concentration in TIA for > 4 Years of Continuous Discharge at 120 L/s
Oxygen[1]	mg/L	8.0
pH[1]	pH units	7.0– 8.7
Nitrate-N	mg/L	118
Salinity	‰	0-116
Total Arsenic	mg/L	0.381
Total Cadmium	mg/L	0.0025
Total Chromium	mg/L	0.017
Total Mercury	mg/L	0.00037

[1] Oxygen and pH were not modelled; rather the CCME guidelines for the protection of marine life were used as the targeted TIA concentrations.

Time-stepped graphs for each parameter are provided in Appendix 5.2-1. For the scenario of discharging treated TIA water to Roberts Bay for a period of 6 years, the model results indicate that concentrations would increase slowly during the winter months when there is no exchange between Roberts Bay and Melville Sound and the treated TIA water 'pools' within Roberts Bay. During the open-water water season, when winds are high and exchange between Roberts Bay and Melville Sound is greatest, concentrations decrease rapidly. Overall, an equilibrium is established after four years, with peak concentrations reaching CCME guideline limits (the upper limit set in the model) when Roberts Bay is ice-covered, and the lowest concentrations reached annually during the summer when exchange with Melville Sound is greatest.

After treated TIA water discharge is discontinued, all parameters return to baseline levels within 3 years due to exchange between Roberts Bay and Melville Sound. This time period could be shorter if full flushing occurs during one of the months in the summer (the model assumes 33% flushing for July, August, and September).

These targets have been used to identify appropriate treatment methods, such that the water in Roberts Bay remains below marine CCME guidelines. As these thresholds are protective of marine life, no adverse effects on water or biota are expected. In addition, any changes to Roberts Bay water quality will be short term in nature, as background water quality concentrations are expected to be achieved a few years after treated TIA discharge has ceased.

5.2.4 Summary of Potential Effects on Water Quality

By keeping water quality concentrations below marine CCME guideline levels in Roberts Bay for the duration of treated TIA water discharge, and discharging the treated TIA water into the deep layer of Roberts Bay, the magnitude of any change to water quality would be below the threshold that would be considered significant. Marine CCME guidelines are conservative, often employing order of magnitude safety factors based on toxicological tests, and are designed to be protective "of all forms of aquatic life and all aspects of aquatic life cycles, … including the most sensitive life stage of the most sensitive life species over the long term" (CCME 1999). Hence no adverse effects on water quality, and hence marine life are expected.

Because Roberts Bay water flushes with Melville Sound water on an annual basis, the duration of any water quality changes will be short term (there will be increases in water quality concentrations during the winter months if treated TIA water is discharged year round), and background water quality

conditions are expected to return within 3 years after treated TIA water is no longer discharged to Roberts Bay. Hence, water quality changes in Roberts Bay are expected to be completely reversible.

The main mitigation measures being employed to protect the water quality of Roberts Bay include the following:

- Project Design: Treatment of Excess TIA Water to ensure MMER Discharge Criteria are met;
- Project Design: Treatment of Excess TIA Water to ensure Marine CCME Guidelines for the Protection of Marine Life are met in Roberts Bay throughout the discharge period of treated TIA water;
- Project Design: Locating the multiport diffuser at 40 m depth, and designing it so that the treated TIA water remains trapped below the productive upper water layers of Roberts Bay;
- Monitoring: The Doris North Aquatic Effects Monitoring Program (AEMP) will be expanded in Roberts Bay, in order to include the geographical areas in Roberts Bay that could be influenced by discharge of treated TIA water, as well as additional reference areas. Please see Chapter 8 of this report for further details.

5.2.5 Cumulative Effects

Cumulative environmental effects are residual effects from a proposed Project (those that are present after mitigation measures have been enacted) that combine with the environmental effects of existing Projects and/or activities to act cumulatively, additively, or synergistically.

The following activities are currently occurring as part of the Doris North Project in Roberts Bay:

- The operation of two accommodations barges anchored along the southern shore, just east of the shipping jetty;
- Shipping and off-loading of site materials at the jetty during the open-water season; and
- Mooring of floating fuel storage vessels in Roberts Bay.

The accommodation barges and moored fuel barges will discharge treated sewage and grey water into Roberts Bay. This water will be clean, freshwater that is not considered a deleterious substance by Environment Canada (EBA Engineering Consultants Ltd. 2010), and therefore does not pose a threat to Roberts Bay water.

Marine shipping traffic peaked in 2010 compared to previous years and the approved Aquatic Effects Monitoring Program (AEMP) in place did not detect any adverse changes as a result of these activities in 2010 (Rescan 2011a). Since shipping activity is expected to decline into the operation phase of the Doris North Project and the treated TIA water will meet CCME guidelines within Roberts Bay, there are no cumulative effects expected regarding shipping activity and the marine discharge of the Doris North TIA water into Roberts Bay.

Due to the mitigation measures that will be applied to the proposed Project, which includes TIA water treatment, design and placement of a diffuser at the end of the subsea pipeline, and discharging at depth, no residual impacts on water quality or marine life are expected due to the proposed Project.

As there are no anticipated residual effects, there are no cumulative effects between the proposed Project and other Doris North activities in Roberts Bay.

5.3 SEDIMENT QUALITY

Because of the inclusion of a multiport diffuser at the end of the subsea pipeline, the treated TIA water will mix vigorously and rise to a trapping depth above the diffuser. The treated TIA water is expected to have little interaction with the Roberts Bay sediments.

In addition, the treated TIA water will be largely free of suspended materials as it will meet the MMER discharge requirement of <15 mg/L total suspended solids (TSS) which must be met at end of pipe. Please refer to Hatch 2011 for details of the proposed treatment methods for TSS.

Hence, the treated TIA water is not anticipated to adversely affect the sediment quality of Roberts Bay.

Mitigation measures in place to ensure that Roberts Bay sediments are not adversely affected include:

- Project Design: Removal of total suspended solids (TSS) in order to comply with MMER discharge criteria, which will ensure that suspended solids will not enter Roberts Bay;
- Project Design: Including a diffuser at the end of the subsea pipeline to actively mix the treated TIA water with surrounding water and help control where the treated effluent water moves within Roberts Bay; and
- Monitoring: The Doris North Aquatic Effects Monitoring Program (AEMP) will be expanded in Roberts Bay, in order to include the geographical areas in Roberts Bay that could be influenced by discharge of treated TIA water, as well as additional reference areas. Sediment quality will be part of this monitoring. Please see Chapter 8 of this report for further details.

5.4 ICE THICKNESS

Discharge of treated TIA water during the winter could introduce a source of heat to Roberts Bay that is not present under natural conditions. Any warming of water during the winter could potentially affect the ice thickness or freeze up timing in Roberts Bay.

The temperature of the treated TIA water during the winter is expected to be approximately 2°C. This temperature is necessary so that the on-land portion of the pipeline does not freeze. Higher temperatures will be avoided because they will require additional power in the heat-traced overland pipeline.

Over the winter at a treated TIA water discharge rate of 120 L/s, approximately 2.8×10^6 m^3 of treated TIA water will be discharged over a 9 month period. The discharge will mix into a 20 m thick layer of water representing approximately 160×10^6 m^3 of water at a temperature of approximately 0°C. The discharge will be trapped by the density gradient in this layer. The discharge would warm the 20 m thick layer by no more than approximately 0.032°C.

As the diffuser is located at 40 m depth, and the treated TIA water will remain below the pycnocline and not interact directly with the sea ice, the maximum change of 0.032°C in deep waters in Roberts Bay is not expected to have an effect on ice thickness or the timing of freeze up in Roberts Bay.

5.5 MARINE FISH

Roberts Bay is inhabited by at least 18 species of marine, brackish and anadromous fishes (see Chapter 4). Smaller species, such as Arctic cisco, least cisco and capelin, provide a food base for larger species such as Arctic char, anadromous lake trout and Greenland cod. Other organisms commonly eaten by Arctic marine fishes include a variety of zooplankton and benthic invertebrates.

By discharging treated TIA water into Roberts Bay, there is the potential for adverse changes to the water quality of Roberts Bay. This could result in adverse effects on marine aquatic life, including the health of fish, as well as the organisms that fish feed upon.

However, the Project has been designed such that marine CCME guideline concentrations will be met in Roberts Bay for the duration of treated TIA discharge. These guidelines are meant to protect all forms of aquatic life and all aspects of the aquatic life cycles from anthropogenic chemical and physical stressors, including the most sensitive life stage of the most sensitive species over the long term. In the case of marine fish, the most sensitive life stages are typically the eggs and pelagic larval stage. By keeping water quality concentrations below marine CCME guideline levels, no adverse residual Project effects on fish or fish resources are anticipated in Roberts Bay.

The main mitigation measures being employed to protect the water quality of Roberts Bay will protect fish and fish resources and include the following:

- Project Design: Treatment of Excess TIA Water to ensure MMER Discharge Criteria are met;
- Project Design: Treatment of Excess TIA Water to ensure Marine CCME Guidelines for the Protection of Marine Life are met in Roberts Bay throughout the discharge period of treated TIA water;
- Project Design: Locating the multiport diffuser at 40 m depth, and designing it so that the treated TIA water remains trapped below the productive upper water layers of Roberts Bay;
- Monitoring: The Doris North Aquatic Effects Monitoring Program (AEMP) will be expanded in Roberts Bay, in order to include the geographical areas in Roberts Bay that could be influenced by discharge of treated TIA water, as well as additional reference areas. Sediment quality, benthos, and mussel tissue concentrations are monitored as part of this program. Please see Chapter 8 of this report for further details.

5.6 MARINE FISH HABITAT

The nearshore areas of Roberts Bay provide habitat for at least 18 species of marine fish (see Chapter 4). These fishes utilize a variety of habitat types. Flatfishes inhabit sandy bottoms. Sculpins, gunnels, and cods inhabit areas of hard substrate with vertical relief for shelter. Arctic char, lake trout, and Pacific herring inhabit the mid-water column.

The installation of the subsea pipeline and diffuser has the potential to affect fish habitat. A No Net Loss Plan has been created that covers the infrastructure from the jetty at Roberts Bay to the diffuser at 40 m depth. The objectives of the No Net Loss Plan are to (1) provide DFO with the information it needs to determine if a *Fisheries Authorization* is required for this Project under section 35(2) of the *Fisheries Act*, and (2) propose a strategy for mitigation of fish habitat potentially affected by the proposed Project (the construction of the subsea pipeline and diffuser in Roberts Bay).

An un-insulated (bare) subsea pipeline will be installed in Roberts Bay to discharge the treated TIA water at 40 m depth through a multiport diffuser. The pipeline will be entrenched in the existing jetty and exit the toe of the jetty at 4 m depth. This will ensure that there is no adverse effect on shoreline fish habitat.

After “daylighting” at 4 m depth, below low water, the subsea pipeline will run approximately 2.4 km NNW to the 40 m isobath, where it will terminate in a 95 m long, 20 port diffuser. Rather than being entrenched in the seafloor, the subsea pipeline will be ballasted with concrete weights that will suspend the pipeline approximately 0.5 m above the seafloor (see Chapter 2 of this report). This will eliminate the need for digging a trench or otherwise disturbing the seafloor. Because of the depth of

Roberts Bay (4 m at the pipe exit point to 40 m at the diffuser), the pipe will not obstruct the migration of marine fish such as capelin, which undergo seasonal movements to spawning grounds east of Roberts Bay.

Many studies of fish recruitment to artificial habitats indicate that concrete block structures are useful in creating fish habitat, particularly in sediment bottom areas where no other hard substrate exists (Sherman et al. 2002). Particularly useful is the creation of ledges, crevices and similar shelter sites within these concrete structures (Ebata et al. 2011). In this case, lateral "ears" will be included on either side of the ballast weights to provide overhanging habitat for a variety of demersal fish. Gadids (cods) and Cottids (sculpins) are particularly attracted to complex hard substrates (Tupper and Boutilier 1995). In Roberts Bay, this would include four of the most common marine fishes: Greenland cod (*Gadus ogac*), saffron cod (*Eleginus gracilis*), fourhorn sculpin (*Triglopsis quadricornis*) and shorthorn sculpin (*Myoxocephalus scorpius*).

Each ballast weight will have a footprint of 80 × 40 cm or 0.32 m^2 (Figure 2.2-5 in Chapter 2). The ballast weights will be spaced at approximately 8 m intervals for a total of 2.4 km, requiring 300 ballast weight units. Thus the total footprint of the ballast weights will be 96 m^2. The "ears" will be 40 cm long × 20 cm wide. The total surface area (excluding the bottom surface) of each ballast weight will be 2.72 m^2, of which 0.16 m^2 will be high-quality overhanging ledge habitat. Thus, the total amount of new fish habitat created by the ballast weights will be 816 m^2. In addition to providing shelter for fish, the rough concrete surface of the ballast weights will form a settlement substrate for algae and sessile invertebrates, which may form a food source for small fishes and macroinvertebrates.

The colonization and fish use of the ballast weights and pipeline will be monitored by underwater videography (see Chapter 8 for more details of the proposed monitoring program).

Since no fish habitat will be altered, disturbed or destroyed by the proposed Project, there will be no net loss of fish habitat productivity, and in fact a net gain of at least 720 m^2 should be realized. This net gain in habitat could be considered a positive residual effect, especially given that increasing suitable habitat for the recruitment and colonization of marine organisms should lead to increased biological production in Roberts Bay.

5.7 MARINE WILDLIFE

5.7.1 Marine Mammals

Two of the three possible marine mammal species, ringed seal and bearded seal, were detected during aerial and barge surveys conducted in 2010. Ringed seals are an abundant seal species, distributed widely across the Arctic (Hammill 2009). Bearded seals have a much lower population density in the Canadian Arctic and a much patchier distribution than do ringed seals (Kovacs 2009). Ringed seals are the only seal present in the Arctic regions that are able to maintain open breathing holes in landfast sea ice throughout the winter, constantly abrading the edges of holes with their teeth to keep them open (Hammill 2009; Kovacs et al. 2010). This ability allows the ringed seals to have a much wider distribution than bearded seals, which are generally associated with drifting pack ice and rely on open waters leads, such as polynyas, throughout the winter (Kovacs et al. 2010).

Ringed and bearded seals also feed on different food items that correspond to their varying distributions. Ringed seals primarily feed on ice-associated organisms, such as Arctic cod, polar cod, and large zooplankton (Wathne, Haug, and Lydersen 2000). Bearded seals rely on benthic organisms and are thus more often found within shallow waters with drifting pack ice (Kovacs 2009). Seals are not abundant in Roberts Bay, although they are abundant in Melville Sound. For seals that may be present in Roberts Bay, water quality will remain below marine CCME guidelines and there are no adverse

effects expected for aquatic life and fish that seals may be feeding on. Considering the mobile nature of ringed and bearded seals, and that Roberts Bay is not a permanent residence for these seals, any exposure to the treated TIA will be temporary and no direct effects on the seals is expected.

The third marine mammal that has historically been observed in Melville Sound is the narwhal; however, this species has not been observed during baseline studies of Roberts Bay. Narwhals may not use this area, or are infrequent visitors to Roberts Bay. Narwhal were present for the first time in many years in 2011 in Cambridge Bay, and were reported in Melville Sound. With water quality remaining below CCME guidelines, no adverse effects are predicted for any of the invertebrate or fish diet of narwhals, thus no adverse effects are predicted for narwhals.

5.7.2 Seabirds

During aerial surveys conducted in August 2010 in Roberts Bay and adjacent bays, relatively few of the 19 seabird species that could possibly occur in the area were observed, with the lowest numbers in Roberts Bay itself. Regionally, small islands within Parry Bay and Melville Sound appear to be important areas for nesting common eiders and for supporting colonies of other seabirds such as glaucous gulls (Hoover, Dickson, and Dufour 2010).

Relatively little nesting activity has been observed in Roberts Bay and in adjacent bays between 2006 and 2010, and Roberts Bay consistently hosts the lowest density of seabirds of the surveyed inlets (Rescan 2011b). For seabirds that may be present, water quality will remain below marine CCME guidelines and there are no adverse effects expected for aquatic life and fish that seabirds may be feeding on.

5.8 CARIBOU

The annual movement patterns of Dolphin and Union caribou vary between sexes. Cows generally start their northward migration in May; the median migration initiation date of female caribou based on a decade of satellite collar data was May 24th (Poole et al. 2010). Females generally take less than five days to complete the northward trip (Poole et al. 2010). Males and juveniles tend to be the last members of the herd to travel to Victoria Island, crossing well into June (Gunn et al. 1997). This pattern agrees with the results of the ice crossing survey in 2010, where only male caribou were observed. It is likely that at the time of the survey, most female caribou had crossed and were on their calving grounds on Victoria Island.

Dolphin and Union caribou exhibit fidelity to crossing areas across Dease Strait and within the Coronation Gulf and Queen Maud Gulf. Based on twenty years of satellite collar data, some female caribou left from the same general area on the Arctic mainland for as many as five to six years (Poole et al. 2010). Several areas east and west of Bathurst Inlet appear to be used consistently across years. West of Bathurst Inlet, many female caribou started their northward migration from around Grays Bay and proceeded northwards towards the Richardson Islands (Poole et al. 2010). East of Bathurst Inlet, several females consistently started their northward migration from the edge of the Kent Peninsula and crossed eastward towards Cape Colborne just south of Cambridge Bay as well as roughly northward towards Byron Bay (Poole et al. 2010). The annual fidelity may be an artefact of the shortest possible “over ice” crossing distance, for example, island chains shorten the ice crossing distance west of Bathurst Inlet (e.g., Richardson Islands). The results of the ice crossing survey agree with historical and current movement patterns of Dolphin and Union caribou. The majority of caribou tracks documented during the 2010 ice crossing survey were oriented in a north or north-westerly direction, suggestive of caribou that pass from the northern edge of the Kent Peninsula towards Byron Bay on Victoria Island.

Roberts Bay is not a main crossing point for caribou moving between the mainland and the Kent Peninsula and ultimately Victoria Island. Typically, caribou will select narrower crossing points from the points to the east or west of Roberts Bay. Furthermore, there will be no effect to ice thickness as a result of discharging treated TIA water to Roberts Bay. As a result, there are no anticipated effects to caribou migration and ocean crossing patterns due to the discharge of treated TIA water to Roberts Bay.

6. Mitigation and Adaptive Management

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6. Mitigation and Adaptive Management

The proposed Project has been designed to eliminate or minimize potential adverse effects to the marine environment of Roberts Bay. The following text highlights the mitigation measures that have been included in the design of the proposed Project, as well as highlighting examples of adaptive management and other mitigation measures that will be used during the construction, operation, and closure of the proposed subsea pipeline/diffuser system.

6.1 MITIGATION BY PROJECT DESIGN

The following are major mitigation features that have been incorporated into the design of the proposed Project:

1. The saline TIA water will be discharged to the marine environment rather than the freshwater environment. This will eliminate potential adverse effects to the freshwater environment, and discharge the treated TIA water to a more appropriate receiving environment where the saline nature of the water will not result in adverse effects to resident marine organisms.
2. Any treated TIA water discharged to the marine environment will meet the MMER discharge criteria prior to discharge, as specified in the Doris North Type A Water Licence. This includes passing the required MMER toxicity tests.
3. The overall Project has been designed so that the water quality in Roberts Bay will remain below CCME guidelines for the protection of marine and estuarine life for the duration of operation of the TIA. By using Canadian guidelines that are meant to be protective of all marine life, the treated TIA discharge will not have significant adverse effects on the marine ecosystem in Roberts Bay.
4. The shoreline crossing of the pipeline has been designed to avoid disturbing sensitive shoreline fish habitat. By installing the pipeline through the jetty that already exists there will be no new disturbances to shoreline fish habitat.
5. The DFO policy of No Net Loss of fish habitat has been met by providing additional habitat in the form of ballast weights, which will provide surface area for colonization of algae and invertebrates, and habitat for demersal fish.
6. The installation of the pipeline and diffuser will not be conducted in late July, to avoid the time period when capelin spawning migrations are on-going.
7. The diffuser is being located at 40 m depth to ensure that the treated TIA water remains below the productive, sun-lit portion of the water column in Roberts Bay. This will minimize the potential for nutrients (e.g. nitrogen) in the treated TIA water to cause changes to the Roberts Bay ecosystem, and mitigate the potential for interaction of slightly warmer treated TIA water interacting with the surface ice.

6.2 ADAPTIVE MANAGEMENT

In addition to Project Design mitigation features, there are also additional mitigation measures that would be in place, which would allow for adaptive management if unexpected environmental concerns arise.

6.2.1 Expansion of the Aquatic Effects Monitoring Program

There is currently an approved (by Environment Canada and the Nunavut Water Board) AEMP in place for the Doris North Project. As part of the No. 04 amendment request, HBML is proposing to expand the AEMP in the marine environment to include the geographical area of the proposed diffuser and potential area of influence of the treated TIA water in Roberts Bay. An additional marine reference site is also proposed. There are currently two AEMP monitoring stations in Roberts Bay, and a marine reference site in Reference Bay. The final marine AEMP sites will be determined in consultation with Environment Canada.

The marine portion of the Doris North AEMP monitors water quality, dissolved oxygen, sediment quality, phytoplankton biomass, benthic invertebrates, and marine bivalves. The proposed new AEMP monitoring locations are adjacent to the proposed diffuser location (100 m) and ~2 km seaward of the proposed diffuser location, half way between the southern shoreline of Roberts Bay and Melville Sound.

The frequency of marine AEMP sampling is 4 times per year for water quality, dissolved oxygen, and phytoplankton biomass. Sediment quality and benthic invertebrates are sampled one time per year during the summer. Marine bivalves are sampled one time every three years.

The AEMP monitoring will determine whether the water quality in Roberts Bay is remaining below marine CCME guidelines, whether dissolved oxygen concentrations remain above marine CCME guidelines, whether phytoplankton biomass levels are being influenced by nutrient input, whether sediment quality or benthic communities are being influenced by the TIA water, and whether the discharge of TIA water is causing any changes in marine bivalve metal concentrations.

If results from the AEMP show that adverse environmental changes are occurring, HBML can implement adaptive management measures that could potentially change the quality, quantity, or timing of the treated TIA discharge to Roberts Bay. Examples of potential adaptive management measures could be:

- Reviewing the TIA Operational Plan. Aspects such as how much water is discharged and the timing of the discharge could be reviewed to see if changes could be made in the event of detecting adverse changes via the AEMP.
- Aerating the TIA effluent. If dissolved oxygen levels appear to be declining in Roberts Bay, an adaptive management measure could be including aeration of the treated TIA water prior to discharge in Roberts Bay.
- Modifying the Treatment. The treatment measures in place for the TIA water prior to discharge to Roberts Bay could be reviewed and optimized if needed.

6.2.2 Fish Habitat and No Net Loss Plan Monitoring

As part of ensuring that there is no net loss of productive fish habitat associated with the presence of the subsea pipeline in Roberts Bay, it is proposed to conduct a pipeline/ballast utilization monitoring program to confirm the utility of the concrete ballast weights in providing fish habitat.

The monitoring would occur one year following the installation of the pipe, and again 3 years post-installation.

If the monitoring shows that the ballasts are not being colonized and used as fish habitat, HBML could adapt by discussing results with DFO and determining whether the monitoring program could be modified, and/or additional mitigation measures should be considered.

6.3 MITIGATION AND COMPLIANCE WITH JETTY REPAIR FISHERIES AUTHORIZATION

During the installation of the pipeline in the transitional area of the jetty, the following mitigation measures, as outlined in the Jetty Expansion Fisheries Authorization (DFO No. NU-10-0028) will be followed:

- No in-water work shall occur between July 15 and August 15 to protect critical spawning and rearing periods for all fish species in Roberts Bay.
- A qualified biologist or environmental inspector shall be on site during all in-water construction, compensation and restoration works to ensure implementation of the designs as intended in the Plan and conditions of this Authorization.
- All materials and equipment used for the purpose of all work phases shall be operated and stored in a manner that prevents any deleterious substance (e.g. petroleum products, silt, debris, etc.) from entering the water.
  - Any stockpiled materials shall be stored and stabilized above the ordinary high water mark of any water body.
  - Vehicle and equipment re-fuelling and maintenance shall be conducted above the ordinary high water mark of any water body.
  - Any part of any equipment entering the water shall be free of fluid leaks and externally cleaned/degreased to prevent any deleterious substance from entering the water.
- Only clean, competent, certified non-acid generating rock and material free of fine particulate matter shall be placed in the water.
- Material used for habitat compensation features shall not be taken from below the ordinary high water mark or shoreline of any water body.
- Sediment and erosion control measures shall be implemented prior to work, and maintained during the work phases, to prevent entry of sediment into the water or the movement of re-suspended sediment.
- All disturbed areas shall be stabilized upon completion of work and restored to a pre-disturbed state or better.
- Sediment and erosion control measures shall be left in place and maintained until all disturbed areas have been stabilized.
- A sediment and erosion control plan shall be submitted to the Iqaluit, NU office of the Department of Fisheries and Oceans, Fish Habitat Management, Eastern Arctic Area, at least 10 days prior to the start of construction.

6.4 DORIS NORTH MITIGATION MEASURES AND PLANS

The Doris North Project has many mitigation measures in place that have been used and will continue to be used during construction, operation, and closure of the Doris North Project.

All of the existing measures and plans would be in place for the construction, operation, and closure of the subsea pipeline and diffuser, and all requirements of the existing Type A Water Licence, Project Certificate, and other licences and permits would be met.

Examples of mitigation plans/programs that are currently in place include:

- Noise Abatement Plan;

- Wildlife Monitoring and Mitigation Plan;
- Spill Contingency Plan;
- Oil Pollution Prevention Plan/Oil Pollution Emergency Plan;
- Emergency Response Plan;
- Hazardous Waste Management Plan;
- Incinerator Management Plan;
- Doris North Landfarm Management and Monitoring Plan;
- Quality Assurance and Quality Control Plan;
- Hope Bay Quarry Monitoring; and
- Doris North Infrastructure Project Management Plan.

7. Reclamation and Closure

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7. Reclamation and Closure

It is anticipated that the subsea pipeline and concrete ballast weights will become fish habitat over time. Hence, it is proposed to leave these structures in place upon closure. The final closure plan for the subsea pipeline will need to be determined in collaboration with DFO and other interested parties.

The closure plan for the TIA has been updated and is included as part of the amendment application package.

8. Monitoring

8. Monitoring

The Doris North Project has many monitoring programs in place, some of which already encompass the Roberts Bay geographical area.

A recent summary of the current Doris North monitoring programs can be found in the report entitled *Monitoring and Follow-Up Plan, Doris North Gold Mine Project* (HBML 2011).

As part of the amendment application, it is proposed to add the following monitoring activities to the existing Doris North monitoring programs:

1. Expand the existing AEMP in Roberts Bay to include the geographical area of the proposed new diffuser and potential area of influence; and
2. Implement the fish habitat monitoring proposed in the No Net Loss Plan to monitor the use and colonization of the subsea pipeline and ballast weights.

The Wildlife Monitoring and Mitigation Program (WMMP) study area already includes all of Roberts Bay, and there are no proposed changes to this program as a result of the addition of the subsea pipeline and diffuser.

8.1 AQUATIC EFFECTS MONITORING PROGRAM

The Aquatic Effects Monitoring Program (AEMP) is a requirement of the Doris North Type A Water Licence. An AEMP Plan was reviewed by Environment Canada (EC) and approved by the Nunavut Water Board (NWB) in early 2010 (Rescan 2010a), and the first year of the program was initiated in 2010 (Rescan 2011a).

The current AEMP includes two monitoring stations in Roberts Bay, and a marine reference monitoring station in Reference Bay (a bay to the east of Roberts Bay).

Since the discharge of treated TIA water to Roberts Bay has the potential to influence the water in Roberts Bay, it is proposed that grid stations be established around the diffuser and throughout Roberts Bay to monitor the geographical extent and dilution of the plume via CTD casts, and that two new discrete stations be established in Roberts Bay, and one new station be established in Reference Bay. The final locations of these stations will be determined in consultation with EC.

Figure 8.1-1 presents the proposed new CTD stations, the two new AEMP stations in Roberts Bay, along with the two existing AEMP stations located closer to shore. Figure 8.1-1 also presents the proposed new AEMP marine reference station in Reference Bay, along with the existing marine AEMP reference station.

The proposed new stations are provided in Table 8.1-1.

For the CTD stations, it is proposed to conduct CTD casts synchronously with the water quality sampling, which has a sampling frequency of 4 times per year. These CTD stations would be used to monitor the geographic extent and dilution of the plume, as the treated TIA water will have a distinct salinity signature that can be detected by the CTD. The CTD stations would be distributed throughout Roberts Bay, as indicated in Figure 8.1-1.

Table 8.1-1. Proposed New Marine AEMP Sampling Stations, Descriptions, and Purpose

Proposed New AEMP Station	Coordinates	Bottom Depth	Description	Purpose
CTD Stations	Various (see Figure 8.1-1)	Various	Stations located throughout Roberts Bay	To monitor the geographical extent and dilution of the treated TIA discharge plume
Station RB1	431936 E 7565566 N	~40 m	100 m away from the diffuser	Exposure site located as close to the diffuser as safely and logistically possible
Station RB2	432304 E 7567343 N	~70 m	~2 km seaward of the diffuser, in the center of Roberts Bay	Central monitoring site on seaward side of diffuser; midway between southern shore of Roberts Bay and Melville Sound; 2 stations are already in place in the nearshore environment
Station REF-Marine2	441984 E 7565159 N	~40 m	~2.3 km seaward from existing Reference Site	To provide a reference station for the 2 new proposed AEMP stations in Roberts Bay, particularly Station RB1

Coordinates are in NAD83 UTM Z13N.

For the discrete sampling locations in Roberts Bay and Reference Bay, it is proposed to conduct full AEMP sampling at these stations, which includes water quality, dissolved oxygen, phytoplankton biomass, sediment quality, and benthic invertebrates sampling. Due to the deep nature of the proposed station in the centre of the Bay (~70 m depth at proposed station RB2), it may not be possible to collect sediment and benthos samples at that station. All other AEMP components would be monitored at the deep station.

Table 8.1-2 provides the recommended sampling frequency at all new stations. The within-year sampling frequencies indicated are the same as for the current Doris North AEMP as outlined in the approved AEMP Plan (Rescan 2010a). Water quality and sediment quality parameters to be analyzed will be the same as for the current AEMP. In addition, methyl mercury samples will be collected from sediment and water.

Table 8.1-2. Proposed Sampling Components and Sampling Frequency for New Marine AEMP Stations

Component to be Monitored	Proposed New CTD Stations (various depths)	Proposed New Station RB1 (38 m depth)	Proposed New Station RB2 (67 m depth)	Proposed New Reference Station REF-Marine2 (~40 m depth)
Salinity (via CTD casts)	4 times/year	4 times/year	4 times/year	4 times/year
Water Quality (includes Dissolved Oxygen)		4 times/year	4 times/year	4 times/year*
Phytoplankton Biomass		4 times/year	4 times/year	4 times/year*
Sediment Quality		1 time/year		1 time/year
Benthic Invertebrates		1 time/year		1 time/year

**Please note: access to the Reference Bay is restricted during the winter months when no helicopter is on site, and the area is too far away to access by snowmobile. Sampling at the reference station may have to be restricted to the summer months. This would reduce the water quality and phytoplankton biomass sampling to 3 times/year.*

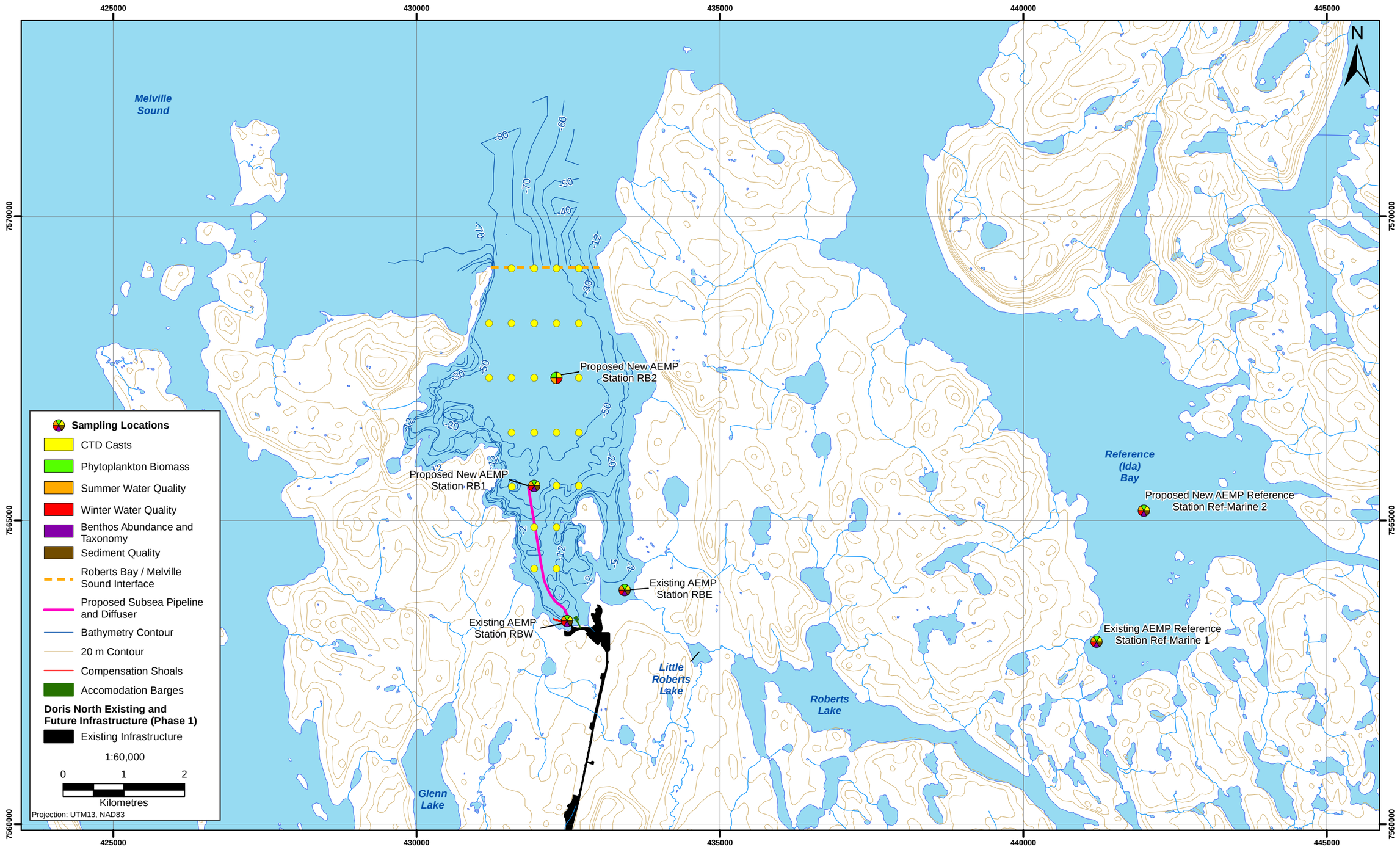

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Figure 8.1-1

Proposed New Marine AEMP Sampling Stations

For the overall monitoring schedule, it is proposed to base the sampling years relative to when the subsea pipeline and diffuser would be constructed, and when the discharge of treated TIA water would commence. Table 8.1-3 presents a proposed overall monitoring schedule for the new AEMP stations.

Table 8.1-3. Proposed Overall Monitoring Schedule for New Marine AEMP Stations

Year	Anticipated TIA Discharge	AEMP Sampling	EEM Cycle
Year Minus 2	No	Yes (pre-discharge)	
Year Minus 1	No	Yes (pre-discharge)	
Construction of pipeline/diffuser	Construction of pipeline/diffuser	No (construction)	
Year 1	No	No	
Year 2	No	No	
Year 3	Yes	Yes (evaluation of effects)	EEM First Study Design Report (within 12 mo of TIA discharge)
Year 4	Yes	Yes (evaluation of effects)	
Year 5	Yes	Yes (evaluation of effects)	EEM Cycle 1 Interpretive Report (within 36 mo of TIA discharge)
Year 6	Not Anticipated	Evaluate in Year 5 in consultation with EC	

For the overall monitoring schedule, it is proposed that 2 years of data be collected prior to the construction of the pipeline/diffuser. This would allow for the use of a before-after-control-impact approach to the evaluation of effects that would be conducted once treated TIA discharge commences. The overall proposed monitoring schedule should be finalized with EC at a later date as the schedule will depend upon receiving approval of the amendment application for the Type A Water Licence.

8.2 FISH HABITAT AND NO NET LOSS PLAN MONITORING

As part of ensuring that there is no net loss of fish habitat associated with the presence of the subsea pipeline in Roberts Bay, it is proposed to conduct a monitoring program to confirm the utility of the concrete ballast weights in providing fish habitat.

The pipeline/ballast utilization monitoring program would involve an underwater video assessment of the pipeline at the exit point (i.e. where the pipe "daylights") and at four depth strata: 5 m, 10 m, 15 m, and 20 m. Observers would use a Delta Vision SplashCam or similar underwater video system, lowered from a boat, to record the colonization of the ballast weights and pipeline by sessile marine organisms and to record the presence of fish associated with the ballast weights.

A total of 2 hours of video would be recorded at each depth stratum during August of the year following pipeline construction, and again 3 years following pipeline construction. Colonization of the pipeline and concrete ballasts in Roberts Bay will likely be too slow to warrant yearly monitoring. In each video recording, the percentage cover of encrusting organisms on the pipe and ballast weights would be estimated, and the number and species of macroinvertebrates and fish would be recorded.

Results from the pipeline/ballast utilization monitoring would be presented in a report that would include the methods, results, and conclusions of the survey. A separate report would be prepared for the year 1 and year 3 monitoring surveys. These reports would be provided to DFO within 6 months of completion of the surveys.

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Appendix 4.2-1

Data Used for Summer Circulation Model

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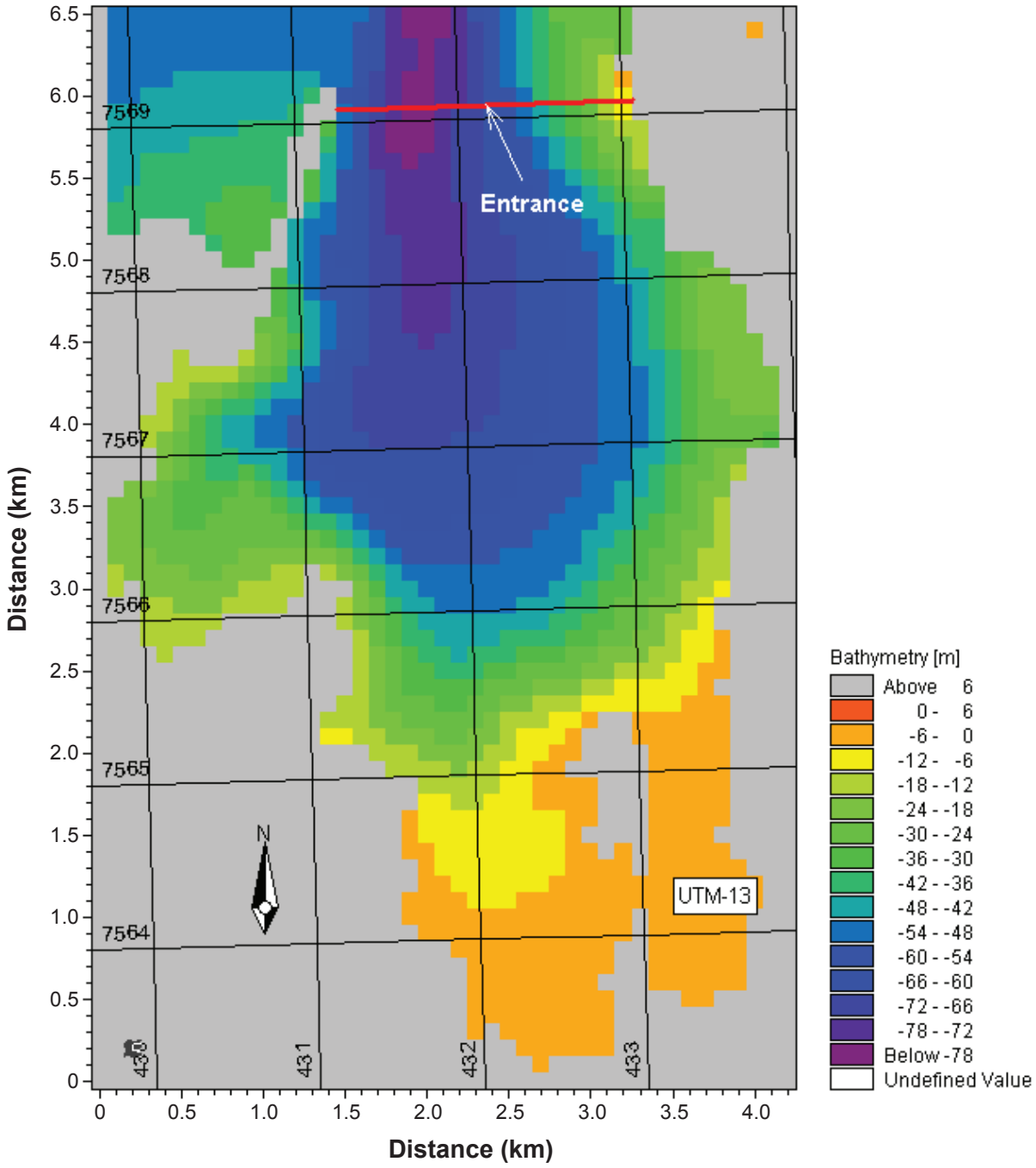

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Bathymetry Data Used for Summer Circulation Model

Appendix 4.2-1a

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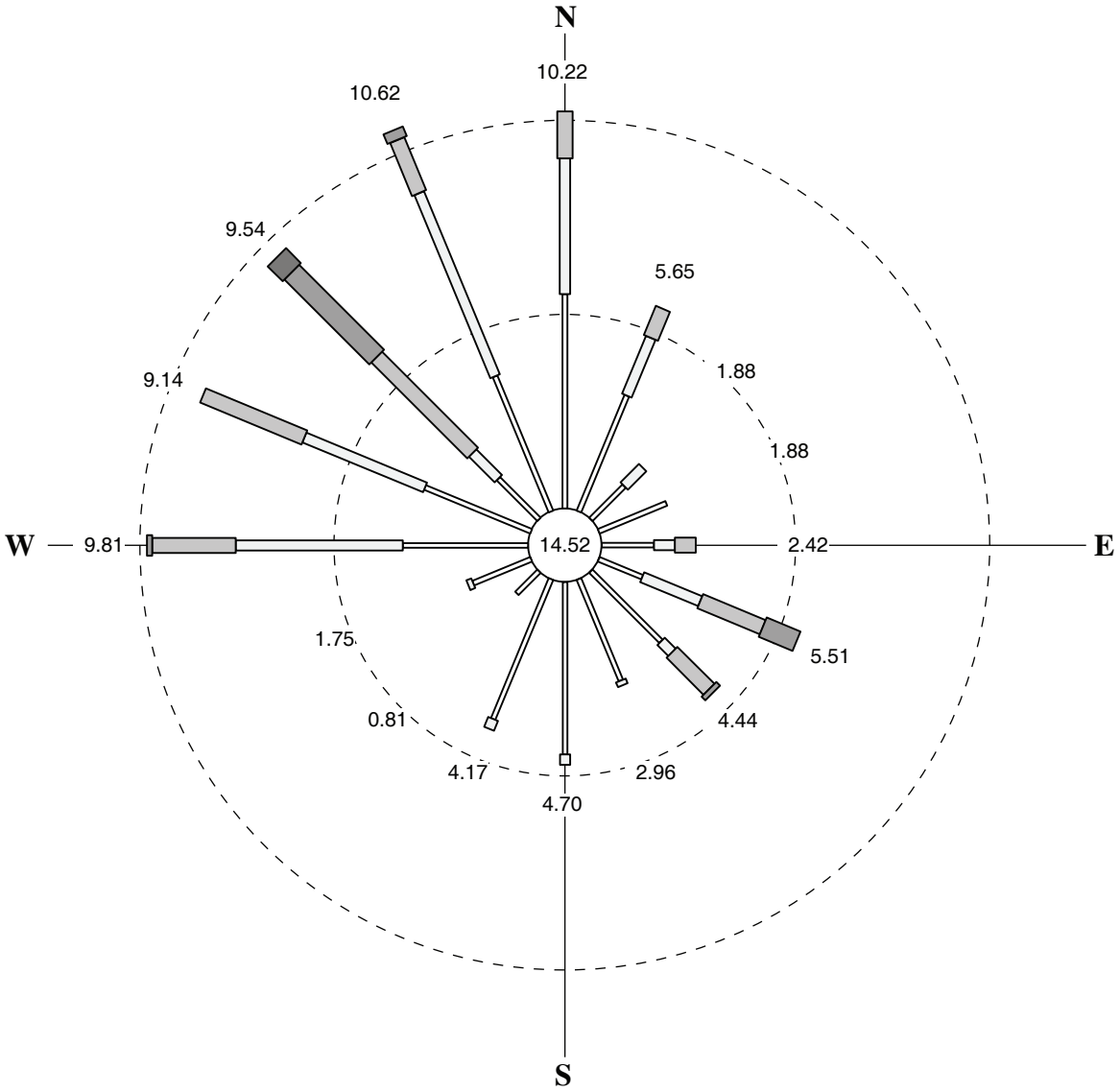

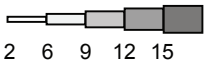

Wind Speed
(Meters Per Second)

Calms included at center.
Rings drawn at 5% intervals.
Wind flow is FROM the directions shown.
No observations were missing.
Calm winds = hourly average wind speeds below 2 m/s.
Wind data are from August 1 to August 31, 2000.

NEWMONT NORTH AMERICA

August Wind Rose Data Used for Summer Circulation Model

Appendix 4.2-1b

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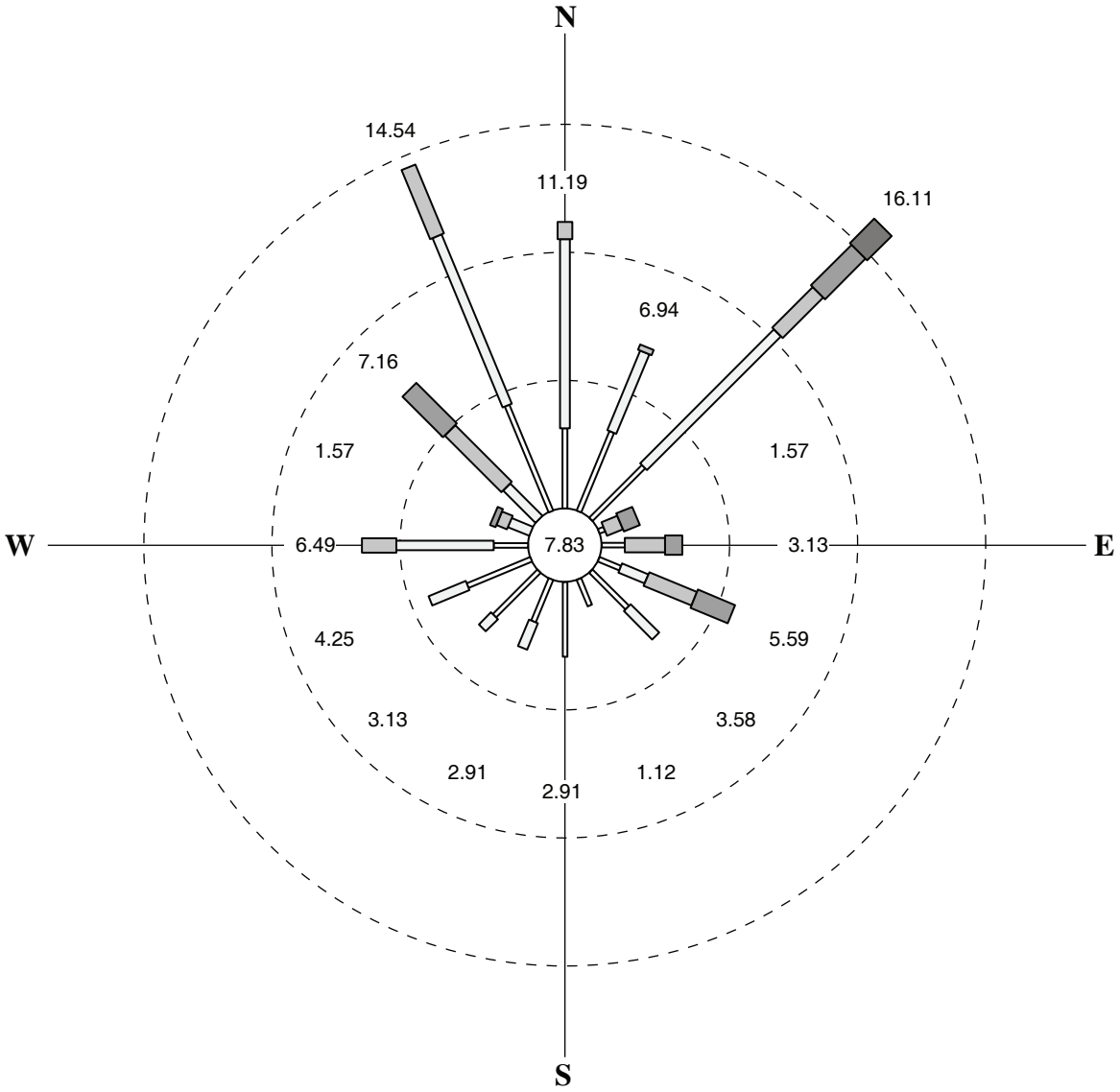

Wind Speed (Meters Per Second)

Calms included at center.
Rings drawn at 5% intervals.
Wind flow is FROM the directions shown.
No observations were missing.
Calm winds = hourly average wind speeds below 2 m/s.
Wind data are from August 25 to September 12, 2000.

NEWMONT NORTH AMERICA

September Wind Rose Data Used for Summer Circulation Model

Appendix 4.2-1c

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Appendix 4.2-2

Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

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Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

2009

WT1 April 28, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
1.81	21.75	-1.29	26.60		
2.00				11.38	90.8
2.14	21.74	-1.24	26.54		
2.15	21.75	-1.25	26.56		
2.19	21.75	-1.27	26.58		
2.38	21.75	-1.27	26.58		
2.50				11.40	90.9
2.59	21.75	-1.27	26.58		
2.79	21.75	-1.28	26.59		
3.00	21.74	-1.29	26.58	11.40	90.9
3.44	21.74	-1.28	26.58		
3.50				11.44	91.5
4.00	21.74	-1.28	26.57	11.44	91.3
4.50				11.44	91.2
4.52	21.75	-1.29	26.59		
5.00				11.48	91.7
5.06	21.75	-1.27	26.58		
5.50				11.54	92.1
5.61	21.76	-1.28	26.59		
5.97	21.76	-1.28	26.60		
6.00				11.59	92.6
6.25	21.77	-1.28	26.61		
6.41	21.77	-1.29	26.62		
6.47	21.77	-1.28	26.61		
6.50				11.74	93.7
7.00				11.84	94.4

(end of table)

WT2 April 28, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
1.65	21.73	-0.84	26.17		
2.00				10.78	86.0
2.38	21.74	-0.84	26.19		
3.00				10.79	86.1
3.12	21.73	-0.83	26.16		
4.00				10.80	86.1

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT2 April 28, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
4.08	21.74	-0.82	26.17		
4.87	21.74	-0.79	26.14		
5.00				10.81	86.2
5.72	21.76	-0.81	26.19		
6.00				10.84	86.5
6.67	21.76	-0.80	26.18		
7.00				10.80	86.5
7.53	21.77	-0.83	26.22		
8.00				10.90	87.2
8.15	21.79	-0.82	26.23		
8.76	21.78	-0.87	26.26		
9.00				10.88	87.0
9.37	21.78	-0.83	26.23		
9.73	21.79	-0.85	26.26		
10.00				11.06	88.4
10.50				11.22	89.4

(end of table)

WT4 April 30, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
1.74	21.75	-1.51	26.80		
2.00				9.71	77.3
2.39	21.74	-1.51	26.78		
3.00				9.87	78.4
3.33	21.75	-1.51	26.80		
4.00				9.92	78.7
4.03	21.75	-1.52	26.80		
4.70	21.76	-1.52	26.81		
5.00				9.95	78.9
5.33	21.76	-1.52	26.81		
6.00				9.92	78.7
6.04	21.76	-1.51	26.80		
6.72	21.77	-1.51	26.81		
7.00				9.95	78.9
7.39	21.76	-1.51	26.80		
7.94	21.76	-1.51	26.80		
8.00				9.97	79.1
8.58	21.77	-1.50	26.80		

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT4 April 30, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
9.00				9.95	79.0
9.27	21.77	-1.48	26.78		
10.00	21.77	-1.42	26.74	10.00	79.4
10.58	21.79	-1.29	26.65		
11.00				9.81	78.2
11.21	21.87	-1.08	26.56		
11.99	22.16	-0.94	26.82		
12.00				8.69	70.0
12.71	22.37	-0.95	27.11		
13.00				8.66	69.9
13.50	22.31	-0.96	27.03		
14.00				8.72	70.4
14.25	22.34	-0.93	27.05		
15.00				8.74	70.3
15.12	22.40	-0.88	27.09		
15.96	22.47	-0.88	27.18		
16.00				8.54	68.9
16.70	22.48	-0.90	27.21		
17.00				8.48	68.6
17.44	22.49	-0.91	27.24		
18.00				8.53	68.8
18.28	22.50	-0.92	27.25		
19.00	22.49	-0.92	27.25	8.51	68.9
19.91	22.52	-0.92	27.27		
20.00				8.51	68.7
20.70	22.56	-0.91	27.32		
21.00				8.49	68.5
21.30	22.56	-0.92	27.33		
21.81	22.58	-0.92	27.35		
22.00				8.48	68.5
22.55	22.59	-0.94	27.39		
23.00				8.49	68.6
23.26	22.59	-0.95	27.40		
23.98	22.60	-0.94	27.40		
24.00				8.38	67.6
24.59	22.61	-0.94	27.41		
25.00				8.30	67.0
25.27	22.61	-0.95	27.43		
26.00				8.32	67.1
26.08	22.62	-0.95	27.44		

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT4 April 30, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
26.69	22.63	-0.96	27.46		
27.00				8.29	66.9
27.27	22.63	-0.96	27.46		
27.98	22.64	-0.98	27.49		
28.00				8.26	66.5
28.45	22.64	-0.98	27.49		
29.00				8.16	65.7
29.08	22.64	-0.99	27.50		
29.78	22.66	-0.99	27.52		
30.29	22.66	-0.99	27.52		
30.95	22.67	-0.99	27.53		
31.74	22.67	-0.99	27.54		
32.43	22.68	-1.00	27.56		
33.33	22.68	-1.00	27.56		
33.73	22.68	-1.00	27.55		
34.09	22.68	-1.01	27.57		
34.89	22.68	-1.02	27.58		
35.61	22.69	-1.02	27.59		
36.20	22.69	-1.04	27.60		
36.86	22.69	-1.04	27.60		
37.43	22.69	-1.04	27.60		
38.17	22.70	-1.03	27.60		
38.73	22.70	-1.03	27.60		
39.35	22.70	-1.03	27.61		
39.94	22.70	-1.05	27.62		
40.47	22.70	-1.04	27.62		
41.02	22.70	-1.04	27.62		
41.54	22.70	-1.04	27.62		
42.05	22.70	-1.04	27.62		
42.64	22.70	-1.03	27.60		
43.02	22.69	-1.04	27.61		
43.64	22.70	-1.04	27.61		
44.02	22.70	-1.05	27.63		
44.58	22.70	-1.06	27.64		
45.21	22.70	-1.05	27.62		
45.68	22.70	-1.06	27.63		
46.13	22.70	-1.06	27.63		

(end of table)

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 30, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
1.78	21.77	-1.25	26.58		
2.00				9.67	76.7
2.35	21.77	-1.25	26.58		
3.00				9.72	77.2
3.18	21.77	-1.26	26.60		
3.84	21.77	-1.25	26.58		
4.00				9.85	78.2
4.58	21.78	-1.23	26.58		
5.00				9.80	77.7
5.32	21.77	-1.22	26.56		
6.00				9.89	78.3
6.21	21.78	-1.24	26.59		
6.27	21.77	-1.22	26.56		
6.80	21.78	-1.21	26.56		
7.00				9.83	77.9
7.45	21.78	-1.22	26.56		
8.00	21.78	-1.20	26.55	9.86	78.1
8.60	21.78	-1.19	26.55		
9.00				9.91	78.5
9.33	21.79	-1.16	26.52		
9.99	21.79	-1.10	26.48		
10.00				9.91	78.7
10.64	21.84	-0.97	26.42		
11.00				9.96	79.1
11.33	22.05	-0.76	26.51		
12.00				9.67	76.8
12.11	22.13	-0.66	26.53		
12.77	22.33	-0.58	26.73		
13.00				9.05	73.2
13.61	22.41	-0.59	26.83		
14.00				8.66	70.1
14.41	22.42	-0.61	26.87		
15.00				8.75	70.5
15.23	22.42	-0.61	26.87		
16.00				8.77	70.7
16.08	22.43	-0.59	26.87		
16.82	22.53	-0.57	26.98		
17.00				8.67	70.1
17.65	22.54	-0.58	27.00		
18.00				8.66	70.0

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 30, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
18.35	22.56	-0.58	27.02		
19.00				8.71	70.4
19.07	22.59	-0.58	27.07		
19.81	22.61	-0.58	27.09		
20.00				8.79	71.1
20.66	22.61	-0.58	27.09		
21.00				8.80	71.1
21.59	22.62	-0.58	27.11		
22.00				8.78	70.9
22.54	22.63	-0.58	27.11		
23.00				8.76	70.8
23.43	22.63	-0.58	27.12		
24.00				8.75	70.8
24.21	22.64	-0.59	27.13		
25.00				8.71	70.4
25.01	22.64	-0.60	27.14		
25.82	22.64	-0.61	27.16		
26.00				8.69	70.3
26.53	22.64	-0.62	27.16		
27.00				8.64	69.6
27.30	22.64	-0.63	27.17		
28.00				8.54	69.0
28.07	22.64	-0.63	27.17		
28.84	22.65	-0.63	27.18		
29.00				8.55	68.9
29.50				8.56	68.7
29.63	22.65	-0.64	27.19		
30.41	22.66	-0.63	27.19		
31.17	22.66	-0.64	27.20		
31.93	22.67	-0.63	27.21		
32.81	22.67	-0.63	27.21		
33.59	22.68	-0.64	27.23		
34.29	22.68	-0.63	27.22		
35.07	22.69	-0.64	27.24		
35.84	22.69	-0.64	27.24		
36.58	22.70	-0.62	27.24		
37.37	22.71	-0.63	27.26		
38.23	22.71	-0.65	27.27		
38.95	22.71	-0.65	27.27		
39.70	22.72	-0.64	27.27		

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 30, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
40.39	22.72	-0.64	27.29		
41.06	22.72	-0.64	27.28		
41.79	22.73	-0.64	27.28		
42.53	22.73	-0.64	27.29		
43.21	22.73	-0.64	27.29		
43.98	22.72	-0.65	27.29		
44.30	22.73	-0.65	27.30		
44.91	22.74	-0.65	27.30		
45.61	22.74	-0.65	27.30		
46.46	22.75	-0.65	27.32		
47.18	22.74	-0.63	27.29		
47.66	22.74	-0.64	27.30		
48.31	22.75	-0.62	27.29		
49.02	22.75	-0.62	27.29		
49.73	22.75	-0.63	27.31		
50.37	22.75	-0.63	27.30		
51.02	22.75	-0.61	27.29		
51.66	22.76	-0.63	27.31		
52.30	22.76	-0.63	27.32		
52.87	22.76	-0.63	27.31		
53.52	22.76	-0.63	27.32		
54.10	22.77	-0.64	27.33		
54.61	22.77	-0.63	27.33		
55.18	22.77	-0.62	27.33		
55.90	22.78	-0.62	27.32		
56.61	22.77	-0.61	27.32		
57.19	22.78	-0.62	27.33		
57.75	22.78	-0.61	27.32		
58.42	22.77	-0.61	27.31		
59.10	22.78	-0.60	27.31		
59.73	22.78	-0.61	27.31		
60.38	22.78	-0.63	27.33		
60.87	22.78	-0.63	27.34		
61.42	22.78	-0.60	27.31		
62.00	22.79	-0.62	27.34		
62.66	22.78	-0.61	27.32		
63.32	22.79	-0.57	27.29		
63.97	22.79	-0.58	27.30		
64.20	22.79	-0.66	27.37		
64.21	22.79	-0.64	27.35		

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 30, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
64.22	22.79	-0.63	27.34		
64.22	22.78	-0.64	27.35		
64.23	22.79	-0.62	27.34		
64.33	22.79	-0.59	27.32		
64.41	22.79	-0.64	27.35		

(end of table)

ST2 August 14, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.00				10.62	109.7
0.50	18.66	10.13	15.90		
1.00				10.52	108.5
1.02	18.80	10.10	16.05		
1.51	18.80	10.07	16.06		
2.00				10.56	108.5
2.12	18.90	10.02	16.18		
2.80	18.78	9.53	16.28		
3.00				10.74	107.6
3.45	18.97	9.05	16.68		
4.00				10.66	105.8
4.21	19.13	8.78	16.96		
5.00				10.77	106.2
5.05	19.28	8.49	17.26		
5.86	19.57	8.29	17.63		
6.00				11.25	110.5
6.91	20.46	8.11	18.60		
7.00				11.65	111.0
7.16	21.16	7.33	19.74		
8.00				13.12	118.9

(end of table)

ST3 August 14, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.00				10.63	110.0
0.56	18.44	10.02	15.75		
0.88	18.40	9.82	15.80		

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST3 August 14, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
1.00				10.54	107.3
1.27	18.43	9.58	15.94		
1.63	18.50	9.21	16.17		
1.97	18.64	8.97	16.41		
2.00				10.56	106.1
2.05	18.73	8.90	16.52		
2.05	18.74	8.89	16.54		
2.06	18.76	8.88	16.56		
2.06	18.75	8.87	16.56		
2.33	18.81	8.88	16.61		
2.89	18.99	8.89	16.78		
3.00				10.52	105.4
3.47	19.13	8.85	16.93		
4.00				10.63	105.4
4.32	19.26	8.67	17.15		
4.78	19.40	8.39	17.42		
5.00				10.73	105.8
5.74	19.62	8.23	17.71		
6.00				10.82	106.2
6.71	20.00	8.08	18.17		
7.00				11.55	110.5
7.62	21.71	7.40	20.26		
8.00				12.51	114.2
8.51	22.35	6.18	21.67		
9.00				13.06	114.0
9.49	22.69	4.84	22.92		
10.00				13.40	113.0
10.23	22.82	3.35	24.14		

(end of table)

ST4 August 14, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.00				11.51	118.4
0.74	17.94	9.73	15.41		
0.94	17.96	9.44	15.55		
1.00				11.60	117.2
1.15	18.04	9.30	15.68		
1.32	18.16	9.23	15.83		

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST4 August 14, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
1.71	18.65	9.18	16.31		
2.00				11.53	116.4
2.21	18.72	9.15	16.40		
2.69	18.76	9.14	16.45		
3.00				11.56	115.9
3.38	18.92	9.05	16.64		
4.00				11.62	115.8
4.23	19.19	8.80	17.02		
4.96	19.71	8.41	17.71		
5.00				11.83	116.2
5.61	19.75	8.16	17.88		
6.00				11.96	116.6
6.27	20.25	7.99	18.46		
6.90	20.54	7.75	18.88		
7.00				12.24	117.6
8.00				13.22	121.4
8.01	21.66	7.15	20.35		
9.00				13.91	121.4
9.26	22.59	5.63	22.29		
10.00				14.18	120.4
10.29	22.70	3.76	23.70		
10.80	22.74	2.78	24.48		
11.00				14.11	117.4
11.62	22.80	2.29	24.93		
12.00				14.19	117.1
12.77	22.86	1.79	25.40		
13.00				14.30	117.5
13.58	22.91	1.43	25.74		
14.00				14.34	117.0
14.32	22.91	1.14	25.99		
15.00				14.47	117.6
15.17	22.93	0.96	26.16		
15.74	22.94	0.78	26.32		
16.00				14.31	115.5
16.89	22.87	0.62	26.38		
17.00				14.24	114.2
18.00				14.20	113.1
18.30	22.82	0.44	26.47		
19.00				13.88	110.6
19.05	22.77	0.24	26.58		

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST4 August 14, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
20.00				13.49	106.9
20.20	22.75	0.08	26.68		
21.00				13.08	103.9
21.38	22.71	-0.03	26.73		
22.00				12.79	100.8
22.14	22.72	-0.13	26.83		
22.48	22.71	-0.19	26.87		
22.97	22.71	-0.22	26.89		
23.00				12.47	98.5
23.92	22.70	-0.25	26.91		
24.00				12.10	95.4
25.00				11.86	93.5
25.01	22.71	-0.33	26.99		
25.89	22.72	-0.37	27.04		
26.00				11.50	90.6
26.72	22.72	-0.40	27.08		
27.77	22.73	-0.43	27.12		
28.79	22.74	-0.46	27.15		
29.61	22.74	-0.50	27.19		
30.94	22.74	-0.53	27.21		
32.70	22.75	-0.56	27.25		
33.40	22.75	-0.61	27.29		
35.41	22.77	-0.63	27.34		
37.03	22.78	-0.64	27.36		
38.90	22.77	-0.64	27.35		
40.70	22.78	-0.67	27.39		
42.20	22.78	-0.69	27.41		
43.85	22.77	-0.69	27.39		
45.16	22.78	-0.70	27.42		
45.65	22.81	-0.68	27.42		
45.65	22.85	-0.69	27.49		
45.66	22.84	-0.68	27.46		
45.70	22.86	-0.67	27.48		
45.70	22.86	-0.63	27.44		
45.70	22.87	-0.66	27.49		
45.73	22.81	-0.70	27.45		
45.78	22.81	-0.69	27.44		
45.80	22.84	-0.70	27.48		
45.85	22.81	-0.69	27.43		

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST4 August 14, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
46.19	22.80	-0.69	27.43		
46.26	22.81	-0.70	27.44		

(end of table)

ST5 August 14, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.00				10.23	107.0
0.68	18.35	10.02	15.67		
1.00				10.42	107.3
1.50	18.29	9.94	15.64		
2.00				10.44	106.2
2.09	18.32	9.61	15.81		
2.86	18.55	9.30	16.17		
3.00				10.47	105.3
3.59	18.63	9.14	16.32		
4.00				10.43	104.9
4.46	18.75	9.02	16.49		
4.95	18.80	9.00	16.55		
5.00				10.44	104.6
5.82	19.85	8.77	17.68		
6.00				10.99	107.4
6.33	20.33	8.23	18.42		
6.98	21.28	7.74	19.63		
7.00				11.50	110.2
7.92	21.97	6.93	20.81		
8.00				11.92	112.3
8.94	22.33	5.60	22.02		
9.00				12.38	112.5
9.79	22.69	4.31	23.30		
10.00				13.12	113.9
10.46	22.74	3.17	24.18		
11.00				13.37	112.8
11.55	22.76	2.52	24.71		
12.00				13.44	112.2
12.38	22.82	2.04	25.14		
13.00				13.55	111.9
13.19	22.90	1.70	25.51		
14.00				13.78	112.3

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST5 August 14, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
14.11	22.94	1.30	25.89		
14.92	22.92	1.03	26.09		
15.00				14.01	114.0
16.00				14.08	114.2
16.11	22.94	0.83	26.29		
17.00	22.87	0.69	26.32	14.04	112.9
18.00				13.79	110.5
18.44	22.78	0.44	26.43		
19.00				13.57	108.6
19.52	22.76	0.27	26.53		
20.00				13.19	104.6
20.62	22.74	0.13	26.63		
21.00				12.92	102.5
21.95	22.70	-0.02	26.71		
22.00				12.64	99.9
22.64	22.70	-0.13	26.80		
23.00				12.52	99.0
23.76	22.70	-0.21	26.87		
24.00				12.31	97.0
24.87	22.69	-0.24	26.89		
25.00				11.84	93.5
25.63	22.70	-0.30	26.96		
26.00				11.28	89.0
26.69	22.72	-0.34	27.02		
27.64	22.76	-0.36	27.09		
28.75	22.77	-0.34	27.08		
29.44	22.77	-0.36	27.10		
30.59	22.76	-0.42	27.14		
32.08	22.77	-0.46	27.18		
33.17	22.76	-0.48	27.20		
34.90	22.75	-0.52	27.22		
37.04	22.76	-0.58	27.28		
38.26	22.77	-0.57	27.29		
39.12	22.78	-0.60	27.33		
39.71	22.77	-0.62	27.32		
40.77	22.77	-0.61	27.32		
41.93	22.78	-0.62	27.34		
43.29	22.77	-0.62	27.32		
44.12	22.78	-0.62	27.34		
45.21	22.78	-0.63	27.34		

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST5 August 14, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
46.58	22.78	-0.64	27.35		
47.70	22.79	-0.67	27.38		
48.86	22.79	-0.68	27.40		
49.82	22.79	-0.70	27.42		
51.15	22.79	-0.70	27.41		
52.40	22.79	-0.71	27.44		
53.26	22.80	-0.73	27.46		
54.14	22.80	-0.72	27.44		
54.66	22.81	-0.71	27.45		
55.47	22.80	-0.72	27.44		
56.44	22.80	-0.72	27.46		
57.03	22.81	-0.74	27.47		
57.69	22.81	-0.73	27.46		
58.56	22.81	-0.70	27.45		
59.25	22.80	-0.71	27.44		
60.11	22.81	-0.73	27.46		
60.88	22.81	-0.73	27.47		
61.96	22.80	-0.72	27.45		
62.96	22.80	-0.74	27.47		
63.52	22.80	-0.76	27.48		
64.43	22.81	-0.75	27.48		
65.16	22.80	-0.75	27.48		
65.85	22.82	-0.77	27.51		

(end of table)

ST6 August 14, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.00				10.60	104.6
0.73	18.85	10.38	15.98		
1.00				10.17	104.2
1.11	18.79	9.93	16.12		
1.63	18.78	9.72	16.20		
2.00				10.32	103.8
2.63	18.80	9.56	16.29		
3.00				10.32	103.7
3.20	18.85	9.43	16.40		
3.76	18.91	9.32	16.51		
4.00				10.32	103.3

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST6 August 14, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
4.12	18.97	9.19	16.62		
4.48	19.03	9.12	16.71		
5.00				10.35	103.3
5.28	19.94	9.02	17.64		
5.86	20.26	8.53	18.19		
6.00				10.83	105.7
6.48	20.99	8.12	19.13		
7.00				11.57	110.3
7.55	22.02	7.25	20.67		
8.00				12.48	113.3
8.74	22.31	6.06	21.70		
9.00				12.82	112.8
10.00				13.18	112.9
10.06	22.71	4.54	23.15		
10.82	22.76	3.51	23.95		
11.00				13.20	111.5
12.00				13.40	110.9
12.49	22.81	2.57	24.72		
13.00				13.43	110.7
13.37	22.89	1.71	25.50		
14.00				13.54	110.6
14.35	22.91	1.38	25.79		
15.00				13.60	110.9
15.21	22.92	1.21	25.94		
16.00				13.61	110.0
16.45	22.91	1.02	26.09		
17.00				13.66	110.3
17.44	22.90	0.82	26.24		
18.00				13.70	110.2
18.18	22.88	0.73	26.30		
18.95	22.87	0.66	26.34		
19.00				13.59	109.1
19.74	22.84	0.52	26.42		
20.00				13.66	109.0
20.69	22.79	0.40	26.47		
21.00				13.14	104.7
21.41	22.79	0.35	26.50		
22.00				12.73	100.9
22.06	22.77	0.31	26.51		
22.97	22.74	0.20	26.57		

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST6 August 14, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
23.00				12.38	97.8
24.00				12.14	95.8
24.08	22.71	0.05	26.66		
24.82	22.73	-0.03	26.76		
25.00				12.02	94.8
26.00				11.65	91.8
26.41	22.72	-0.06	26.77		
27.11	22.74	-0.12	26.85		
28.59	22.73	-0.21	26.91		
29.84	22.77	-0.25	27.00		
30.55	22.77	-0.26	27.01		
31.51	22.76	-0.31	27.04		
32.41	22.77	-0.34	27.08		
33.16	22.77	-0.37	27.11		
34.18	22.79	-0.40	27.15		
34.95	22.78	-0.39	27.14		
35.60	22.78	-0.37	27.12		
36.59	22.80	-0.40	27.17		
37.13	22.78	-0.42	27.17		
38.21	22.78	-0.42	27.16		
38.64	22.80	-0.37	27.14		
39.86	22.80	-0.45	27.21		
40.09	22.80	-0.47	27.24		
41.37	22.78	-0.44	27.19		
42.32	22.79	-0.48	27.23		
43.59	22.80	-0.50	27.26		
45.14	22.78	-0.52	27.25		
46.35	22.80	-0.54	27.29		
47.58	22.79	-0.56	27.29		
48.63	22.80	-0.57	27.31		
49.55	22.79	-0.54	27.28		
50.63	22.80	-0.56	27.30		
51.58	22.79	-0.58	27.31		
52.95	22.80	-0.59	27.33		
54.19	22.79	-0.60	27.32		
55.78	22.80	-0.62	27.36		
56.45	22.81	-0.61	27.36		
57.74	22.79	-0.62	27.35		
58.82	22.80	-0.63	27.36		
59.70	22.80	-0.65	27.38		

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST6 August 14, 2009					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
60.81	22.80	-0.64	27.37		
61.67	22.81	-0.63	27.38		
62.69	22.80	-0.66	27.39		
64.03	22.80	-0.67	27.40		
64.86	22.81	-0.68	27.41		
65.69	22.82	-0.68	27.43		
66.35	22.81	-0.68	27.42		
67.41	22.81	-0.69	27.42		
68.25	22.81	-0.67	27.41		
69.31	22.81	-0.69	27.43		
70.28	22.81	-0.69	27.42		
71.24	22.81	-0.69	27.42		
72.27	22.82	-0.69	27.43		
73.39	22.81	-0.67	27.41		
74.08	22.81	-0.67	27.41		
75.15	22.81	-0.69	27.43		
76.14	22.82	-0.69	27.43		
77.02	22.82	-0.70	27.44		
78.08	22.82	-0.70	27.44		
79.26	22.83	-0.69	27.44		
80.32	22.82	-0.71	27.45		
81.32	22.82	-0.72	27.47		
82.10	22.83	-0.73	27.48		

(end of table)

2010

RBW April 24, 2010					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
1.67	21.68	-1.40	26.60		
1.73	21.67	-1.40	26.59		
1.75	21.67	-1.40	26.59		
1.76	21.69	-1.39	26.61		
1.77	21.70	-1.39	26.62		
1.78	21.71	-1.39	26.63		
1.78	21.70	-1.38	26.62		
1.83	21.70	-1.38	26.61		
1.97	21.68	-1.38	26.59		
2.00				9.95	83.9

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

RBW April 24, 2010					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
2.12	21.67	-1.38	26.57		
2.27	21.64	-1.38	26.53		
2.42	21.63	-1.38	26.52		
2.50				9.94	83.9
2.58	21.63	-1.38	26.51		
2.77	21.63	-1.38	26.51		
2.94	21.63	-1.38	26.51		
3.00				9.93	83.8
3.17	21.63	-1.38	26.51		
3.42	21.63	-1.38	26.51		
3.50				9.94	83.8
3.72	21.63	-1.38	26.51		
3.89	21.63	-1.38	26.51		
4.00				9.94	83.8
4.09	21.63	-1.38	26.51		
4.29	21.63	-1.38	26.52		
4.50	21.63	-1.38	26.51		
4.54	21.63	-1.38	26.52		

(end of table)

WT2 April 24, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)
1.85	19.59	-1.47	23.87
2.35	19.62	-1.45	23.90
2.67	19.65	-1.45	23.93
2.98	19.65	-1.45	23.93
3.33	19.65	-1.44	23.93
3.56	19.66	-1.44	23.94
3.87	19.69	-1.44	23.98
4.17	19.69	-1.44	23.98
4.52	19.70	-1.44	23.99
4.92	19.71	-1.44	24.00
5.22	19.72	-1.44	24.01
5.62	19.73	-1.43	24.03
5.81	19.73	-1.44	24.03
6.04	19.73	-1.44	24.03
6.28	19.74	-1.44	24.05
6.66	19.75	-1.44	24.05
7.03	19.78	-1.44	24.10

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT2 April 24, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)
7.03	19.77	-1.44	24.09
7.32	19.79	-1.44	24.11
7.72	19.80	-1.44	24.12
8.04	19.80	-1.43	24.12
8.43	19.82	-1.43	24.14
8.83	19.84	-1.42	24.15
9.14	19.89	-1.40	24.21
9.44	20.05	-1.25	24.31
9.46	20.11	-1.19	24.33

(end of table)

WT3 April 24, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)
1.54	21.14	-1.71	26.15
1.75	21.61	-1.44	26.54
1.77	21.60	-1.46	26.56
1.78	21.60	-1.46	26.55
1.80	21.60	-1.46	26.54
1.84	21.61	-1.45	26.54
1.84	21.58	-1.52	26.57
1.84	21.60	-1.45	26.54
1.84	21.57	-1.49	26.54
1.84	21.58	-1.50	26.55
1.84	21.57	-1.49	26.53
1.85	21.57	-1.48	26.52
1.85	21.55	-1.58	26.59
1.85	21.61	-1.46	26.56
2.21	21.61	-1.43	26.54
3.00	21.61	-1.42	26.53
3.35	21.62	-1.42	26.53
4.04	21.61	-1.42	26.53
4.68	21.62	-1.42	26.53
5.43	21.62	-1.42	26.53
6.24	21.66	-1.42	26.58
6.93	21.66	-1.39	26.56
7.69	21.64	-1.39	26.53
8.44	21.65	-1.41	26.56
9.23	21.73	-1.40	26.66
10.02	22.36	-1.07	27.21

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT3 April 24, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)
10.86	22.65	-0.63	27.19
11.89	22.72	-0.39	27.07
12.79	22.77	-0.28	27.04
13.08	22.77	-0.13	26.90
13.19	22.76	-0.12	26.89
13.20	22.75	-0.12	26.87
13.21	22.75	-0.12	26.87
13.23	22.76	-0.12	26.88
13.30	22.77	-0.14	26.90
13.41	22.77	-0.16	26.93
13.56	22.77	-0.20	26.97

(end of table)

WT4 April 24, 2010					
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
1.72	21.58	-1.46	26.52		
1.98	21.52	-1.43	26.41		
2.00				9.65	81.6
2.15	21.58	-1.41	26.48		
2.28	21.59	-1.41	26.48		
2.70	21.59	-1.40	26.48		
3.00				9.60	81.2
3.13	21.60	-1.40	26.49		
3.73	21.60	-1.39	26.49		
4.00				9.55	80.8
4.29	21.60	-1.39	26.49		
4.94	21.60	-1.39	26.48		
5.00				9.52	80.6
5.88	21.61	-1.39	26.49		
6.00				9.50	80.3
6.73	21.61	-1.39	26.49		
7.00				9.44	79.9
7.47	21.61	-1.39	26.49		
8.00				8.50	73.1
8.19	21.63	-1.38	26.52		
9.00				8.25	71.9
9.04	22.21	-1.18	27.11		
9.94	22.53	-0.71	27.11		
10.00				8.18	71.4

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT4 April 24, 2010					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
10.93	22.66	-0.44	27.03		
11.00				8.17	71.4
11.97	22.74	-0.26	26.98		
12.00				8.16	70.9
12.94	22.76	-0.18	26.93		
13.00				7.91	69.1
14.00				7.84	68.5
14.04	22.70	-0.22	26.89		
15.00				7.79	68.0
15.01	22.74	-0.24	26.96		
15.90	22.77	-0.23	26.98		
16.00				7.74	67.6
16.77	22.80	-0.22	27.03		
17.00				7.71	67.3
17.69	22.80	-0.21	27.02		
18.00				7.69	67.1
18.65	22.80	-0.24	27.04		
19.00				7.68	66.9
19.64	22.81	-0.26	27.07		
20.00				7.62	66.4
20.64	22.82	-0.28	27.09		
21.62	22.82	-0.30	27.11		
22.00				7.50	65.4
22.67	22.82	-0.32	27.13		
23.73	22.83	-0.33	27.15		
24.00				7.46	64.8
24.76	22.83	-0.35	27.16		
25.97	22.83	-0.37	27.18		
26.00				7.43	64.5
27.04	22.83	-0.38	27.19		
28.00				7.37	64.0
28.36	22.83	-0.40	27.21		
29.55	22.83	-0.41	27.22		
30.00				7.36	63.7
30.85	22.83	-0.42	27.23		
31.98	22.83	-0.43	27.24		
32.00				7.32	63.4
33.07	22.83	-0.44	27.25		
				7.29	63.2
34.02	22.83	-0.44	27.25		
34.93	22.83	-0.45	27.26		

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT4 April 24, 2010					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
35.91	22.84	-0.46	27.27		
36.00				7.24	62.8
37.33	22.84	-0.46	27.27		
38.00				7.19	62.3
38.70	22.84	-0.47	27.28		
39.91	22.84	-0.47	27.28		
40.00				7.15	61.1
40.90	22.84	-0.48	27.29		
42.00	22.84	-0.48	27.29		
42.73	22.84	-0.49	27.30		
43.35	22.84	-0.49	27.30		
44.46	22.84	-0.49	27.30		
45.00				7.08	61.3
45.35	22.84	-0.49	27.30		
46.28	22.84	-0.49	27.30		
46.34	22.85	-0.49	27.31		
48.00				7.05	61.0

(end of table)

WT5 April 24, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)
1.73	21.60	-1.36	26.46
1.73	21.60	-1.37	26.46
1.73	21.61	-1.37	26.48
1.91	21.63	-1.36	26.50
2.63	21.63	-1.32	26.46
3.26	21.60	-1.34	26.44
3.88	21.58	-1.36	26.44
4.52	21.59	-1.38	26.47
5.33	21.70	-1.35	26.58
6.04	21.83	-1.24	26.65
6.68	21.86	-1.13	26.60
7.24	21.86	-1.08	26.55
7.78	21.95	-1.07	26.65
8.38	22.39	-0.93	27.12
8.89	22.47	-0.59	26.92
9.48	22.50	-0.46	26.85
10.11	22.56	-0.37	26.84
10.77	22.63	-0.31	26.88

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT5 April 24, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)
11.50	22.68	-0.24	26.88
12.25	22.73	-0.20	26.91
13.07	22.68	-0.20	26.85
13.84	22.68	-0.24	26.88
14.62	22.78	-0.22	26.99
15.43	22.80	-0.19	27.00
16.33	22.78	-0.21	26.99
17.24	22.80	-0.25	27.04
18.22	22.81	-0.25	27.06
19.44	22.81	-0.28	27.09
20.77	22.81	-0.30	27.10
21.70	22.82	-0.32	27.13
22.50	22.82	-0.33	27.14
23.11	22.82	-0.34	27.15
24.43	22.82	-0.35	27.16
25.45	22.82	-0.37	27.17
27.01	22.82	-0.39	27.19
28.08	22.83	-0.40	27.21
29.27	22.83	-0.42	27.22
30.25	22.83	-0.43	27.23
31.39	22.83	-0.44	27.24
32.52	22.83	-0.45	27.25
33.87	22.83	-0.45	27.26
34.79	22.83	-0.46	27.27
36.10	22.83	-0.47	27.28
37.04	22.83	-0.47	27.28
38.29	22.84	-0.48	27.28
40.06	22.84	-0.48	27.29
41.56	22.84	-0.49	27.30
42.52	22.84	-0.49	27.30
43.54	22.84	-0.50	27.31
44.84	22.84	-0.50	27.31
45.82	22.85	-0.50	27.32

(end of table)

WT6 April 24, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)
1.41	21.44	-1.45	26.33
1.58	21.47	-1.45	26.36

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 24, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)
1.82	21.49	-1.45	26.39
1.88	21.48	-1.45	26.37
1.89	21.48	-1.45	26.37
1.89	21.47	-1.45	26.37
1.99	21.49	-1.45	26.39
2.20	21.48	-1.44	26.37
2.24	21.48	-1.43	26.37
2.55	21.49	-1.44	26.38
2.95	21.65	-1.43	26.58
3.15	21.64	-1.42	26.56
3.15	21.64	-1.42	26.56
3.26	21.60	-1.41	26.49
3.39	21.75	-1.36	26.65
3.82	21.80	-1.22	26.60
4.12	21.71	-1.20	26.47
4.31	21.64	-1.25	26.42
4.57	21.72	-1.29	26.55
4.91	21.85	-1.21	26.66
5.27	21.85	-1.12	26.57
5.50	21.87	-1.10	26.58
5.95	21.84	-1.09	26.54
6.27	21.85	-1.09	26.55
6.60	21.84	-1.08	26.53
7.10	21.66	-1.15	26.36
7.37	21.69	-1.27	26.49
7.57	21.75	-1.29	26.59
7.78	21.80	-1.27	26.64
8.14	21.92	-1.15	26.70
8.60	22.20	-1.01	26.94
8.93	22.30	-0.87	26.94
9.11	22.36	-0.72	26.89
9.32	22.46	-0.65	26.96
9.77	22.56	-0.50	26.96
10.30	22.59	-0.37	26.88
10.71	22.62	-0.31	26.88
11.09	22.64	-0.30	26.89
11.62	22.66	-0.28	26.89
12.17	22.67	-0.26	26.89
12.67	22.65	-0.25	26.85
13.39	22.67	-0.29	26.91
13.81	22.68	-0.29	26.93
14.34	22.75	-0.26	26.99

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 24, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)
14.99	22.79	-0.21	26.99
15.33	22.79	-0.19	26.98
15.73	22.80	-0.18	26.99
16.17	22.81	-0.18	26.99
16.44	22.81	-0.19	27.00
17.23	22.81	-0.20	27.01
17.64	22.81	-0.21	27.03
17.75	22.81	-0.21	27.03
18.07	22.81	-0.22	27.03
18.55	22.82	-0.23	27.05
18.97	22.82	-0.24	27.06
19.23	22.83	-0.25	27.08
19.63	22.83	-0.25	27.09
19.73	22.83	-0.26	27.09
19.85	22.83	-0.26	27.09
20.20	22.83	-0.27	27.10
20.81	22.82	-0.29	27.10
21.23	22.82	-0.30	27.11
21.72	22.82	-0.31	27.12
22.01	22.82	-0.32	27.13
22.42	22.82	-0.32	27.14
22.84	22.82	-0.33	27.14
23.42	22.82	-0.34	27.15
23.98	22.83	-0.35	27.16
24.41	22.82	-0.35	27.16
24.75	22.82	-0.36	27.16
25.18	22.81	-0.37	27.17
25.51	22.82	-0.38	27.18
26.15	22.82	-0.38	27.18
26.57	22.82	-0.38	27.18
26.98	22.82	-0.38	27.19
27.24	22.82	-0.38	27.19
27.78	22.82	-0.39	27.19
28.21	22.82	-0.39	27.20
28.62	22.82	-0.40	27.20
29.11	22.82	-0.40	27.21
29.58	22.83	-0.41	27.21
29.94	22.83	-0.41	27.22
30.25	22.83	-0.41	27.22
30.38	22.82	-0.42	27.22
30.75	22.83	-0.42	27.22
31.35	22.83	-0.42	27.23

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 24, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)
31.83	22.83	-0.43	27.23
32.44	22.83	-0.43	27.24
33.17	22.83	-0.44	27.24
33.49	22.83	-0.44	27.25
34.03	22.83	-0.45	27.25
34.45	22.83	-0.45	27.26
34.84	22.83	-0.45	27.26
35.13	22.83	-0.45	27.26
35.75	22.83	-0.46	27.26
36.18	22.83	-0.46	27.27
36.70	22.83	-0.46	27.27
36.94	22.83	-0.47	27.27
37.46	22.83	-0.47	27.27
38.00	22.84	-0.47	27.28
38.64	22.83	-0.47	27.28
39.43	22.84	-0.47	27.28
40.29	22.84	-0.48	27.29
41.21	22.84	-0.48	27.29
42.04	22.84	-0.48	27.30
42.91	22.84	-0.49	27.30
43.72	22.84	-0.49	27.30
44.27	22.84	-0.49	27.30
44.83	22.85	-0.49	27.30
45.72	22.84	-0.49	27.31
45.87	22.84	-0.50	27.31

(end of table)

WT7 April 24, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)
1.53	21.56	-1.54	26.56
1.98	21.55	-1.45	26.47
2.00	21.55	-1.41	26.44
2.04	21.55	-1.39	26.42
2.07	21.55	-1.39	26.41
2.57	21.68	-1.37	26.57
3.24	21.67	-1.25	26.46
3.76	21.59	-1.31	26.40
4.51	21.59	-1.37	26.46
5.12	21.60	-1.38	26.48
5.74	21.60	-1.39	26.48

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT7 April 24, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)
6.42	21.78	-1.36	26.70
7.07	21.76	-1.17	26.50
7.77	21.81	-1.20	26.59
8.57	22.29	-1.09	27.14
9.31	22.51	-0.61	26.99
10.03	22.66	-0.40	27.00
10.78	22.69	-0.26	26.91
11.68	22.76	-0.18	26.93
12.57	22.78	-0.13	26.91
13.40	22.73	-0.17	26.88
14.28	22.80	-0.17	26.98
15.15	22.81	-0.14	26.97
16.19	22.82	-0.15	26.98
17.12	22.81	-0.18	27.00
17.97	22.82	-0.20	27.03
18.64	22.82	-0.21	27.04
19.36	22.83	-0.23	27.06
19.97	22.83	-0.25	27.07
20.66	22.82	-0.27	27.09
21.41	22.82	-0.28	27.10
22.04	22.81	-0.30	27.11
22.77	22.81	-0.33	27.12
23.57	22.83	-0.33	27.15
24.28	22.82	-0.34	27.15
25.20	22.81	-0.35	27.15
25.98	22.81	-0.38	27.17
26.91	22.82	-0.39	27.19
27.80	22.82	-0.40	27.20
28.76	22.82	-0.41	27.21
29.65	22.82	-0.42	27.22
30.57	22.83	-0.42	27.23
31.56	22.83	-0.43	27.24
32.50	22.83	-0.44	27.24
33.55	22.83	-0.44	27.25
34.53	22.83	-0.45	27.26
35.57	22.83	-0.46	27.26
36.56	22.83	-0.46	27.27
37.61	22.83	-0.47	27.28
38.59	22.83	-0.48	27.28
39.78	22.84	-0.48	27.29
40.80	22.84	-0.48	27.29

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT7 April 24, 2010			
Depth (m)	**Conductivity (µS/cm)**	**Temperature (°C)**	**Salinity (ppt)**
41.85	22.84	-0.49	27.29
42.96	22.84	-0.49	27.30
44.21	22.84	-0.49	27.30
45.15	22.84	-0.50	27.31
45.93	22.85	-0.50	27.31

(end of table)

WT8 April 24, 2010			
Depth (m)	**Conductivity (µS/cm)**	**Temperature (°C)**	**Salinity (ppt)**
1.45	21.32	-1.50	26.20
1.70	21.31	-1.46	26.17
2.12	21.33	-1.44	26.16
2.85	21.34	-1.43	26.16
3.53	21.37	-1.41	26.19
3.58	21.38	-1.42	26.22
4.16	21.37	-1.40	26.18
4.55	21.53	-1.40	26.40
6.05	21.60	-1.35	26.44
6.86	21.62	-1.35	26.47
7.33	21.79	-1.36	26.70
8.07	22.05	-1.23	26.94
8.75	22.18	-0.94	26.85
9.44	22.27	-0.78	26.83
10.24	22.44	-0.65	26.93
11.11	22.43	-0.55	26.84
12.14	22.49	-0.52	26.88
13.19	22.51	-0.49	26.88
14.01	22.56	-0.46	26.92
14.75	22.62	-0.44	26.98
15.70	22.67	-0.39	27.00
16.68	22.65	-0.38	26.97
17.43	22.66	-0.39	26.99
18.85	22.70	-0.39	27.04
19.73	22.75	-0.38	27.10
20.98	22.81	-0.34	27.13
22.24	22.80	-0.33	27.12
23.24	22.81	-0.34	27.13
23.85	22.81	-0.34	27.14
24.86	22.81	-0.36	27.15

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT8 April 24, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)
25.92	22.81	-0.38	27.17
26.96	22.81	-0.39	27.19
27.81	22.81	-0.40	27.19
28.94	22.82	-0.41	27.21
30.28	22.82	-0.42	27.22
31.42	22.82	-0.43	27.23
32.51	22.83	-0.44	27.24
33.66	22.83	-0.44	27.25
34.79	22.83	-0.45	27.26
35.92	22.83	-0.46	27.26
37.19	22.83	-0.46	27.27
38.34	22.84	-0.47	27.28
39.48	22.84	-0.47	27.28
40.37	22.84	-0.47	27.28
41.47	22.84	-0.47	27.28
43.01	22.84	-0.48	27.29
44.31	22.84	-0.48	27.29
45.54	22.85	-0.49	27.30
46.46	22.85	-0.50	27.31

(end of table)

RBW August 15, 2010					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.00				8.72	88.7
0.50				8.80	89.4
1.00				8.91	90.1
1.32	25.39	11.23	21.61		
1.50				8.66	89.3
2.50	25.44	11.24	21.65		
3.40	25.79	11.32	21.94		
3.73	25.92	11.26	22.09		

(end of table)

ST2 August 15, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)
1.19	25.51	12.89	20.79
1.92	25.51	12.31	21.11

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST2 August 15, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)
2.46	25.53	12.01	21.29
2.94	25.65	11.76	21.55
3.45	25.75	11.65	21.70
3.61	25.78	11.57	21.78
3.88	26.00	11.51	22.02
3.75	25.97	11.45	22.02
4.37	25.93	11.47	21.97

(end of table)

ST3 August 15, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)
0.65	26.82	11.67	22.69
1.15	26.82	11.53	22.78
1.82	26.82	11.47	22.81
2.67	26.83	11.43	22.84
3.04	26.83	11.40	22.86
3.80	26.82	11.40	22.86
4.56	26.82	11.39	22.85
5.34	26.82	11.37	22.86
5.96	26.82	11.35	22.88
6.70	26.81	11.34	22.87
7.25	26.79	11.30	22.88
8.18	26.77	11.26	22.89
8.84	26.77	11.24	22.90
9.28	26.76	11.20	22.91
9.38	26.76	11.18	22.92

(end of table)

ST4 August 15, 2010					
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.00				9.14	94.6
0.86	26.72	10.71	23.18		
1.00				9.26	95.5
2.00				9.34	96.1
2.28	26.72	10.69	23.20		
3.00				9.38	96.1
3.70	26.72	10.68	23.20		

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST4 August 15, 2010					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
4.00				9.39	96.4
4.83	26.72	10.64	23.22		
5.00				9.43	96.4
5.92	26.69	10.36	23.38		
6.00				9.44	96.7
6.15	26.71	10.52	23.29		
6.19	26.71	10.62	23.24		
6.21	26.71	10.60	23.25		
6.24	26.71	10.46	23.33		
6.25	26.70	10.58	23.25		
6.30	26.71	10.60	23.25		
6.89	26.70	10.05	23.59		
7.00				9.52	96.9
8.00				9.64	97
8.75	26.70	9.11	24.21		
9.00				10.31	100.8
10.00				11.20	103.5
10.40	26.06	6.42	25.46		
11.00				11.77	105.5
12.00				11.74	103.1
12.47	24.86	3.11	26.71		
13.00				12.18	103.8
14.00				12.38	102.5
14.38	24.07	1.95	26.73		
14.60	23.97	1.87	26.69		
14.84	23.98	2.10	26.50		
14.96	23.89	1.73	26.70		
15.00				12.55	103.2
15.19	23.91	1.94	26.55		
15.20	23.93	2.13	26.42		
15.33	23.85	1.53	26.82		
15.53	23.89	1.99	26.48		
15.92	23.86	1.94	26.49		
16.00				12.57	103.4
16.45	23.67	1.22	26.86		
16.75	23.58	1.10	26.85		
17.77	23.51	1.04	26.82		
18.00				12.52	100.9
18.35	23.51	1.00	26.86		
19.01	23.44	0.89	26.86		

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST4 August 15, 2010					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
19.23	23.44	0.87	26.87		
19.76	23.42	0.82	26.90		
20.00				12.44	99.8
20.20	23.40	0.74	26.93		
21.12	23.36	0.67	26.96		
21.69	23.31	0.56	26.99		
22.00				12.37	98.9
22.12	23.27	0.49	27.00		
23.35	23.24	0.43	27.01		
23.70	23.23	0.39	27.03		
23.76	23.20	0.33	27.05		
24.00				12.29	97.7
24.16	23.17	0.27	27.05		
24.97	23.15	0.19	27.10		
25.56	23.12	0.21	27.05		
25.61	23.13	0.20	27.07		
25.75	23.11	0.20	27.04		
25.86	23.11	0.16	27.08		
25.87	23.10	0.19	27.04		
25.89	23.10	0.14	27.09		
25.92	23.10	0.16	27.07		
26.00				12.22	97.2
26.07	23.11	0.18	27.06		
26.20	23.11	0.18	27.06		
26.32	23.08	0.06	27.12		
26.51	23.09	0.14	27.07		
26.56	23.09	0.18	27.03		
26.60	23.09	0.15	27.06		
26.67	23.10	0.14	27.07		
26.97	23.06	0.01	27.14		
28.00				12.11	95.8
28.34	23.04	-0.02	27.15		
29.00				12.13	95.9
29.38	23.04	-0.06	27.17		
30.33	23.00	-0.11	27.17		
31.00	22.99	-0.12	27.17		
31.03	22.99	-0.13	27.18		
31.09	22.99	-0.12	27.16		
31.17	22.99	-0.14	27.19		
31.27	22.98	-0.16	27.19		

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST4 August 15, 2010					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
31.98	22.97	-0.17	27.18		
32.00	22.96	-0.17	27.18		
32.74	22.96	-0.18	27.19		
32.74	22.97	-0.19	27.20		
33.02	22.96	-0.20	27.20		
33.06	22.96	-0.22	27.21		
33.85	22.95	-0.25	27.23		
34.71	22.94	-0.28	27.25		
35.88	22.92	-0.32	27.25		
36.91	22.91	-0.34	27.26		
37.94	22.91	-0.36	27.27		
39.22	22.89	-0.39	27.27		
40.23	22.87	-0.40	27.26		
41.07	22.87	-0.41	27.27		
41.19	22.87	-0.40	27.27		
41.19	22.86	-0.39	27.24		
41.39	22.87	-0.41	27.26		
41.42	22.87	-0.42	27.27		
41.46	22.87	-0.39	27.26		
41.49	22.86	-0.41	27.26		
41.75	22.87	-0.39	27.25		
42.41	22.87	-0.45	27.30		
43.71	22.84	-0.48	27.29		
43.96	22.84	-0.49	27.30		
44.10	22.84	-0.44	27.25		
44.15	22.84	-0.46	27.27		
44.16	22.84	-0.45	27.26		
44.20	22.84	-0.44	27.26		
44.33	22.84	-0.45	27.26		
44.38	22.83	-0.45	27.25		
44.43	22.83	-0.43	27.24		
44.44	22.84	-0.45	27.27		
44.49	22.84	-0.44	27.26		
44.51	22.84	-0.43	27.25		
44.52	22.84	-0.45	27.26		
44.55	22.85	-0.45	27.26		
44.56	22.84	-0.45	27.26		
44.60	22.84	-0.43	27.25		
44.60	22.84	-0.45	27.26		
44.67	22.85	-0.46	27.28		

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST4 August 15, 2010					
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
44.71	22.84	-0.45	27.25		
44.71	22.84	-0.45	27.26		
44.72	22.84	-0.44	27.25		
44.74	22.84	-0.42	27.24		
44.77	22.84	-0.45	27.26		
44.85	22.85	-0.42	27.25		
44.92	22.85	-0.41	27.24		
44.99	22.84	-0.43	27.25		
45.06	22.84	-0.45	27.26		
45.07	22.85	-0.40	27.24		
45.08	22.85	-0.40	27.23		
45.23	22.85	-0.37	27.19		

(end of table)

ST5 August 15, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)
1.15	26.77	10.77	23.20
3.21	26.77	10.72	23.23
4.86	26.76	10.65	23.26
5.05	26.74	10.63	23.26
5.10	26.75	10.60	23.29
5.15	26.74	10.62	23.27
5.29	26.74	10.64	23.25
5.36	26.74	10.46	23.37
6.63	26.64	10.19	23.44
7.81	26.58	10.06	23.47
7.83	26.59	9.78	23.66
8.47	26.58	9.07	24.12
9.71	26.21	6.99	25.21
11.76	25.48	4.63	26.20
13.32	24.67	3.41	26.24
13.36	24.58	3.75	25.87
13.69	24.56	3.69	25.88
14.03	24.60	2.32	27.06
15.29	23.83	1.45	26.86
16.89	23.66	1.08	26.97
17.56	23.53	1.02	26.86
17.86	23.51	1.08	26.78
17.98	23.50	1.07	26.79

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST5 August 15, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)
18.05	23.50	1.08	26.77
18.17	23.50	1.07	26.78
18.23	23.50	1.08	26.77
18.27	23.50	1.07	26.77
18.40	23.47	0.87	26.92
19.05	23.43	0.85	26.88
19.22	23.43	0.81	26.91
19.90	23.42	0.68	27.01
20.96	23.32	0.47	27.07
22.04	23.22	0.35	27.05
22.72	23.20	0.30	27.06
22.86	23.20	0.25	27.11
24.04	23.14	0.19	27.09
24.29	23.15	0.16	27.13
24.98	23.12	0.10	27.15
26.11	23.09	0.01	27.18
27.05	23.05	-0.06	27.20
27.64	23.03	-0.12	27.21
27.84	23.03	-0.10	27.20
28.07	23.01	-0.08	27.16
28.24	23.01	-0.08	27.16
28.29	23.00	-0.09	27.16
28.45	22.99	-0.16	27.20
28.53	23.00	-0.09	27.15
28.70	23.00	-0.11	27.17
28.76	23.00	-0.10	27.16
28.79	23.00	-0.12	27.18
28.90	23.00	-0.11	27.18
28.94	22.99	-0.21	27.24
28.97	23.00	-0.11	27.17
29.00	23.00	-0.11	27.17
29.13	22.99	-0.12	27.17
30.13	22.95	-0.26	27.24
31.37	22.95	-0.29	27.27
32.42	22.91	-0.35	27.28
33.47	22.89	-0.39	27.27
34.63	22.88	-0.41	27.28
35.80	22.89	-0.41	27.29
36.98	22.90	-0.41	27.31
38.14	22.89	-0.44	27.33
39.34	22.88	-0.45	27.31

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST5 August 15, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)
40.65	22.87	-0.45	27.30
41.16	22.87	-0.45	27.30
41.21	22.87	-0.48	27.34
41.22	22.87	-0.46	27.31
41.30	22.87	-0.46	27.31
41.38	22.87	-0.47	27.31
41.43	22.87	-0.46	27.31
41.51	22.86	-0.46	27.31
42.11	22.86	-0.50	27.33
43.08	22.85	-0.52	27.33
44.11	22.84	-0.52	27.33
44.94	22.84	-0.53	27.34
45.84	22.84	-0.53	27.33
46.25	22.83	-0.55	27.34
46.36	22.83	-0.57	27.35
47.37	22.83	-0.59	27.37
48.32	22.82	-0.60	27.36
49.45	22.81	-0.61	27.37
50.46	22.81	-0.61	27.37
51.53	22.80	-0.62	27.37
52.47	22.80	-0.62	27.37
53.30	22.80	-0.63	27.37
54.43	22.80	-0.64	27.37
55.70	22.80	-0.64	27.37
55.78	22.79	-0.63	27.36
55.88	22.80	-0.65	27.38
55.88	22.79	-0.64	27.36
55.92	22.80	-0.64	27.38
56.04	22.79	-0.65	27.37
56.86	22.80	-0.65	27.38
58.09	22.81	-0.64	27.39
59.11	22.80	-0.63	27.37
60.02	22.80	-0.63	27.37
60.46	22.80	-0.63	27.37
60.55	22.80	-0.61	27.35

(end of table)

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST6 August 15, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)
1.03	26.73	10.12	23.57
1.21	26.74	10.31	23.46
1.98	26.74	10.39	23.41
2.67	26.74	10.46	23.37
3.08	26.75	10.50	23.35
4.06	26.75	10.53	23.33
4.79	26.75	10.52	23.33
5.34	26.75	10.54	23.32
6.56	26.74	10.53	23.32
7.04	26.75	10.53	23.33
8.03	26.70	10.50	23.30
8.84	26.66	10.42	23.31
9.72	26.53	10.29	23.27
10.43	26.03	9.96	23.00
11.20	25.80	8.80	23.52
12.20	25.60	8.06	23.81
13.16	24.51	6.41	23.80
14.14	24.13	4.22	24.98
15.03	24.06	3.20	25.70
15.52	23.92	2.81	25.85
16.90	23.70	2.25	26.04
17.83	23.52	1.87	26.13
18.74	23.44	1.46	26.38
19.66	23.42	1.17	26.60
20.30	23.38	1.07	26.63
21.18	23.30	0.90	26.68
22.36	23.28	0.78	26.75
23.26	23.24	0.70	26.77
24.17	23.20	0.57	26.83
25.11	23.18	0.47	26.90
26.23	23.16	0.42	26.92
27.16	23.16	0.39	26.94
28.08	23.10	0.34	26.91
28.69	23.06	0.22	26.97
29.49	23.05	0.17	26.99
30.61	23.04	0.12	27.02
31.65	23.03	0.07	27.05
32.60	23.01	0.03	27.06
33.69	22.96	-0.03	27.05
34.33	22.95	-0.12	27.12
35.06	22.94	-0.17	27.15
35.54	22.94	-0.21	27.18
36.54	22.92	-0.23	27.17

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

ST6 August 15, 2010			
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)
37.72	22.93	-0.27	27.22
38.80	22.90	-0.26	27.18
39.54	22.91	-0.30	27.22
41.00	22.87	-0.33	27.20
42.03	22.85	-0.41	27.24
42.97	22.84	-0.44	27.26
44.01	22.83	-0.45	27.25
45.00	22.84	-0.49	27.29
46.23	22.83	-0.50	27.30
47.26	22.83	-0.52	27.31
48.16	22.82	-0.54	27.32
49.43	22.82	-0.56	27.34
50.34	22.82	-0.55	27.32
51.14	22.81	-0.57	27.33
51.90	22.81	-0.59	27.35
52.92	22.81	-0.60	27.35
53.62	22.80	-0.59	27.33
54.28	22.80	-0.61	27.35
54.97	22.81	-0.60	27.34
55.90	22.81	-0.62	27.37
56.87	22.80	-0.61	27.35
58.02	22.81	-0.62	27.37
58.51	22.81	-0.64	27.38
59.34	22.80	-0.64	27.38
60.29	22.80	-0.64	27.38
60.97	22.80	-0.67	27.40
60.99	22.79	-0.66	27.38
61.01	22.80	-0.67	27.39
61.08	22.80	-0.67	27.40
61.19	22.79	-0.66	27.38
61.27	22.80	-0.66	27.39
61.48	22.80	-0.67	27.40
61.50	22.80	-0.66	27.39
61.56	22.80	-0.67	27.40
61.63	22.80	-0.67	27.40
61.74	22.80	-0.66	27.38
62.21	22.80	-0.66	27.39
63.00	22.80	-0.67	27.40
64.20	22.80	-0.68	27.40
64.59	22.80	-0.69	27.42
64.74	22.79	-0.68	27.40

(end of table)

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

2011

RBW April 24, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
1.80	19.11	-1.40	23.18	12.29	95.14
2.11	19.13	-1.40	23.20	12.28	95.06
2.88	19.16	-1.38	23.24	12.29	95.16
3.16	19.24	-1.38	23.33	12.29	95.22
3.97	19.34	-1.40	23.48	12.30	95.35
4.26	19.36	-1.39	23.49	12.30	95.42
4.67	19.35	-1.38	23.49	12.30	95.43
4.90	19.33	-1.36	23.44	12.30	95.46
5.16	19.30	-1.39	23.42	12.35	95.73

(end of table)

WT2 April 21, 2011				
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)	Dissolved Oxygen (mg/L)
1.51	21.71	-0.67	26.00	13.29
1.60	21.74	-0.67	26.05	13.18
1.71	21.73	-0.67	26.02	13.08
1.79	21.73	-0.67	26.02	13.02
1.86	21.73	-0.67	26.03	13.18
1.98	21.77	-0.67	26.07	13.21
2.12	21.75	-0.68	26.06	13.05
2.55	21.72	-0.69	26.03	13.00

(end of table)

WT4 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
1.50	21.86	-1.40	26.84	11.90	94.52
1.86	21.86	-1.40	26.84	11.90	94.50
1.87	21.86	-1.40	26.84	11.91	94.55
1.87	21.86	-1.40	26.84	11.90	94.48
1.88	21.86	-1.40	26.84	11.91	94.54
1.88	21.87	-1.40	26.85	11.90	94.52
1.88	21.86	-1.40	26.84	11.90	94.52
1.88	21.86	-1.40	26.84	11.90	94.50
1.88	21.86	-1.40	26.84	11.91	94.53
1.88	21.86	-1.40	26.84	11.90	94.45

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT4 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
1.88	21.87	-1.40	26.84	11.90	94.46
1.88	21.86	-1.40	26.84	11.90	94.48
1.89	21.86	-1.40	26.84	11.90	94.51
1.89	21.86	-1.40	26.84	11.90	94.49
1.89	21.86	-1.40	26.84	11.90	94.46
1.89	21.86	-1.40	26.84	11.90	94.51
2.33	21.87	-1.39	26.84	11.89	94.40
2.86	21.87	-1.39	26.85	11.89	94.45
2.90	21.87	-1.39	26.84	11.89	94.45
2.90	21.87	-1.39	26.84	11.90	94.48
2.90	21.87	-1.40	26.84	11.89	94.43
2.90	21.87	-1.39	26.84	11.90	94.48
2.90	21.87	-1.39	26.84	11.90	94.51
2.91	21.87	-1.39	26.84	11.90	94.47
2.92	21.86	-1.40	26.84	11.91	94.53
2.92	21.87	-1.39	26.84	11.90	94.49
2.92	21.87	-1.39	26.84	11.89	94.44
2.92	21.87	-1.40	26.85	11.90	94.50
2.92	21.86	-1.40	26.84	11.90	94.48
2.93	21.87	-1.39	26.84	11.89	94.41
2.93	21.87	-1.39	26.84	11.89	94.43
2.93	21.87	-1.39	26.84	11.90	94.49
2.93	21.87	-1.40	26.85	11.90	94.50
2.93	21.87	-1.39	26.84	11.90	94.45
2.96	21.87	-1.40	26.84	11.89	94.44
3.79	21.87	-1.40	26.84	11.89	94.43
3.88	21.87	-1.40	26.85	11.90	94.52
3.88	21.87	-1.40	26.84	11.90	94.46
3.88	21.86	-1.40	26.84	11.89	94.40
3.88	21.86	-1.40	26.84	11.89	94.43
3.88	21.87	-1.40	26.84	11.88	94.35
3.88	21.87	-1.40	26.84	11.90	94.47
3.88	21.87	-1.40	26.84	11.89	94.44
3.88	21.87	-1.40	26.84	11.90	94.48
3.89	21.87	-1.40	26.85	11.90	94.48
3.89	21.87	-1.40	26.84	11.89	94.43
3.89	21.87	-1.40	26.85	11.89	94.43
3.89	21.87	-1.40	26.85	11.90	94.46
3.89	21.87	-1.40	26.84	11.90	94.46
3.89	21.87	-1.40	26.84	11.89	94.38

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT4 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
3.89	21.86	-1.40	26.84	11.89	94.41
3.89	21.87	-1.40	26.85	11.89	94.43
3.89	21.86	-1.40	26.84	11.90	94.48
3.89	21.87	-1.40	26.84	11.89	94.39
3.89	21.87	-1.40	26.85	11.90	94.47
3.89	21.87	-1.40	26.85	11.89	94.41
3.89	21.86	-1.40	26.84	11.90	94.45
3.89	21.87	-1.40	26.85	11.90	94.45
3.89	21.87	-1.40	26.84	11.89	94.43
3.90	21.87	-1.40	26.85	11.89	94.42
3.90	21.87	-1.40	26.85	11.89	94.39
3.93	21.87	-1.40	26.85	11.89	94.42
4.81	21.86	-1.40	26.84	11.88	94.31
4.87	21.87	-1.40	26.85	11.89	94.37
4.87	21.87	-1.40	26.85	11.90	94.46
4.87	21.87	-1.40	26.85	11.88	94.35
4.88	21.87	-1.40	26.84	11.89	94.38
4.88	21.87	-1.40	26.85	11.88	94.34
4.88	21.87	-1.40	26.84	11.88	94.36
4.88	21.87	-1.40	26.85	11.88	94.36
4.88	21.87	-1.40	26.84	11.89	94.38
4.88	21.86	-1.40	26.84	11.89	94.38
4.88	21.87	-1.40	26.84	11.89	94.38
4.88	21.87	-1.40	26.84	11.89	94.38
4.88	21.87	-1.40	26.85	11.89	94.38
4.88	21.87	-1.40	26.84	11.88	94.36
5.65	21.87	-1.40	26.84	11.88	94.30
5.73	21.87	-1.40	26.84	11.87	94.28
5.83	21.87	-1.40	26.85	11.88	94.36
5.83	21.87	-1.40	26.84	11.88	94.34
5.84	21.87	-1.40	26.84	11.89	94.41
5.86	21.87	-1.40	26.85	11.88	94.30
5.90	21.87	-1.40	26.84	11.88	94.35
5.91	21.87	-1.40	26.84	11.88	94.33
5.91	21.87	-1.40	26.84	11.88	94.33
5.91	21.87	-1.40	26.84	11.89	94.40
5.91	21.87	-1.40	26.84	11.88	94.33
5.91	21.87	-1.40	26.85	11.88	94.33
5.92	21.87	-1.40	26.84	11.88	94.32
5.92	21.87	-1.40	26.85	11.88	94.36

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT4 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
5.92	21.87	-1.40	26.84	11.88	94.34
5.92	21.87	-1.40	26.85	11.88	94.31
5.92	21.87	-1.40	26.84	11.88	94.35
5.92	21.87	-1.40	26.84	11.88	94.30
5.92	21.87	-1.40	26.84	11.88	94.35
5.92	21.87	-1.40	26.85	11.88	94.37
6.76	21.87	-1.40	26.84	11.88	94.35
6.78	21.87	-1.39	26.84	11.88	94.36
6.78	21.87	-1.40	26.85	11.89	94.38
6.79	21.87	-1.40	26.85	11.89	94.42
6.80	21.87	-1.40	26.85	11.88	94.35
6.80	21.87	-1.40	26.85	11.89	94.39
6.80	21.87	-1.39	26.85	11.88	94.34
6.80	21.87	-1.40	26.84	11.88	94.34
6.80	21.87	-1.40	26.85	11.88	94.29
6.81	21.87	-1.40	26.84	11.89	94.39
6.81	21.87	-1.40	26.85	11.88	94.36
6.81	21.87	-1.40	26.85	11.89	94.38
6.81	21.87	-1.39	26.84	11.88	94.34
6.81	21.87	-1.40	26.84	11.88	94.35
6.81	21.87	-1.40	26.84	11.88	94.33
6.82	21.87	-1.40	26.84	11.88	94.35
6.84	21.87	-1.40	26.84	11.89	94.37
6.85	21.87	-1.40	26.84	11.89	94.41
6.85	21.87	-1.40	26.85	11.88	94.37
6.85	21.87	-1.40	26.85	11.89	94.39
6.86	21.87	-1.40	26.84	11.89	94.38
6.86	21.87	-1.40	26.84	11.88	94.35
6.86	21.87	-1.40	26.84	11.88	94.31
7.77	21.87	-1.40	26.85	11.89	94.39
7.77	21.87	-1.40	26.84	11.89	94.38
7.77	21.87	-1.40	26.85	11.89	94.37
7.77	21.87	-1.40	26.85	11.89	94.41
7.77	21.87	-1.40	26.85	11.89	94.40
7.78	21.87	-1.40	26.85	11.89	94.43
7.78	21.87	-1.40	26.85	11.88	94.35
7.78	21.87	-1.40	26.85	11.89	94.37
7.78	21.87	-1.39	26.85	11.89	94.38
7.78	21.87	-1.40	26.85	11.89	94.38
7.78	21.87	-1.40	26.85	11.89	94.38

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT4 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
7.78	21.87	-1.39	26.85	11.89	94.38
7.78	21.87	-1.40	26.85	11.88	94.37
7.78	21.87	-1.40	26.84	11.88	94.34
7.79	21.87	-1.40	26.85	11.89	94.37
7.81	21.87	-1.40	26.85	11.88	94.36
7.81	21.87	-1.40	26.85	11.88	94.33
7.97	21.87	-1.40	26.84	11.88	94.32
8.80	21.87	-1.40	26.85	11.88	94.33
8.80	21.87	-1.40	26.84	11.88	94.33
8.82	21.87	-1.40	26.84	11.87	94.28
8.83	21.87	-1.40	26.84	11.88	94.33
8.84	21.87	-1.40	26.84	11.88	94.30
8.84	21.87	-1.40	26.84	11.89	94.39
8.84	21.87	-1.40	26.85	11.88	94.33
8.84	21.87	-1.40	26.85	11.89	94.39
8.84	21.87	-1.40	26.85	11.88	94.36
8.84	21.87	-1.40	26.85	11.88	94.33
8.84	21.87	-1.40	26.85	11.88	94.33
8.84	21.87	-1.40	26.85	11.88	94.31
8.84	21.87	-1.40	26.85	11.88	94.30
8.84	21.87	-1.40	26.85	11.88	94.32
8.84	21.87	-1.40	26.85	11.88	94.32
8.85	21.87	-1.40	26.85	11.88	94.37
8.85	21.87	-1.40	26.85	11.88	94.33
8.85	21.87	-1.40	26.85	11.88	94.34
8.85	21.87	-1.40	26.85	11.88	94.37
9.50	21.87	-1.40	26.85	11.87	94.29
9.73	21.87	-1.40	26.84	11.87	94.27
9.74	21.87	-1.40	26.84	11.87	94.28
9.78	21.87	-1.39	26.85	11.88	94.30
9.78	21.87	-1.39	26.85	11.88	94.31
9.78	21.87	-1.39	26.85	11.88	94.30
9.78	21.87	-1.39	26.85	11.88	94.30
9.78	21.87	-1.39	26.85	11.87	94.26
9.79	21.87	-1.40	26.84	11.87	94.27
9.79	21.87	-1.39	26.85	11.88	94.30
9.79	21.87	-1.39	26.85	11.87	94.29
9.79	21.87	-1.39	26.84	11.87	94.29
9.79	21.87	-1.39	26.84	11.88	94.33
9.80	21.87	-1.39	26.84	11.87	94.28

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT4 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
9.80	21.87	-1.39	26.85	11.88	94.31
9.80	21.87	-1.39	26.85	11.88	94.34
9.80	21.87	-1.39	26.85	11.87	94.26
10.14	21.87	-1.40	26.84	11.87	94.26
10.34	21.87	-1.40	26.84	11.87	94.29
10.81	21.87	-1.39	26.85	11.86	94.20
11.70	21.87	-1.40	26.84	11.86	94.20
11.72	21.87	-1.40	26.84	11.86	94.20
11.72	21.87	-1.40	26.85	11.86	94.20
11.72	21.87	-1.40	26.85	11.87	94.27
11.73	21.87	-1.40	26.85	11.87	94.22
11.73	21.87	-1.40	26.84	11.86	94.18
11.73	21.87	-1.40	26.85	11.86	94.18
11.73	21.87	-1.39	26.85	11.87	94.28
11.73	21.88	-1.39	26.85	11.88	94.31
11.73	21.87	-1.40	26.85	11.87	94.26
11.73	21.87	-1.39	26.85	11.87	94.30
11.73	21.87	-1.39	26.85	11.87	94.22
11.74	21.87	-1.40	26.85	11.87	94.29
11.74	21.87	-1.39	26.85	11.87	94.28
11.74	21.87	-1.39	26.85	11.87	94.28
11.74	21.87	-1.39	26.85	11.87	94.26
11.74	21.87	-1.40	26.85	11.87	94.22
11.74	21.87	-1.39	26.85	11.88	94.32
11.74	21.87	-1.40	26.85	11.87	94.26
11.74	21.87	-1.39	26.85	11.87	94.25
11.74	21.87	-1.39	26.85	11.88	94.31
11.74	21.87	-1.39	26.85	11.87	94.28
11.92	21.87	-1.40	26.84	11.86	94.17
13.12	21.87	-1.39	26.84	11.85	94.09
13.66	21.87	-1.40	26.84	11.85	94.06
13.68	21.87	-1.40	26.85	11.85	94.11
13.69	21.87	-1.40	26.85	11.85	94.11
13.69	21.87	-1.40	26.85	11.86	94.16
13.69	21.88	-1.39	26.85	11.86	94.18
13.69	21.87	-1.39	26.85	11.86	94.21
13.69	21.87	-1.40	26.85	11.86	94.15
13.69	21.87	-1.40	26.85	11.86	94.16
13.69	21.87	-1.40	26.85	11.86	94.14
13.69	21.87	-1.39	26.85	11.86	94.19

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT4 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
13.69	21.87	-1.40	26.84	11.86	94.16
13.69	21.87	-1.40	26.85	11.86	94.18
13.69	21.87	-1.39	26.85	11.86	94.15
13.69	21.88	-1.39	26.85	11.87	94.24
13.69	21.87	-1.40	26.84	11.85	94.13
13.69	21.87	-1.40	26.85	11.85	94.10
13.69	21.87	-1.39	26.85	11.86	94.15
14.25	21.87	-1.40	26.84	11.85	94.05
15.48	21.87	-1.40	26.84	11.84	94.02
15.69	21.87	-1.39	26.85	11.85	94.08
15.73	21.87	-1.39	26.85	11.84	94.05
15.77	21.88	-1.39	26.85	11.85	94.11
15.77	21.87	-1.40	26.85	11.84	94.03
15.78	21.87	-1.39	26.85	11.84	94.02
15.78	21.88	-1.39	26.85	11.84	94.04
15.78	21.88	-1.39	26.85	11.85	94.12
15.78	21.88	-1.39	26.85	11.85	94.09
15.78	21.88	-1.39	26.85	11.85	94.10
15.78	21.87	-1.39	26.85	11.84	94.05
15.78	21.87	-1.40	26.85	11.84	94.04
15.78	21.87	-1.40	26.85	11.84	94.04
15.79	21.87	-1.40	26.84	11.84	94.03
16.40	21.87	-1.39	26.84	11.82	93.90
17.63	21.88	-1.39	26.85	11.83	93.92
17.64	21.87	-1.39	26.84	11.80	93.70
17.65	21.88	-1.39	26.85	11.83	93.94
17.65	21.88	-1.39	26.85	11.83	93.96
17.65	21.88	-1.39	26.85	11.83	93.95
17.65	21.88	-1.39	26.85	11.82	93.85
17.65	21.88	-1.39	26.85	11.83	93.96
17.65	21.88	-1.39	26.85	11.83	93.93
17.65	21.88	-1.39	26.85	11.83	93.92
17.66	21.88	-1.39	26.85	11.83	93.92
17.67	21.88	-1.39	26.85	11.82	93.84
17.67	21.88	-1.39	26.85	11.82	93.86
17.67	21.88	-1.39	26.85	11.82	93.86
17.67	21.88	-1.39	26.85	11.82	93.87
17.69	21.88	-1.39	26.85	11.81	93.76
17.69	21.88	-1.39	26.85	11.82	93.91
17.69	21.88	-1.39	26.85	11.81	93.76

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT4 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
17.69	21.87	-1.38	26.83	11.78	93.57
17.69	21.88	-1.39	26.85	11.82	93.83
17.69	21.88	-1.39	26.85	11.81	93.80
17.70	21.88	-1.39	26.85	11.81	93.78
18.51	21.89	-1.35	26.83	11.78	93.60
19.41	21.91	-1.36	26.87	11.82	93.99
19.51	21.91	-1.34	26.85	11.82	93.96
19.61	21.92	-1.34	26.85	11.80	93.85
19.61	21.92	-1.34	26.86	11.80	93.83
19.61	21.92	-1.34	26.85	11.79	93.80
19.61	21.93	-1.34	26.86	11.78	93.73
19.61	21.92	-1.34	26.86	11.79	93.80
19.61	21.92	-1.34	26.86	11.79	93.80
19.61	21.92	-1.34	26.86	11.79	93.79
19.61	21.92	-1.34	26.85	11.80	93.87
19.61	21.93	-1.34	26.86	11.79	93.79
19.61	21.92	-1.34	26.86	11.79	93.77
19.61	21.93	-1.34	26.86	11.79	93.81
19.62	21.92	-1.34	26.85	11.80	93.85
19.62	21.92	-1.34	26.86	11.80	93.87
19.62	21.92	-1.34	26.86	11.79	93.81
19.62	21.92	-1.34	26.86	11.79	93.81
19.64	21.92	-1.34	26.86	11.79	93.73
20.09	21.90	-1.39	26.88	11.84	94.03
21.14	21.87	-1.41	26.86	11.81	93.77
22.29	21.88	-1.40	26.85	11.80	93.68
23.43	21.88	-1.39	26.85	11.78	93.58
24.51	21.90	-1.39	26.88	11.79	93.68
24.51	21.90	-1.39	26.87	11.79	93.67
24.51	21.89	-1.39	26.86	11.78	93.57
24.54	21.89	-1.40	26.87	11.62	92.29
24.57	21.89	-1.40	26.86	11.65	92.48
24.57	21.89	-1.40	26.87	11.68	92.73
24.57	21.91	-1.38	26.89	11.73	93.17
24.57	21.93	-1.38	26.91	11.75	93.38
24.57	21.93	-1.38	26.91	11.76	93.46
24.57	21.90	-1.39	26.87	11.68	92.74
24.58	21.92	-1.38	26.89	11.75	93.40
24.58	21.91	-1.39	26.89	11.71	93.06
24.58	21.93	-1.38	26.90	11.74	93.31

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT4 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
24.58	21.92	-1.38	26.90	11.76	93.47
24.58	21.93	-1.39	26.91	11.73	93.24
24.58	21.90	-1.39	26.88	11.69	92.82
24.58	21.92	-1.39	26.89	11.72	93.11
24.58	21.92	-1.39	26.90	11.74	93.24
24.58	21.93	-1.38	26.91	11.77	93.50
24.58	21.92	-1.39	26.90	11.73	93.18
24.58	21.93	-1.38	26.90	11.76	93.47
24.58	21.92	-1.39	26.90	11.72	93.13
24.58	21.93	-1.38	26.91	11.75	93.39
24.58	21.90	-1.39	26.88	11.70	92.91
24.58	21.91	-1.39	26.89	11.70	92.95
24.59	21.92	-1.38	26.89	11.73	93.18
24.59	21.90	-1.39	26.88	11.68	92.81
24.59	21.93	-1.38	26.91	11.79	93.70
24.59	21.93	-1.38	26.91	11.79	93.66
24.59	21.93	-1.38	26.90	11.77	93.51
24.59	21.93	-1.38	26.91	11.77	93.56
24.59	21.93	-1.38	26.91	11.79	93.70
24.60	21.92	-1.39	26.90	11.76	93.44
25.72	21.88	-1.41	26.86	11.58	91.93
27.22	21.88	-1.41	26.86	11.53	91.56
28.31	21.88	-1.40	26.86	11.47	91.11
29.26	21.89	-1.33	26.80	10.67	84.87
29.40	21.90	-1.40	26.89	11.44	90.82
29.40	21.89	-1.40	26.87	11.44	90.84
29.40	21.89	-1.40	26.87	11.37	90.29
29.40	21.90	-1.40	26.89	11.42	90.69
29.49	21.90	-1.37	26.85	10.85	86.21
29.51	21.92	-1.40	26.91	11.27	89.51
29.51	21.92	-1.40	26.91	11.22	89.13
29.52	21.90	-1.38	26.86	10.91	86.64
29.52	21.93	-1.40	26.92	11.24	89.27
29.52	21.92	-1.40	26.90	11.18	88.77
29.52	21.91	-1.38	26.88	10.93	86.85
29.52	21.91	-1.38	26.88	10.98	87.21
29.53	21.90	-1.40	26.88	11.28	89.60
29.53	21.91	-1.40	26.90	11.33	90.01
29.53	21.92	-1.39	26.90	11.04	87.68
29.53	21.91	-1.40	26.90	11.36	90.19

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT4 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
29.54	21.92	-1.39	26.90	11.04	87.70
29.54	21.94	-1.40	26.92	11.15	88.61
29.54	21.92	-1.39	26.90	11.11	88.22
29.55	21.91	-1.39	26.89	11.06	87.85
29.55	21.93	-1.40	26.91	11.14	88.49
30.29	21.91	-1.20	26.71	10.48	83.58
31.56	22.06	-0.91	26.65	10.26	82.43
32.78	22.32	-0.42	26.56	10.09	82.08
33.91	22.72	-0.35	27.02	10.16	83.13
34.48	22.71	-0.31	26.97	10.10	82.70
34.48	22.71	-0.36	27.01	10.16	83.07
34.48	22.71	-0.33	26.99	10.14	82.99
34.48	22.71	-0.33	26.99	10.13	82.92
34.48	22.71	-0.35	27.01	10.16	83.08
34.49	22.71	-0.33	26.99	10.14	83.00
34.49	22.71	-0.33	26.99	10.15	83.01
34.49	22.71	-0.35	27.01	10.16	83.10
34.49	22.71	-0.36	27.02	10.16	83.10
34.49	22.71	-0.31	26.98	10.12	82.85
34.49	22.71	-0.34	27.00	10.15	83.04
34.49	22.71	-0.36	27.01	10.16	83.12
34.49	22.71	-0.35	27.00	10.15	83.04
34.49	22.71	-0.36	27.01	10.16	83.09
34.49	22.71	-0.34	27.00	10.15	83.04
34.49	22.71	-0.33	26.99	10.13	82.93
34.49	22.71	-0.31	26.98	10.11	82.77
34.49	22.71	-0.31	26.98	10.12	82.85
34.50	22.71	-0.31	26.98	10.12	82.87
34.50	22.71	-0.32	26.99	10.13	82.91
34.50	22.71	-0.33	26.99	10.14	82.93
34.50	22.71	-0.32	26.98	10.13	82.90
34.50	22.71	-0.36	27.01	10.16	83.12
34.61	22.71	-0.30	26.97	10.09	82.63
35.19	22.72	-0.30	26.98	10.09	82.61
35.33	22.73	-0.30	26.99	10.08	82.57
36.05	22.72	-0.31	26.99	10.08	82.53
36.66	22.72	-0.31	26.99	10.07	82.44
37.17	22.72	-0.31	26.99	10.06	82.35
38.03	22.73	-0.31	27.01	10.05	82.30
39.15	22.74	-0.34	27.03	10.04	82.15

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT4 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
39.30	22.74	-0.30	27.00	10.02	82.04
39.33	22.74	-0.31	27.01	10.03	82.14
39.34	22.74	-0.31	27.01	10.04	82.18
39.35	22.74	-0.31	27.01	10.04	82.18
39.35	22.74	-0.31	27.01	10.04	82.18
39.35	22.74	-0.31	27.01	10.04	82.21
39.35	22.73	-0.34	27.02	10.04	82.18
39.35	22.74	-0.30	27.00	10.02	82.09
39.35	22.74	-0.32	27.01	10.04	82.21
39.36	22.73	-0.33	27.02	10.05	82.22
39.36	22.74	-0.31	27.01	10.04	82.19
39.36	22.74	-0.32	27.02	10.04	82.18
39.36	22.73	-0.34	27.02	10.05	82.20
39.36	22.74	-0.30	27.00	10.03	82.11
39.36	22.73	-0.33	27.02	10.04	82.20
39.36	22.74	-0.31	27.01	10.03	82.13
39.36	22.73	-0.33	27.02	10.04	82.19
39.36	22.74	-0.31	27.01	10.03	82.15
39.36	22.74	-0.30	27.00	10.02	82.09
39.37	22.74	-0.30	27.00	10.03	82.11
40.73	22.74	-0.31	27.00	10.01	81.93
41.86	22.73	-0.33	27.01	9.99	81.76
42.83	22.74	-0.31	27.01	9.97	81.64
44.25	22.76	-0.30	27.02	9.93	81.30
44.27	22.76	-0.34	27.05	9.97	81.59
44.27	22.76	-0.29	27.01	9.90	81.09
44.30	22.76	-0.33	27.05	9.97	81.59
44.30	22.76	-0.31	27.02	9.95	81.45
44.30	22.75	-0.30	27.02	9.94	81.44
44.30	22.76	-0.32	27.05	9.97	81.59
44.30	22.75	-0.31	27.02	9.96	81.52
44.30	22.76	-0.32	27.04	9.96	81.53
44.31	22.75	-0.30	27.02	9.95	81.47
44.31	22.76	-0.29	27.01	9.92	81.26
44.61	22.76	-0.26	26.99	9.88	80.98
45.31	22.80	-0.25	27.03	9.88	81.00
46.13	22.80	-0.25	27.03	9.87	80.97
46.87	22.80	-0.26	27.04	9.88	81.02
47.94	22.81	-0.26	27.05	9.87	80.97
48.05	22.81	-0.27	27.06	9.87	80.92

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT4 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
48.97	22.81	-0.29	27.08	9.88	80.93
49.25	22.80	-0.27	27.05	9.88	81.00
49.27	22.80	-0.27	27.05	9.87	80.94
49.27	22.81	-0.25	27.05	9.88	81.02
49.27	22.80	-0.26	27.04	9.87	80.96
49.27	22.80	-0.27	27.05	9.87	80.92
49.27	22.80	-0.26	27.04	9.87	80.98
49.28	22.81	-0.27	27.06	9.88	80.98
49.28	22.80	-0.27	27.05	9.87	80.94
49.28	22.79	-0.28	27.05	9.87	80.90
49.28	22.78	-0.30	27.05	9.86	80.80
49.28	22.79	-0.31	27.07	9.87	80.88
49.28	22.79	-0.27	27.04	9.87	80.87
49.28	22.79	-0.27	27.04	9.87	80.89
49.28	22.79	-0.28	27.04	9.86	80.85
49.28	22.80	-0.27	27.04	9.87	80.88
49.28	22.81	-0.26	27.05	9.87	80.91
49.28	22.78	-0.30	27.05	9.87	80.85
49.28	22.80	-0.28	27.05	9.87	80.91
49.28	22.78	-0.30	27.06	9.87	80.83
49.28	22.80	-0.28	27.06	9.87	80.88
49.28	22.79	-0.28	27.04	9.87	80.90
49.28	22.79	-0.28	27.04	9.86	80.84
49.28	22.80	-0.29	27.07	9.87	80.88
49.29	22.79	-0.29	27.04	9.86	80.82
49.29	22.82	-0.25	27.05	9.89	81.12
49.29	22.80	-0.29	27.07	9.87	80.87
49.29	22.79	-0.29	27.05	9.87	80.89
49.29	22.80	-0.27	27.05	9.87	80.91
49.46	22.81	-0.26	27.05	9.90	81.16
49.88	22.81	-0.26	27.05	9.91	81.26
50.12	22.80	-0.26	27.04	9.92	81.33

(end of table)

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
1.56	21.85	-1.41	26.84	11.90	94.41
1.82	21.85	-1.41	26.84	11.90	94.44
1.82	21.85	-1.41	26.84	11.90	94.46
1.83	21.85	-1.41	26.84	11.89	94.40
1.83	21.85	-1.41	26.84	11.90	94.41
1.83	21.85	-1.41	26.84	11.90	94.43
1.83	21.85	-1.42	26.84	11.90	94.40
1.83	21.85	-1.42	26.84	11.89	94.39
1.83	21.85	-1.41	26.84	11.90	94.40
1.84	21.85	-1.41	26.84	11.90	94.42
1.84	21.85	-1.41	26.84	11.90	94.42
1.84	21.85	-1.41	26.84	11.90	94.44
1.84	21.85	-1.41	26.85	11.90	94.42
1.84	21.85	-1.41	26.84	11.90	94.47
1.84	21.85	-1.41	26.84	11.89	94.36
1.84	21.85	-1.41	26.84	11.90	94.46
1.85	21.85	-1.41	26.84	11.90	94.42
1.86	21.85	-1.41	26.84	11.89	94.40
2.03	21.85	-1.41	26.84	11.89	94.35
2.81	21.85	-1.41	26.84	11.89	94.33
2.85	21.85	-1.41	26.84	11.89	94.39
2.86	21.85	-1.41	26.84	11.89	94.37
2.86	21.85	-1.41	26.84	11.89	94.39
2.86	21.85	-1.41	26.84	11.89	94.39
2.86	21.85	-1.41	26.84	11.89	94.36
2.86	21.85	-1.41	26.84	11.89	94.40
2.87	21.85	-1.41	26.84	11.89	94.36
2.87	21.85	-1.41	26.84	11.89	94.39
2.87	21.85	-1.41	26.84	11.89	94.34
2.87	21.85	-1.41	26.84	11.89	94.37
2.87	21.85	-1.41	26.84	11.90	94.41
2.87	21.85	-1.41	26.84	11.89	94.37
2.88	21.85	-1.41	26.84	11.89	94.38
2.88	21.85	-1.41	26.84	11.90	94.42
2.88	21.85	-1.41	26.84	11.89	94.40
2.88	21.85	-1.41	26.84	11.90	94.45
2.88	21.85	-1.41	26.84	11.89	94.38
2.88	21.85	-1.41	26.84	11.90	94.41
2.88	21.85	-1.41	26.84	11.89	94.39
2.89	21.85	-1.41	26.84	11.89	94.39

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
3.29	21.85	-1.41	26.84	11.88	94.26
3.77	21.85	-1.41	26.84	11.88	94.32
3.86	21.85	-1.41	26.84	11.88	94.30
3.86	21.85	-1.41	26.85	11.89	94.36
3.92	21.85	-1.41	26.84	11.89	94.35
3.93	21.85	-1.41	26.84	11.89	94.35
3.93	21.85	-1.41	26.84	11.89	94.35
3.93	21.85	-1.41	26.84	11.90	94.41
3.93	21.85	-1.41	26.85	11.89	94.34
3.93	21.85	-1.41	26.84	11.88	94.32
3.93	21.85	-1.41	26.84	11.89	94.33
3.93	21.85	-1.41	26.84	11.89	94.33
3.94	21.85	-1.41	26.84	11.88	94.32
3.94	21.85	-1.41	26.84	11.89	94.35
3.95	21.85	-1.41	26.84	11.89	94.39
3.96	21.85	-1.41	26.84	11.89	94.38
3.96	21.85	-1.41	26.84	11.89	94.35
3.97	21.85	-1.41	26.84	11.89	94.34
4.01	21.85	-1.41	26.84	11.88	94.29
4.73	21.85	-1.41	26.84	11.88	94.27
4.76	21.85	-1.41	26.84	11.87	94.24
4.77	21.85	-1.41	26.84	11.88	94.27
4.77	21.85	-1.41	26.84	11.89	94.38
4.78	21.85	-1.41	26.84	11.89	94.35
4.78	21.85	-1.41	26.84	11.88	94.27
4.79	21.85	-1.41	26.84	11.89	94.34
4.79	21.85	-1.41	26.84	11.89	94.34
4.79	21.85	-1.41	26.85	11.88	94.26
4.79	21.85	-1.41	26.84	11.88	94.29
4.79	21.85	-1.41	26.84	11.89	94.34
4.79	21.86	-1.41	26.84	11.88	94.31
4.80	21.85	-1.41	26.84	11.89	94.35
4.80	21.85	-1.41	26.84	11.88	94.32
4.80	21.86	-1.41	26.84	11.89	94.33
4.81	21.85	-1.41	26.84	11.89	94.33
5.34	21.85	-1.41	26.84	11.88	94.27
5.74	21.85	-1.41	26.84	11.88	94.31
5.75	21.86	-1.41	26.84	11.88	94.30
5.75	21.85	-1.41	26.84	11.88	94.31
5.75	21.86	-1.41	26.84	11.88	94.29

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
5.76	21.86	-1.41	26.84	11.89	94.33
5.76	21.86	-1.41	26.84	11.88	94.30
5.76	21.86	-1.41	26.84	11.88	94.30
5.76	21.85	-1.41	26.84	11.88	94.29
5.76	21.85	-1.41	26.84	11.88	94.30
5.76	21.86	-1.41	26.84	11.89	94.37
5.77	21.85	-1.41	26.84	11.89	94.34
5.77	21.86	-1.41	26.84	11.88	94.33
5.78	21.85	-1.41	26.84	11.88	94.30
5.78	21.86	-1.41	26.84	11.88	94.31
5.78	21.86	-1.41	26.84	11.87	94.25
5.78	21.86	-1.41	26.84	11.88	94.32
5.79	21.86	-1.41	26.84	11.88	94.31
5.81	21.85	-1.41	26.84	11.88	94.28
5.82	21.85	-1.41	26.84	11.88	94.29
5.84	21.86	-1.41	26.84	11.88	94.31
6.73	21.86	-1.41	26.85	11.88	94.25
6.77	21.85	-1.41	26.84	11.88	94.26
6.78	21.86	-1.41	26.84	11.88	94.26
6.78	21.86	-1.41	26.84	11.88	94.29
6.79	21.86	-1.41	26.84	11.88	94.31
6.79	21.86	-1.41	26.84	11.88	94.31
6.81	21.86	-1.41	26.84	11.88	94.33
6.87	21.86	-1.41	26.85	11.88	94.31
6.87	21.86	-1.41	26.85	11.88	94.28
6.88	21.86	-1.41	26.84	11.88	94.31
6.89	21.86	-1.41	26.84	11.89	94.37
6.89	21.86	-1.41	26.84	11.88	94.30
6.89	21.86	-1.41	26.84	11.87	94.24
6.90	21.85	-1.41	26.84	11.88	94.30
7.06	21.85	-1.41	26.84	11.88	94.30
7.59	21.86	-1.41	26.84	11.88	94.31
7.78	21.86	-1.41	26.84	11.88	94.30
7.79	21.86	-1.41	26.85	11.88	94.32
7.79	21.86	-1.41	26.84	11.88	94.28
7.80	21.86	-1.41	26.84	11.88	94.26
7.80	21.86	-1.41	26.84	11.88	94.27
7.81	21.86	-1.41	26.84	11.88	94.28
7.81	21.86	-1.41	26.84	11.88	94.31
7.81	21.86	-1.41	26.84	11.88	94.26

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
7.81	21.86	-1.41	26.84	11.88	94.31
7.81	21.86	-1.41	26.84	11.88	94.32
8.65	21.86	-1.41	26.84	11.87	94.23
8.67	21.86	-1.41	26.84	11.88	94.28
8.68	21.86	-1.41	26.84	11.88	94.27
8.68	21.86	-1.41	26.84	11.88	94.27
8.68	21.86	-1.41	26.84	11.88	94.31
8.68	21.86	-1.41	26.84	11.87	94.20
8.68	21.86	-1.41	26.84	11.88	94.31
8.68	21.86	-1.41	26.84	11.87	94.25
8.68	21.86	-1.41	26.84	11.87	94.24
8.68	21.86	-1.41	26.84	11.88	94.32
8.68	21.86	-1.41	26.84	11.87	94.23
8.69	21.86	-1.41	26.84	11.88	94.27
8.69	21.86	-1.41	26.84	11.87	94.25
8.69	21.86	-1.41	26.84	11.88	94.32
8.69	21.86	-1.41	26.84	11.88	94.29
8.69	21.86	-1.41	26.84	11.88	94.30
8.69	21.86	-1.41	26.84	11.88	94.28
8.69	21.86	-1.41	26.84	11.88	94.27
8.69	21.86	-1.41	26.84	11.88	94.27
9.10	21.86	-1.41	26.84	11.87	94.19
9.64	21.86	-1.41	26.84	11.87	94.22
9.66	21.86	-1.41	26.84	11.88	94.27
9.66	21.86	-1.41	26.84	11.88	94.26
9.67	21.86	-1.41	26.84	11.87	94.21
9.67	21.86	-1.41	26.84	11.87	94.21
9.68	21.86	-1.40	26.84	11.87	94.26
9.69	21.86	-1.41	26.84	11.87	94.21
9.69	21.86	-1.40	26.84	11.87	94.25
9.70	21.86	-1.41	26.84	11.87	94.22
9.70	21.86	-1.41	26.84	11.87	94.19
9.70	21.86	-1.40	26.84	11.87	94.24
9.70	21.86	-1.40	26.84	11.87	94.26
9.70	21.86	-1.40	26.84	11.88	94.32
9.71	21.86	-1.40	26.84	11.87	94.23
9.71	21.86	-1.41	26.84	11.87	94.22
9.71	21.86	-1.41	26.84	11.87	94.23
9.71	21.86	-1.41	26.84	11.87	94.21
9.72	21.86	-1.40	26.84	11.86	94.18

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
9.74	21.86	-1.41	26.84	11.87	94.19
10.98	21.86	-1.41	26.84	11.86	94.13
11.70	21.86	-1.40	26.84	11.87	94.21
11.70	21.86	-1.41	26.84	11.87	94.22
11.71	21.86	-1.40	26.84	11.87	94.26
11.71	21.86	-1.41	26.84	11.87	94.21
11.71	21.86	-1.40	26.84	11.87	94.19
11.71	21.86	-1.40	26.84	11.88	94.27
11.71	21.86	-1.41	26.84	11.86	94.17
11.71	21.86	-1.40	26.84	11.87	94.22
11.72	21.86	-1.40	26.84	11.87	94.21
11.72	21.86	-1.40	26.84	11.87	94.24
11.72	21.86	-1.40	26.84	11.87	94.24
11.72	21.86	-1.41	26.84	11.87	94.24
11.72	21.86	-1.41	26.84	11.86	94.16
11.74	21.86	-1.41	26.84	11.87	94.24
11.74	21.86	-1.41	26.84	11.86	94.15
11.80	21.86	-1.41	26.84	11.87	94.21
13.26	21.86	-1.40	26.84	11.86	94.16
13.45	21.86	-1.41	26.84	11.86	94.12
13.53	21.86	-1.41	26.84	11.86	94.14
13.55	21.86	-1.40	26.84	11.87	94.20
13.56	21.86	-1.41	26.84	11.86	94.15
13.58	21.86	-1.41	26.84	11.87	94.18
13.58	21.86	-1.41	26.84	11.87	94.19
13.59	21.86	-1.41	26.84	11.87	94.21
13.59	21.86	-1.40	26.84	11.86	94.15
13.59	21.86	-1.40	26.84	11.87	94.20
13.59	21.86	-1.40	26.84	11.86	94.18
13.59	21.86	-1.40	26.84	11.87	94.21
13.60	21.86	-1.40	26.84	11.87	94.23
13.60	21.86	-1.40	26.84	11.88	94.28
13.60	21.86	-1.40	26.84	11.87	94.21
13.60	21.86	-1.40	26.84	11.87	94.20
13.60	21.87	-1.40	26.84	11.87	94.21
13.60	21.87	-1.40	26.84	11.87	94.22
13.60	21.86	-1.40	26.84	11.87	94.21
14.23	21.86	-1.40	26.84	11.86	94.15
15.48	21.86	-1.40	26.84	11.85	94.09
15.58	21.86	-1.39	26.83	11.85	94.11

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
15.61	21.86	-1.40	26.84	11.85	94.08
15.61	21.87	-1.40	26.84	11.86	94.13
15.61	21.87	-1.40	26.84	11.85	94.10
15.61	21.87	-1.40	26.84	11.85	94.13
15.62	21.87	-1.40	26.84	11.86	94.17
15.62	21.87	-1.40	26.84	11.86	94.17
15.62	21.86	-1.40	26.84	11.86	94.14
15.62	21.86	-1.40	26.84	11.86	94.17
15.62	21.86	-1.40	26.84	11.86	94.15
15.62	21.87	-1.40	26.84	11.86	94.20
15.62	21.87	-1.39	26.84	11.86	94.18
15.63	21.87	-1.40	26.84	11.86	94.17
15.63	21.86	-1.40	26.84	11.85	94.11
16.59	21.86	-1.40	26.84	11.84	94.03
17.48	21.87	-1.39	26.84	11.84	94.01
17.50	21.86	-1.40	26.84	11.82	93.88
17.54	21.87	-1.39	26.84	11.85	94.05
17.54	21.87	-1.40	26.84	11.85	94.07
17.54	21.87	-1.40	26.84	11.84	93.99
17.55	21.87	-1.39	26.84	11.85	94.10
17.55	21.87	-1.40	26.84	11.85	94.11
17.55	21.87	-1.39	26.84	11.84	94.04
17.55	21.87	-1.40	26.84	11.86	94.16
17.55	21.87	-1.39	26.84	11.85	94.08
17.55	21.87	-1.39	26.84	11.85	94.13
17.56	21.87	-1.39	26.84	11.85	94.08
17.56	21.87	-1.40	26.84	11.84	94.04
17.56	21.87	-1.39	26.84	11.85	94.12
17.56	21.87	-1.40	26.84	11.85	94.04
17.56	21.87	-1.40	26.84	11.85	94.07
17.56	21.87	-1.40	26.84	11.84	94.01
17.56	21.87	-1.39	26.84	11.85	94.06
17.57	21.87	-1.39	26.84	11.85	94.08
18.06	21.86	-1.39	26.83	11.82	93.88
19.22	21.87	-1.40	26.84	11.76	93.35
19.46	21.87	-1.38	26.83	11.83	93.95
19.47	21.87	-1.40	26.84	11.78	93.54
19.48	21.87	-1.40	26.84	11.77	93.46
19.48	21.88	-1.38	26.85	11.83	93.98
19.49	21.87	-1.39	26.84	11.83	93.90

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
19.49	21.87	-1.39	26.84	11.82	93.88
19.49	21.88	-1.39	26.84	11.83	93.92
19.49	21.88	-1.39	26.85	11.82	93.88
19.49	21.88	-1.39	26.84	11.83	93.95
19.50	21.87	-1.39	26.84	11.81	93.81
19.53	21.87	-1.38	26.83	11.80	93.71
19.53	21.87	-1.40	26.84	11.78	93.56
19.56	21.87	-1.40	26.84	11.80	93.68
19.56	21.87	-1.39	26.84	11.80	93.71
19.56	21.88	-1.38	26.85	11.81	93.80
19.56	21.88	-1.38	26.85	11.81	93.79
19.56	21.88	-1.38	26.85	11.81	93.78
19.57	21.88	-1.39	26.84	11.80	93.73
19.57	21.88	-1.39	26.84	11.80	93.73
19.57	21.88	-1.38	26.85	11.82	93.85
19.57	21.87	-1.39	26.84	11.80	93.70
19.58	21.88	-1.38	26.85	11.81	93.81
19.58	21.89	-1.38	26.85	11.82	93.87
19.58	21.88	-1.38	26.85	11.81	93.79
19.59	21.89	-1.38	26.85	11.82	93.86
20.25	21.87	-1.39	26.83	11.74	93.23
21.72	21.87	-1.39	26.83	11.72	93.08
23.06	21.87	-1.38	26.82	11.70	92.92
24.40	21.88	-1.38	26.84	11.56	91.81
24.41	21.88	-1.38	26.84	11.57	91.86
24.42	21.88	-1.38	26.84	11.54	91.64
24.42	21.88	-1.38	26.85	11.58	91.95
24.42	21.89	-1.37	26.84	11.63	92.42
24.42	21.89	-1.38	26.84	11.60	92.12
24.42	21.89	-1.38	26.85	11.60	92.13
24.43	21.89	-1.38	26.85	11.60	92.19
24.43	21.89	-1.37	26.85	11.62	92.37
24.43	21.90	-1.37	26.85	11.62	92.32
24.44	21.88	-1.36	26.81	11.69	92.92
24.44	21.89	-1.37	26.85	11.64	92.45
24.46	21.89	-1.37	26.84	11.65	92.54
24.48	21.89	-1.37	26.84	11.68	92.79
24.49	21.89	-1.37	26.85	11.69	92.86
24.50	21.87	-1.38	26.83	11.50	91.35
24.50	21.89	-1.37	26.84	11.68	92.81

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
24.50	21.89	-1.37	26.84	11.70	92.99
24.50	21.88	-1.38	26.84	11.66	92.66
24.50	21.89	-1.37	26.84	11.70	92.93
24.51	21.90	-1.36	26.85	11.70	92.96
24.53	21.88	-1.37	26.84	11.65	92.56
25.53	21.87	-1.38	26.82	11.45	90.92
26.61	21.88	-1.36	26.82	11.38	90.46
27.96	21.90	-1.33	26.81	11.29	89.79
29.24	21.95	-1.27	26.84	11.21	89.30
29.26	21.93	-1.30	26.83	11.28	89.77
29.31	22.09	-1.16	26.92	10.74	85.84
29.33	22.01	-1.24	26.89	11.13	88.74
29.33	22.09	-0.96	26.74	10.41	83.62
29.34	22.10	-1.14	26.92	10.86	86.89
29.36	22.06	-1.17	26.89	10.92	87.24
29.36	21.98	-1.25	26.85	11.17	89.01
29.36	22.03	-1.25	26.92	11.07	88.33
29.37	22.05	-1.24	26.94	10.99	87.70
29.37	22.03	-1.20	26.88	10.96	87.51
29.37	22.03	-1.24	26.91	11.04	88.12
29.37	22.04	-1.24	26.93	10.96	87.47
29.37	22.03	-1.23	26.90	11.02	87.91
29.37	22.04	-1.25	26.93	11.11	88.65
29.38	22.16	-1.01	26.88	10.58	84.97
29.38	22.13	-1.02	26.84	10.67	85.62
29.38	22.04	-1.26	26.93	11.09	88.45
29.38	22.10	-1.10	26.87	10.71	85.77
29.39	22.10	-1.06	26.84	10.70	85.74
29.43	22.03	-1.14	26.83	10.76	85.99
29.86	22.43	-0.62	26.89	10.42	84.51
31.51	22.44	-0.61	26.89	10.37	84.18
32.97	22.53	-0.49	26.90	10.32	84.04
34.15	22.56	-0.47	26.92	10.33	84.13
34.15	22.56	-0.47	26.92	10.34	84.28
34.15	22.56	-0.47	26.92	10.34	84.22
34.16	22.55	-0.48	26.91	10.30	83.93
34.16	22.56	-0.47	26.92	10.32	84.10
34.17	22.56	-0.47	26.92	10.33	84.15
34.17	22.56	-0.47	26.92	10.33	84.13
34.17	22.56	-0.48	26.92	10.31	83.99

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
34.18	22.56	-0.47	26.93	10.33	84.20
34.18	22.56	-0.48	26.92	10.30	83.93
34.18	22.56	-0.48	26.92	10.32	84.06
34.18	22.56	-0.48	26.92	10.32	84.06
34.19	22.56	-0.48	26.92	10.31	84.01
34.22	22.56	-0.47	26.92	10.26	83.61
34.23	22.56	-0.48	26.92	10.29	83.78
34.23	22.55	-0.47	26.91	10.28	83.71
34.23	22.55	-0.47	26.91	10.29	83.83
34.23	22.55	-0.47	26.91	10.30	83.89
34.23	22.56	-0.47	26.92	10.30	83.87
34.23	22.55	-0.47	26.91	10.27	83.69
34.23	22.55	-0.47	26.91	10.26	83.55
34.23	22.55	-0.47	26.91	10.28	83.74
34.23	22.56	-0.47	26.92	10.25	83.52
34.24	22.56	-0.47	26.92	10.24	83.39
34.25	22.56	-0.43	26.88	10.13	82.59
34.26	22.56	-0.48	26.93	10.23	83.34
34.26	22.56	-0.48	26.93	10.24	83.44
34.27	22.56	-0.48	26.93	10.23	83.32
34.27	22.56	-0.48	26.92	10.20	83.12
34.34	22.55	-0.47	26.90	10.20	83.13
34.36	22.56	-0.46	26.90	10.18	82.95
35.12	22.62	-0.29	26.83	10.10	82.62
36.59	22.73	-0.26	26.95	10.09	82.72
37.95	22.74	-0.25	26.96	10.08	82.65
39.16	22.73	-0.25	26.94	10.06	82.44
39.17	22.72	-0.25	26.93	10.08	82.63
39.17	22.75	-0.25	26.96	10.07	82.55
39.17	22.73	-0.25	26.94	10.07	82.58
39.17	22.75	-0.25	26.96	10.08	82.68
39.17	22.74	-0.25	26.95	10.07	82.56
39.18	22.74	-0.25	26.95	10.09	82.71
39.18	22.72	-0.25	26.93	10.06	82.43
39.18	22.74	-0.25	26.95	10.07	82.52
39.19	22.75	-0.25	26.97	10.07	82.59
39.19	22.70	-0.25	26.90	10.06	82.43
39.20	22.70	-0.24	26.89	10.04	82.31
39.21	22.70	-0.24	26.90	10.05	82.38
39.22	14.07	-0.24		10.03	76.23

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
39.22	18.37	-0.24		10.03	79.14
39.22	22.71	-0.24	26.91	10.05	82.35
39.42	11.12	-0.22		10.01	74.25
40.81	11.08	-0.22		10.01	74.20
42.31	10.96	-0.22		10.00	74.08
43.81	10.82	-0.23		9.99	73.91
44.07	10.39	-0.22		9.94	73.25
44.11	10.46	-0.22		9.95	73.35
44.11	10.49	-0.22		9.95	73.39
44.12	10.63	-0.23		9.97	73.65
44.12	10.69	-0.23		9.98	73.72
44.12	10.70	-0.23		9.99	73.80
44.12	10.70	-0.23		9.99	73.82
44.12	10.64	-0.23		9.97	73.66
44.12	10.62	-0.23		9.97	73.63
44.13	10.68	-0.23		9.98	73.72
44.13	10.56	-0.22		9.96	73.54
44.13	10.59	-0.23		9.97	73.62
44.13	10.61	-0.22		9.97	73.59
44.13	10.66	-0.23		9.98	73.74
44.13	10.71	-0.24		9.99	73.80
44.13	10.65	-0.23		9.98	73.70
44.13	10.67	-0.23		9.99	73.79
44.13	10.52	-0.22		9.95	73.42
44.13	10.58	-0.22		9.97	73.59
44.13	10.53	-0.22		9.96	73.50
44.13	10.55	-0.22		9.96	73.49
44.13	10.73	-0.24		10.00	73.87
44.13	10.65	-0.23		9.98	73.71
44.14	10.72	-0.24		9.99	73.81
44.14	10.72	-0.24		10.00	73.85
44.15	10.74	-0.23		10.00	73.89
45.21	10.31	-0.24		9.93	73.14
46.45	10.17	-0.25		9.92	72.97
47.78	10.06	-0.26		9.91	72.81
48.98	9.82	-0.24		9.87	72.35
49.10	9.86	-0.23		9.87	72.44
49.11	9.98	-0.25		9.91	72.76
49.11	9.88	-0.24		9.89	72.55
49.11	9.95	-0.25		9.90	72.68

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
49.11	9.90	-0.25		9.89	72.54
49.11	9.88	-0.23		9.88	72.48
49.11	9.89	-0.24		9.89	72.56
49.11	9.93	-0.25		9.89	72.58
49.11	9.94	-0.25		9.90	72.66
49.11	9.91	-0.26		9.89	72.56
49.12	9.87	-0.23		9.88	72.49
49.12	9.95	-0.25		9.90	72.68
49.12	9.97	-0.25		9.91	72.75
49.12	9.96	-0.26		9.91	72.70
49.12	9.97	-0.25		9.91	72.72
49.12	9.90	-0.24		9.89	72.58
49.12	9.92	-0.25		9.89	72.53
49.12	9.96	-0.25		9.90	72.68
49.12	9.93	-0.25		9.89	72.61
49.13	9.92	-0.25		9.90	72.62
49.38	9.78	-0.26		9.87	72.31
50.26	9.71	-0.31		9.87	72.16
51.53	9.64	-0.33		9.84	71.85
52.91	9.60	-0.34		9.83	71.77
53.02	9.57	-0.33		9.79	71.48
53.05	9.59	-0.33		9.81	71.63
53.06	9.60	-0.33		9.82	71.76
53.06	9.59	-0.33		9.82	71.69
53.06	9.61	-0.34		9.82	71.74
53.07	9.53	-0.31		9.75	71.18
53.08	9.57	-0.33		9.79	71.47
53.09	9.55	-0.31		9.77	71.34
53.09	9.56	-0.32		9.78	71.41
53.09	9.52	-0.30		9.73	71.09
53.09	9.57	-0.32		9.79	71.49
53.10	9.54	-0.31		9.75	71.20
53.10	9.56	-0.31		9.77	71.36
53.46	9.49	-0.27		9.71	70.98
54.17	9.47	-0.26		9.69	70.84
54.29	9.44	-0.25		9.67	70.69
55.03	9.40	-0.23		9.66	70.57
56.46	9.36	-0.26		9.63	70.34
57.41	9.14	-0.24		9.41	68.64
57.51	9.20	-0.25		9.44	68.88

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
57.84	9.35	-0.27		9.61	70.15
57.85	9.32	-0.27		9.57	69.81
57.86	9.35	-0.27		9.60	70.05
57.86	9.37	-0.28		9.62	70.23
57.86	9.34	-0.27		9.58	69.96
57.86	9.37	-0.28		9.62	70.19
57.87	9.36	-0.27		9.62	70.19
58.04	9.30	-0.30		9.56	69.67
58.06	9.26	-0.25		9.48	69.20
58.07	9.30	-0.28		9.55	69.63
58.08	9.27	-0.26		9.51	69.42
58.08	9.29	-0.25		9.54	69.61
58.08	9.28	-0.26		9.52	69.49
58.08	9.28	-0.25		9.54	69.62
58.40	9.13	-0.25		9.39	68.43
59.30	9.11	-0.26		9.34	68.09
60.01	9.10			9.29	67.66
60.80	9.07			9.25	67.24
61.52	9.05			9.21	66.88
62.70	9.05			9.21	65.93
62.84	8.76			9.36	66.38
62.91	9.05			9.23	65.78
62.91	9.04			9.23	66.01
62.91	9.05			9.22	65.71
62.98	9.00			9.25	66.06
62.98	8.70			9.37	66.40
62.98	9.01			9.23	65.77
62.98	9.01			9.24	65.84
63.01	9.02			9.23	65.74
63.01	8.80			9.32	66.12
63.03	8.78			9.33	66.22
63.04	8.96			9.26	65.96
63.12	8.83			9.30	66.03
63.12	8.81			9.31	66.06
63.12	8.97			9.24	66.01
63.15	8.84			9.30	66.02
63.24	8.93			9.26	65.79
63.25	8.90			9.28	66.09
63.25	8.92			9.27	65.86
63.25	8.91			9.28	65.94

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT6 April 23, 2011					
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
63.25	8.87			9.29	66.23
63.25	8.93			9.27	65.85
64.61	8.75			9.36	66.30
65.83	8.77			9.36	66.28
65.92	8.75			9.37	66.26
65.99	8.73			9.37	66.27
66.00	8.71			9.37	66.29

(end of table)

WT8 April 21, 2011				
Depth (m)	Conductivity (µS/cm)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L)
1.21	21.83	-1.44	26.83	11.52
1.67	21.86	-1.44	26.87	11.52
1.69	21.86	-1.44	26.88	11.52
1.71	21.86	-1.44	26.87	11.52
1.89	21.86	-1.44	26.88	11.51
2.29	21.86	-1.44	26.88	11.51
2.30	21.86	-1.45	26.89	11.52
2.30	21.86	-1.44	26.88	11.52
2.31	21.86	-1.45	26.88	11.52
2.38	21.86	-1.44	26.87	11.50
2.41	21.86	-1.44	26.88	11.50
3.30	21.86	-1.44	26.87	11.50
3.35	21.86	-1.44	26.87	11.50
3.36	21.86	-1.44	26.88	11.51
4.37	21.86	-1.44	26.87	11.49
5.87	21.86	-1.44	26.88	11.50
5.87	21.86	-1.44	26.87	11.49
6.52	21.86	-1.44	26.88	11.48
8.46	21.86	-1.44	26.88	11.48
8.51	21.86	-1.44	26.88	11.49
9.47	21.86	-1.44	26.88	11.46
10.78	21.86	-1.45	26.89	11.47
10.80	21.86	-1.44	26.88	11.47
10.83	21.86	-1.44	26.88	11.45
12.25	21.87	-1.44	26.88	11.41
13.01	21.87	-1.43	26.87	11.43
13.02	21.87	-1.44	26.89	11.44
13.04	21.87	-1.41	26.86	11.40

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT8 April 21, 2011				
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)	Dissolved Oxygen (mg/L)
14.15	21.91	-1.39	26.90	11.35
14.88	21.91	-1.40	26.90	11.35
14.89	21.91	-1.39	26.90	11.34
14.89	21.91	-1.40	26.90	11.37
14.99	21.91	-1.40	26.90	11.27
16.98	21.90	-1.41	26.89	11.14
17.00	21.90	-1.40	26.89	11.08
17.02	21.90	-1.41	26.90	11.18
17.06	21.90	-1.39	26.88	11.02
17.06	21.90	-1.41	26.90	11.22
17.07	21.90	-1.42	26.90	11.24
17.79	21.90	-1.36	26.85	10.92
19.21	21.93	-1.27	26.80	10.71
21.52	22.11	-0.97	26.78	10.65
22.71	22.26	-0.92	26.93	10.64
22.72	22.25	-0.95	26.94	10.66
22.73	22.24	-0.96	26.94	10.66
22.73	22.25	-0.94	26.94	10.66
22.75	22.27	-0.90	26.92	10.62
22.95	22.27	-0.85	26.89	10.61
23.84	22.35	-0.81	26.96	10.63
25.93	22.35	-0.84	26.98	10.62
27.95	22.33	-0.87	26.97	10.60
28.12	22.33	-0.89	27.00	10.59
28.39	22.33	-0.87	26.97	10.54
28.41	22.32	-0.87	26.96	10.57
28.41	22.32	-0.87	26.96	10.56
28.42	22.31	-0.88	26.96	10.58
28.42	22.32	-0.87	26.96	10.57
28.42	22.31	-0.88	26.97	10.57
28.43	22.31	-0.88	26.96	10.59
28.44	22.30	-0.90	26.96	10.59
28.67	22.32	-0.87	26.97	10.53
28.69	22.33	-0.88	26.98	10.48
29.70	22.31	-0.89	26.96	10.47
29.82	22.32	-0.84	26.94	10.42
31.24	22.38	-0.77	26.96	10.43
32.59	22.42	-0.76	27.00	10.43
32.59	22.40	-0.77	26.98	10.43
32.60	22.42	-0.76	26.99	10.42
32.76	22.42	-0.79	27.02	10.39

Appendix 4.2-2. Roberts Bay CTD and Dissolved Oxygen Data, Doris North Project, 2009-2011

WT8 April 21, 2011				
Depth (m)	Conductivity (µS/cm)	Temperature (˚C)	Salinity (ppt)	Dissolved Oxygen (mg/L)
32.80	22.41	-0.81	27.03	10.37
32.87	22.40	-0.79	27.00	10.41
32.96	22.41	-0.77	27.00	10.40
33.63	22.37	-0.83	26.99	10.33
33.64	22.39	-0.83	27.02	10.31
33.64	22.36	-0.84	26.98	10.34
33.70	22.37	-0.87	27.02	10.34
33.82	22.38	-0.85	27.02	10.36
33.98	22.38	-0.85	27.03	10.30
33.99	22.40	-0.78	26.99	10.29
33.99	22.40	-0.82	27.03	10.30
34.00	22.36	-0.87	27.02	10.31
34.04	22.36	-0.85	26.99	10.31
34.56	22.46	-0.73	27.02	10.28
35.22	22.47	-0.72	27.02	10.26
35.83	22.48	-0.72	27.03	10.20
36.98	22.41	-0.74	26.96	10.23
37.33	18.12	-0.70		10.24
37.36	18.18	-0.69		10.24
37.56	18.09	-0.68		10.25
37.67	18.03	-0.83		10.25
37.76	17.74	-0.61		10.29
37.80	17.75	-0.60		10.27
37.81	17.76	-0.72		10.27
37.82	17.85	-0.76		10.26
37.83	17.93	-0.82		10.25
37.84	17.84	-0.68		10.27
37.87	17.88	-0.79		10.25
37.87	17.87	-0.74		10.26
38.39	17.63	-0.62		10.31
38.72	17.53	-0.62		10.33
39.37	17.43	-0.64		10.36
40.75	17.24	-0.76		10.39
40.79	17.20	-0.67		10.41
41.20	17.11			10.44
42.27	17.01			10.49
43.45	16.92			10.56
43.87	16.74			10.55
43.87	16.73			10.56

(end of table)

Appendix 4.2-3

Roberts Bay Water Quality, Doris North Project, 2009-2010

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Appendix 4.2-3. Roberts Bay Water Quality, Doris North Project, 2009-2010

Site				WT0	WT1		WT2		WT4				
Date Sampled				30-Apr-09	28-Apr-09		28-Apr-09		30-Apr-09				
Replicate				1	1	2	1	1	1	2	1	1	1
Depth (m)		Realized	CCME Guideline for the	4	4	4	4	9	4	4	11	19	40
ALS Sample ID	Units	Detection Limits	Protection of Aquatic Life[a]	L758568-16	L758317-1	L758317-2	L758317-3	L758317-4	L758568-1	L758568-2	L758568-3	L758568-4	L758568-5
Physical Tests													
Conductivity	µS/cm	2.0		41100	41000	40900	40900	41000	41400	41200	41500	41900	42700
Hardness (as $CaCO_3$)	mg/L	0.86-4.3		5000	5040	5130	5100	5030	5150	5190	5060	5090	5200
pH	pH	0.1	7.0-8.7	7.68	7.46	7.61	7.64	7.66	7.66	7.67	7.63	7.65	7.66
Total Suspended Solids	mg/L	3.0	dependent on background levels	24.7	15.3	15.3	8	11.3	<3.0	12	4.7	6	4
Turbidity	NTU	0.1	dependent on background levels	3.65	0.37	0.27	0.22	0.23	0.16	0.16	0.33	0.17	0.27
Salinity (EC)	g/L	1.0	<10% fluctuation[b]	-	-	-	-	-	-	-	-	-	-
Anions and Nutrients													
Alkalinity, Total (as $CaCO_3$)	mg/L	2.0		-	-	-	-	-	-	-	-	-	-
Ammonia as N	mg/L	0.005-0.01		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	0.05-5		53.5	34	32.9	34.4	33.4	50.8	53.7	53.1	53.9	55.8
Chloride (Cl)	mg/L	0.5-25		14800	15100	14900	14900	15000	15200	14900	14900	15100	15500
Fluoride (F)	mg/L	0.4-1		0.61	<0.40	<0.40	<0.40	<0.40	0.61	0.6	0.59	0.59	0.63
Nitrate+Nitrite-N	mg/L	0.006		0.0506	0.0522	0.052	0.0515	0.0519	0.0485	0.0492	0.0485	0.0745	0.0919
Nitrate (as N)	mg/L	0.006-0.5	3.612[b]	0.0506	0.0495	0.0494	0.0492	0.0491	0.0485	0.0492	0.0485	0.0745	0.0919
Nitrite (as N)	mg/L	0.002-0.1		<0.0020	0.0027	0.0026	0.0023	0.0028	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Ortho Phosphate (as P)	mg/L	0.001		0.036	0.0358	0.038	0.0363	0.0366	0.0364	0.0363	0.0376	0.0425	0.0451
Total Phosphorus	mg/L	0.002		0.0439	0.0333	0.034	0.0376	0.0362	0.0395	0.0365	0.0346	0.0371	0.0449
Silicate (as SiO_2)	mg/L	0.005-0.025		1.32	1.3	1.34	1.31	1.27	1.31	1.29	1.35	1.61	2.01
Sulphate (SO_4)	mg/L	0.5-50		2080	2130	2100	2090	2110	2120	2080	2080	2120	2170
Organic / Inorganic Carbon													
Total Organic Carbon	mg/L	0.5-1		0.93	0.83	0.85	0.87	0.89	1.00	0.88	0.91	0.80	0.75
Total Metals													
Aluminum (Al)-Total	mg/L	0.005-0.01		0.0338	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Antimony (Sb)-Total	mg/L	0.0005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Total	mg/L	0.0002-0.002	0.0125[b]	0.00079	0.00098	0.00091	0.00091	0.00096	0.00093	0.00087	0.00084	0.00093	0.00093
Barium (Ba)-Total	mg/L	0.001-0.005		0.0091	0.0113	0.0098	0.0096	0.0102	0.0095	0.0088	0.0097	0.0098	0.0091
Beryllium (Be)-Total	mg/L	0.0005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Bismuth (Bi)-Total	mg/L	0.0005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Boron (B)-Total	mg/L	0.1-1		3.2	3.4	3.5	3.3	3.6	3.5	3.4	3.5	3.4	3.4
Cadmium (Cd)-Total	mg/L	0.00002-0.00012	0.00012	0.000052	0.000054	0.000052	0.000051	0.00005	0.000051	0.000053	0.000052	0.000055	0.000057
Calcium (Ca)-Total	mg/L	0.1-0.5		327	341	339	346	345	343	353	330	343	340
Cesium (Cs)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Chromium (Cr)-Total	mg/L	0.001-0.05	Cr(VI): 0.0015; Cr(III): 0.056[b]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cobalt (Co)-Total	mg/L	0.00005-0.0005		0.000062	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)-Total	mg/L	0.00005-0.001		0.000584	0.000485	0.000503	0.00474	0.000485	0.00049	0.000477	0.000451	0.000393	0.000384
Gallium (Ga)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Iron (Fe)-Total	mg/L	0.005-0.05		0.054	<0.0050	0.0063	0.0059	0.0061	<0.0050	<0.0050	0.005	0.0058	0.0108
Lead (Pb)-Total	mg/L	0.00005-0.001		0.000077	0.000094	0.000129	0.00013	<0.000050	<0.000050	<0.000050	0.000062	0.000076	0.000058
Lithium (Li)-Total	mg/L	0.02-0.5		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Magnesium (Mg)-Total	mg/L	0.2-1		988	1040	1030	1050	1050	1060	1090	1040	1050	1060
Manganese (Mn)-Total	mg/L	0.00005-0.0005		0.00173	0.000867	0.000871	0.000984	0.000964	0.000991	0.00104	0.00102	0.00121	0.00235
Mercury (Hg)-Total	mg/L	0.00001	Inorganic Hg: 0.000016[b]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000031	<0.000010	0.000096
Molybdenum (Mo)-Total	mg/L	0.002-0.005		0.0087	0.0109	0.0115	0.0104	0.0107	0.0087	0.0081	0.0089	0.0089	0.0087
Nickel (Ni)-Total	mg/L	0.00005-0.0005		0.000619	0.00051	0.000493	0.000487	0.000489	0.000474	0.000508	0.000507	0.000513	0.000495
Phosphorus (P)-Total	mg/L	1-3		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Potassium (K)-Total	mg/L	4-20		282	309	304	304	308	320	321	306	316	315
Rhenium (Re)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Rubidium (Rb)-Total	mg/L	0.005		-	-	-	-	-	-	-	-	-	-
Selenium (Se)-Total	mg/L	0.0004-0.002		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Silicon (Si)-Total	mg/L	0.5		0.57	0.55	0.56	0.55	0.55	0.57	0.56	0.58	0.69	0.85
Silver (Ag)-Total	mg/L	0.0002-0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Sodium (Na)-Total	mg/L	4-20		8080	9150	9040	9090	9150	9180	9270	8760	8980	8970
Strontium (Sr)-Total	mg/L	0.00005-0.05		4.48	5.85	5.91	5.6	5.83	4.85	4.78	4.81	4.88	4.77
Tellurium (Te)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Thallium (Tl)-Total	mg/L	0.0005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Thorium (Th)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Tin (Sn)-Total	mg/L	0.001-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Titanium (Ti)-Total	mg/L	0.005-0.1		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Tungsten (W)-Total	mg/L	0.001		-	-	-	-	-	-	-	-	-	-
Uranium (U)-Total	mg/L	0.00005-0.0005		0.00207	0.00183	0.0016	0.00185	0.00191	0.00184	0.00197	0.00181	0.00178	0.00169
Vanadium (V)-Total	mg/L	0.0005-0.1		<0.10	<0.10	<0.10	<0.20	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10
Yttrium (Y)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Zinc (Zn)-Total	mg/L	0.0005-0.005		0.00059	<0.00050	0.0007	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zirconium (Zr)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Dissolved Metals													
Aluminum (Al)-Dissolved	mg/L	0.005-0.01		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Antimony (Sb)-Dissolved	mg/L	0.0005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Dissolved	mg/L	0.0002-0.002		0.00092	0.00096	0.00089	0.00095	0.00094	0.00093	0.00087	0.00092	0.00091	0.00094
Barium (Ba)-Dissolved	mg/L	0.001-0.005		0.0093	0.0096	0.0095	0.0089	0.0098	0.0099	0.0091	0.0107	0.0099	0.0068
Beryllium (Be)-Dissolved	mg/L	0.0005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Bismuth (Bi)-Dissolved	mg/L	0.0005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Boron (B)-Dissolved	mg/L	0.1-1		3.3	3.6	3.3	3.4	3.7	3.5	3.3	3.9	3.3	2.5
Cadmium (Cd)-Dissolved	mg/L	0.00002-0.00012		0.000056	0.000048	0.000049	0.000051	0.00005	0.00005	0.000053	0.000052	0.000051	0.000055
Calcium (Ca)-Dissolved	mg/L	0.1-0.5		333	341	342	343	328	339	342	332	334	338
Cesium (Cs)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Chromium (Cr)-Dissolved	mg/L	0.001-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cobalt (Co)-Dissolved	mg/L	0.00005-0.0005		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)-Dissolved	mg/L	0.00005-0.001		0.000506	0.000442	0.000365	0.000371	0.000349	0.000363	0.000376	0.000346	0.000311	0.000292
Gallium (Ga)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Iron (Fe)-Dissolved	mg/L	0.005-0.05		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Lead (Pb)-Dissolved	mg/L	0.00005-0.001		<0.000050	0.000078	0.000128	0.000138	<0.000050	0.000076	0.000052	0.000052	0.000076	<0.000050
Lithium (Li)-Dissolved	mg/L	0.02-0.05		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Magnesium (Mg)-Dissolved	mg/L	0.2-1		1010	1020	1040	1030	1020	1050	1050	1030	1030	1060
Manganese (Mn)-Dissolved	mg/L	0.00005-0.0005		0.000883	0.000955	0.000917	0.000913	0.00092	0.000914	0.000935	0.0009	0.000983	0.00191
Mercury (Hg)-Dissolved	mg/L	0.00001		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	0.002-0.005		0.0085	0.0107	0.0095	0.0101	0.0088	0.0085	0.0093	0.0095	0.0077	<0.0050
Nickel (Ni)-Dissolved	mg/L	0.00005-0.0005		0.000583	0.000496	0.000485	0.000495	0.000492	0.000491	0.000516	0.000529	0.000448	0.000465
Phosphorus (P)-Dissolved	mg/L	1-3		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Potassium (K)-Dissolved	mg/L	4-20		290	305	308	310	298	313	314	304	304	318
Rhenium (Re)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Rubidium (Rb)-Dissolved	mg/L	0.005		-	-	-	-	-	-	-	-	-	-
Selenium (Se)-Dissolved	mg/L	0.0004-0.002		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Silicon (Si)-Dissolved	mg/L	0.5		0.56	0.53	0.57	0.6	0.56	0.56	0.57	0.56	0.71	0.82
Silver (Ag)-Dissolved	mg/L	0.0002-0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Sodium (Na)-Dissolved	mg/L	4-20		8300	9060	9160	9180	8790	9040	9010	8720	8720	9020
Strontium (Sr)-Dissolved	mg/L	0.00005-0.05		4.61	5.84	5.75	5.82	6.02	4.95	4.83	5.46	4.69	3.52
Tellurium (Te)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Thallium (Tl)-Dissolved	mg/L	0.0005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Thorium (Th)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Tin (Sn)-Dissolved	mg/L	0.001-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Titanium (Ti)-Dissolved	mg/L	0.005-0.1		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Tungsten (W)-Dissolved	mg/L	0.001		-	-	-	-	-	-	-	-	-	-
Uranium (U)-Dissolved	mg/L	0.00005-0.0005		0.00199	0.00215	0.00205	0.00208	0.00189	0.00198	0.00217	0.0019	0.00193	0.00174
Vanadium (V)-Dissolved	mg/L	0.0005-0.1		<0.10	<0.10	<0.10	<0.20	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10
Yttrium (Y)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Zinc (Zn)-Dissolved	mg/L	0.0005-0.005		0.00069	0.00055	<0.00050	0.00051	<0.00050	0.00069	<0.00050	<0.00050	<0.00050	<0.00050
Zirconium (Zr)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Cyanides													
Cyanide, Total	mg/L	0.001-0.005		-	-	-	-	-	-	-	-	-	-
Radiochemistry													
Radium-226	Bq/L	0.005		-	-	-	-	-	-	-	-	-	-

Notes:

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of marine aquatic life.

a) Canadian water quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

Appendix 4.2-3. Roberts Bay Water Quality, Doris North Project, 2009-2010

Site				WT6					ST0		ST1		ST2	
Date Sampled				30-Apr-09					15-Aug-09		15-Aug-09		15-Aug-09	
Replicate				1	1	1	2	1	1	2	1	2	1	1
Depth (m)		Realized	CCME Guideline for the	4	12	20	20	50	1	1	1	1	1	4
ALS Sample ID	Units	Detection Limits	Protection of Aquatic Life[a]	L758568-6	L758568-7	L758568-8	L758568-9	L758568-10	L806584-5	L806584-6	L806584-25	L806584-24	L806584-11	L806584-16
Physical Tests														
Conductivity	µS/cm	2.0		41400	41200	42100	42300	42600	-	-	-	-	-	-
Hardness (as $CaCO_3$)	mg/L	0.86-4.3		4960	4810	4940	5130	5130	-	-	-	-	-	-
pH	pH	0.1	7.0-8.7	7.61	7.66	7.64	7.65	7.67	7.85	7.85	7.82	7.81	7.8	7.82
Total Suspended Solids	mg/L	3.0	dependent on background levels	11.3	6	<3.0	3.3	10	5.8	5.8	4.4	3.8	5.1	4.4
Turbidity	NTU	0.1	dependent on background levels	0.15	0.22	0.22	0.2	0.16	0.6	0.57	0.74	0.73	0.48	0.36
Salinity (EC)	g/L	1.0	<10% fluctuation[b]	-	-	-	-	-	-	-	-	-	-	-
Anions and Nutrients														
Alkalinity, Total (as $CaCO_3$)	mg/L	2.0		-	-	-	-	-	-	-	-	-	-	-
Ammonia as N	mg/L	0.005-0.01		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0056
Bromide (Br)	mg/L	0.05-5		48.8	52.9	55.1	52	55.8	36.5	36.3	39.6	41.9	37.9	44
Chloride (Cl)	mg/L	0.5-25		14800	14800	15100	15000	15300	9710	9610	9560	9590	9920	10400
Fluoride (F)	mg/L	0.4-1		0.61	0.59	0.61	0.58	0.62	<0.75	<0.75	<0.75	<0.75	<0.75	<0.75
Nitrate+Nitrite-N	mg/L	0.006		0.0571	0.0529	0.0762	0.076	0.0879	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060
Nitrate (as N)	mg/L	0.006-0.5	3.612[b]	0.0571	0.0529	0.0762	0.076	0.0879	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060
Nitrite (as N)	mg/L	0.002-0.1		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Ortho Phosphate (as P)	mg/L	0.001		0.0389	0.0391	0.0419	0.044	0.0436	0.0164	0.0162	0.0158	0.0164	0.0170	0.0198
Total Phosphorus	mg/L	0.002		0.0379	0.0378	0.0441	0.0429	0.0435	0.0210	0.0165	0.0156	0.0191	0.0171	0.0195
Silicate (as SiO_2)	mg/L	0.005-0.025		1.37	1.39	1.62	1.65	1.84	0.627	0.631	0.741	0.736	0.66	0.681
Sulphate (SO_4)	mg/L	0.5-50		2060	2080	2120	2100	2150	1290	1280	1280	1280	1320	1400
Organic / Inorganic Carbon														
Total Organic Carbon	mg/L	0.5-1		0.95	0.70	0.82	0.71	0.68	1.19	1.04	1.13	1.05	0.90	1.13
Total Metals														
Aluminum (Al)-Total	mg/L	0.005-0.01		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.011	0.0093	0.0218	0.0156	0.0058	0.0053
Antimony (Sb)-Total	mg/L	0.0005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Total	mg/L	0.0002-0.002	0.0125[b]	0.00091	0.00088	0.00099	0.00098	0.00097	0.00057	0.00067	0.0006	0.00085	0.00056	0.00058
Barium (Ba)-Total	mg/L	0.001-0.005		0.0089	0.0097	0.0105	0.0097	0.0107	0.008	0.0078	0.0076	0.0085	0.0077	0.0083
Beryllium (Be)-Total	mg/L	0.0005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Bismuth (Bi)-Total	mg/L	0.0005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Boron (B)-Total	mg/L	0.1-1		3.2	3.3	3.4	3.4	3.8	2.4	2.3	2.2	2.4	2.3	2.4
Cadmium (Cd)-Total	mg/L	0.00002-0.00012	0.00012	0.000054	0.000053	0.000051	0.000055	0.000058	0.000021	0.000022	0.000022	0.000023	0.000023	0.000023
Calcium (Ca)-Total	mg/L	0.1-0.5		330	335	339	337	347	208	200	193	196	202	208
Cesium (Cs)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-	-
Chromium (Cr)-Total	mg/L	0.001-0.05	Cr(VI): 0.0015; Cr(III): 0.056[b]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cobalt (Co)-Total	mg/L	0.00005-0.0005		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)-Total	mg/L	0.00005-0.001		0.00044	0.00042	0.00034	0.000397	0.000347	0.000378	0.000354	0.000547	0.000472	0.000444	0.000374
Gallium (Ga)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-	-
Iron (Fe)-Total	mg/L	0.005-0.05		<0.0050	<0.0050	0.0056	0.0059	0.0085	0.014	0.0126	0.0295	0.0218	0.0107	0.0083
Lead (Pb)-Total	mg/L	0.00005-0.001		<0.000050	<0.000050	0.00008	0.000108	0.000145	<0.000050	<0.000050	0.000062	<0.000050	<0.000050	<0.000050
Lithium (Li)-Total	mg/L	0.02-0.5		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Magnesium (Mg)-Total	mg/L	0.2-1		973	1010	1000	1050	1020	643	634	612	618	643	668
Manganese (Mn)-Total	mg/L	0.00005-0.0005		0.00101	0.00106	0.00112	0.0012	0.00193	0.00129	0.00124	0.00137	0.00128	0.00113	0.001
Mercury (Hg)-Total	mg/L	0.00001	Inorganic Hg: 0.000016[b]	0.000095	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L	0.002-0.005		0.0094	0.0085	0.0094	0.0094	0.0094	0.0053	<0.0050	<0.0050	<0.0050	<0.0050	0.0055
Nickel (Ni)-Total	mg/L	0.00005-0.0005		0.000495	0.000473	0.000443	0.000492	0.000476	0.00039	0.000326	0.000419	0.000419	0.000372	0.000392
Phosphorus (P)-Total	mg/L	1-3		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Potassium (K)-Total	mg/L	4-20		291	288	297	309	297	197	183	178	183	186	200
Rhenium (Re)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-	-
Rubidium (Rb)-Total	mg/L	0.005		-	-	-	-	-	-	-	-	-	-	-
Selenium (Se)-Total	mg/L	0.0004-0.002		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Silicon (Si)-Total	mg/L	0.5		0.61	0.57	0.7	0.7	0.82	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Silver (Ag)-Total	mg/L	0.0002-0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Sodium (Na)-Total	mg/L	4-20		8290	8260	8470	8840	8550	5350	5000	4870	4970	4910	5120
Strontium (Sr)-Total	mg/L	0.00005-0.05		4.59	4.67	4.86	4.81	5.22	3.75	3.7	3.79	3.83	3.69	4.05
Tellurium (Te)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-	-
Thallium (Tl)-Total	mg/L	0.0005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Thorium (Th)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-	-
Tin (Sn)-Total	mg/L	0.001-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Titanium (Ti)-Total	mg/L	0.005-0.1		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Tungsten (W)-Total	mg/L	0.001		-	-	-	-	-	-	-	-	-	-	-
Uranium (U)-Total	mg/L	0.00005-0.0005		0.00165	0.00212	0.00168	0.00185	0.00204	0.00136	0.00134	0.00132	0.00122	0.00142	0.00139
Vanadium (V)-Total	mg/L	0.0005-0.1		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Yttrium (Y)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-	-
Zinc (Zn)-Total	mg/L	0.0005-0.005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00064	<0.00050	0.00077	<0.00050	<0.00050	<0.00050
Zirconium (Zr)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-	-
Dissolved Metals														
Aluminum (Al)-Dissolved	mg/L	0.005-0.01		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Antimony (Sb)-Dissolved	mg/L	0.0005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Dissolved	mg/L	0.0002-0.002		0.00095	0.00085	0.00096	0.001	0.00094	0.00055	0.00051	0.00072	0.00071	0.00057	0.0006
Barium (Ba)-Dissolved	mg/L	0.001-0.005		0.0098	0.0095	0.0099	0.0097	0.0092	0.0077	0.0074	0.0077	0.0068	0.0079	0.0083
Beryllium (Be)-Dissolved	mg/L	0.0005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Bismuth (Bi)-Dissolved	mg/L	0.0005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Boron (B)-Dissolved	mg/L	0.1-1		3.3	3.3	3.4	3.4	3.3	2.2	2.3	2.2	2.2	2.4	2.5
Cadmium (Cd)-Dissolved	mg/L	0.00002-0.00012		0.000051	0.00005	0.000054	0.000056	0.000058	0.000023	0.000023	0.000022	0.00005	0.000022	0.000026
Calcium (Ca)-Dissolved	mg/L	0.1-0.5		331	318	343	331	345	210	211	190	195	214	211
Cesium (Cs)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-	-
Chromium (Cr)-Dissolved	mg/L	0.001-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cobalt (Co)-Dissolved	mg/L	0.00005-0.0005		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)-Dissolved	mg/L	0.00005-0.001		0.000358	0.000361	0.000302	0.000283	0.000428	0.000339	0.000367	0.000403	0.00044	0.00036	0.000366
Gallium (Ga)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-	-
Iron (Fe)-Dissolved	mg/L	0.005-0.05		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Lead (Pb)-Dissolved	mg/L	0.00005-0.001		<0.000050	0.000052	<0.000050	0.000071	0.000135	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	mg/L	0.02-0.05		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Magnesium (Mg)-Dissolved	mg/L	0.2-1		1000	975	992	1040	1040	664	673	605	623	662	676
Manganese (Mn)-Dissolved	mg/L	0.00005-0.0005		0.000927	0.000871	0.000998	0.000973	0.00177	0.000613	0.000668	0.000491	0.00081	0.000405	0.000241
Mercury (Hg)-Dissolved	mg/L	0.00001		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	0.002-0.005		0.0091	0.009	0.0096	0.0091	0.0086	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nickel (Ni)-Dissolved	mg/L	0.00005-0.0005		0.000505	0.000519	0.000517	0.000495	0.000544	0.000379	0.000417	0.000379	0.000449	0.000381	0.000384
Phosphorus (P)-Dissolved	mg/L	1-3		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Potassium (K)-Dissolved	mg/L	4-20		293	280	298	306	298	197	194	177	181	202	203
Rhenium (Re)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-	-
Rubidium (Rb)-Dissolved	mg/L	0.005		-	-	-	-	-	-	-	-	-	-	-
Selenium (Se)-Dissolved	mg/L	0.0004-0.002		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Silicon (Si)-Dissolved	mg/L	0.5		0.58	0.56	0.7	0.74	0.8	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Silver (Ag)-Dissolved	mg/L	0.0002-0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Sodium (Na)-Dissolved	mg/L	4-20		8360	7980	8460	8780	8560	5330	5290	4860	4930	5250	5190
Strontium (Sr)-Dissolved	mg/L	0.00005-0.05		4.73	4.75	4.81	4.75	4.75	3.66	3.75	3.7	3.76	3.86	4.12
Tellurium (Te)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-	-
Thallium (Tl)-Dissolved	mg/L	0.0005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Thorium (Th)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-	-
Tin (Sn)-Dissolved	mg/L	0.001-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Titanium (Ti)-Dissolved	mg/L	0.005-0.1		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Tungsten (W)-Dissolved	mg/L	0.001		-	-	-	-	-	-	-	-	-	-	-
Uranium (U)-Dissolved	mg/L	0.00005-0.0005		0.00186	0.00204	0.00199	0.00206	0.00225	0.00136	0.00136	0.00129	0.00144	0.00144	0.00149
Vanadium (V)-Dissolved	mg/L	0.0005-0.1		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Yttrium (Y)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-	-
Zinc (Zn)-Dissolved	mg/L	0.0005-0.005		<0.00050	<0.00050	<0.00050	<0.00050	0.00064	<0.00050	<0.00050	0.00059	0.00068	<0.0010	<0.0010
Zirconium (Zr)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-	-
Cyanides														
Cyanide, Total	mg/L	0.001-0.005		-	-	-	-	-	-	-	-	-	-	-
Radiochemistry														
Radium-226	Bq/L	0.005		-	-	-	-	-	-	-	-	-	-	-

Notes:

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of marine aquatic life.

a) Canadian water quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

Appendix 4.2-3. Roberts Bay Water Quality, Doris North Project, 2009-2010

Site				ST3				ST4				
Date Sampled				15-Aug-09				15-Aug-09				
Replicate				1	1	2	1	1	2	1	1	1
Depth (m)		Realized	CCME Guideline for the	1	4	4	9	1	1	6	14	30
ALS Sample ID	Units	Detection Limits	Protection of Aquatic Life[a]	L806584-10	L806584-8	L806584-7	L806584-9	L806584-18	L806584-17	L806584-22	L806584-23	L806584-19
Physical Tests												
Conductivity	µS/cm	2.0		-	-	-	-	-	-	-	-	-
Hardness (as $CaCO_3$)	mg/L	0.86-4.3		-	-	-	-	-	-	-	-	-
pH	pH	0.1	7.0-8.7	7.83	7.77	7.84	7.8	7.8	7.8	7.84	7.82	7.77
Total Suspended Solids	mg/L	3.0	dependent on background levels	3.8	3.8	3.8	3.8	3.1	4.4	5.1	7.8	6.4
Turbidity	NTU	0.1	dependent on background levels	0.46	0.47	0.5	0.3	0.53	0.52	0.38	0.39	0.19
Salinity (EC)	g/L	1.0	<10% fluctuation[b]	-	-	-	-	-	-	-	-	-
Anions and Nutrients												
Alkalinity, Total (as $CaCO_3$)	mg/L	2.0		-	-	-	-	-	-	-	-	-
Ammonia as N	mg/L	0.005-0.01		<0.0050	<0.0050	<0.0050	0.0169	<0.0050	<0.0050	<0.0050	0.0054	<0.0050
Bromide (Br)	mg/L	0.05-5		38.3	31.9	39.1	46.5	39.6	36.1	43.4	59.5	59.8
Chloride (Cl)	mg/L	0.5-25		9570	9560	9730	11800	9590	9380	10500	14800	15500
Fluoride (F)	mg/L	0.4-1		<0.75	<0.75	<0.75	<0.75	<0.75	<0.75	<0.75	<0.75	<0.75
Nitrate+Nitrite-N	mg/L	0.006		<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060
Nitrate (as N)	mg/L	0.006-0.5	3.612[b]	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060
Nitrite (as N)	mg/L	0.002-0.1		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Ortho Phosphate (as P)	mg/L	0.001		0.0157	0.0162	0.0157	0.0243	0.0185	0.0154	0.0184	0.0182	0.0365
Total Phosphorus	mg/L	0.002		0.0165	0.0165	0.0170	0.0245	0.0151	0.0160	0.0177	0.0309	0.0322
Silicate (as SiO_2)	mg/L	0.005-0.025		0.646	0.676	0.666	0.669	0.66	0.629	0.659	1.15	1.32
Sulphate (SO_4)	mg/L	0.5-50		1280	1260	1300	1590	1280	1250	1410	2010	2090
Organic / Inorganic Carbon												
Total Organic Carbon	mg/L	0.5-1		0.99	0.93	1.06	0.84	1.13	1.11	0.87	1.13	0.80
Total Metals												
Aluminum (Al)-Total	mg/L	0.005-0.01		0.0077	0.0072	0.0065	<0.0050	0.0085	0.0085	0.0051	<0.0050	<0.0050
Antimony (Sb)-Total	mg/L	0.0005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Total	mg/L	0.0002-0.002	0.0125[b]	0.00056	0.00054	0.00088	0.00079	0.00068	0.00063	0.00058	0.001	0.00094
Barium (Ba)-Total	mg/L	0.001-0.005		0.0072	0.0077	0.0077	0.0085	0.0073	0.0077	0.0086	0.0102	0.0107
Beryllium (Be)-Total	mg/L	0.0005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Bismuth (Bi)-Total	mg/L	0.0005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Boron (B)-Total	mg/L	0.1-1		2.2	2.2	2.3	2.8	2.3	2.2	2.4	3.2	3.5
Cadmium (Cd)-Total	mg/L	0.00002-0.00012	0.00012	0.000021	0.000021	0.000021	0.000028	0.00002	0.000021	0.000022	0.000034	0.000028
Calcium (Ca)-Total	mg/L	0.1-0.5		197	203	195	248	186	187	221	294	318
Cesium (Cs)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-
Chromium (Cr)-Total	mg/L	0.001-0.05	Cr(VI): 0.0015; Cr(III): 0.056[b]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cobalt (Co)-Total	mg/L	0.00005-0.0005		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)-Total	mg/L	0.00005-0.001		0.000361	0.000358	0.000342	0.000373	0.000414	0.000393	0.000401	0.000341	0.000306
Gallium (Ga)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-
Iron (Fe)-Total	mg/L	0.005-0.05		0.0098	0.0104	0.0109	0.0063	0.0115	0.0128	0.0099	<0.0050	<0.0050
Lead (Pb)-Total	mg/L	0.00005-0.001		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Total	mg/L	0.02-0.5		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Magnesium (Mg)-Total	mg/L	0.2-1		621	651	619	779	610	609	689	918	1020
Manganese (Mn)-Total	mg/L	0.00005-0.0005		0.00103	0.00108	0.00106	0.00102	0.00102	0.0011	0.000953	0.001	0.000935
Mercury (Hg)-Total	mg/L	0.00001	Inorganic Hg: 0.000016[b]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L	0.002-0.005		<0.0050	<0.0050	<0.0050	0.0062	<0.0050	<0.0050	0.0053	0.0069	0.008
Nickel (Ni)-Total	mg/L	0.00005-0.0005		0.000308	0.000329	0.00031	0.000408	0.000416	0.000359	0.000362	0.000423	0.000379
Phosphorus (P)-Total	mg/L	1-3		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Potassium (K)-Total	mg/L	4-20		181	193	180	230	188	186	201	277	312
Rhenium (Re)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-
Rubidium (Rb)-Total	mg/L	0.005		-	-	-	-	-	-	-	-	-
Selenium (Se)-Total	mg/L	0.0004-0.002		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00078	0.00078	<0.00050
Silicon (Si)-Total	mg/L	0.5		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.51	0.62
Silver (Ag)-Total	mg/L	0.0002-0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Sodium (Na)-Total	mg/L	4-20		4810	5130	4870	6150	4720	4680	5400	7900	8510
Strontium (Sr)-Total	mg/L	0.00005-0.05		3.61	3.63	3.73	4.4	3.81	3.65	3.94	5.27	5.68
Tellurium (Te)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-
Thallium (Tl)-Total	mg/L	0.0005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Thorium (Th)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-
Tin (Sn)-Total	mg/L	0.001-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Titanium (Ti)-Total	mg/L	0.005-0.1		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Tungsten (W)-Total	mg/L	0.001		-	-	-	-	-	-	-	-	-
Uranium (U)-Total	mg/L	0.00005-0.0005		0.00124	0.00134	0.00132	0.0016	0.00121	0.00132	0.00138	0.00199	0.00212
Vanadium (V)-Total	mg/L	0.0005-0.1		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Yttrium (Y)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-
Zinc (Zn)-Total	mg/L	0.0005-0.005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zirconium (Zr)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-
Dissolved Metals												
Aluminum (Al)-Dissolved	mg/L	0.005-0.01		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Antimony (Sb)-Dissolved	mg/L	0.0005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Dissolved	mg/L	0.0002-0.002		0.00058	0.00053	0.00054	0.00074	0.00058	0.00055	0.00074	0.00083	0.0011
Barium (Ba)-Dissolved	mg/L	0.001-0.005		0.0076	0.0074	0.0078	0.0088	0.0069	0.0076	0.0085	0.0109	0.0107
Beryllium (Be)-Dissolved	mg/L	0.0005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Bismuth (Bi)-Dissolved	mg/L	0.0005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Boron (B)-Dissolved	mg/L	0.1-1		2.3	2.2	2.3	2.8	2.1	2.1	2.5	3.5	3.4
Cadmium (Cd)-Dissolved	mg/L	0.00002-0.00012		0.000021	0.000021	0.000023	0.000026	0.000022	0.000022	0.000024	0.000036	0.00003
Calcium (Ca)-Dissolved	mg/L	0.1-0.5		205	210	204	242	189	200	224	313	325
Cesium (Cs)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-
Chromium (Cr)-Dissolved	mg/L	0.001-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cobalt (Co)-Dissolved	mg/L	0.00005-0.0005		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)-Dissolved	mg/L	0.00005-0.001		0.000367	0.000358	0.000359	0.000368	0.000335	0.000348	0.000317	0.000257	0.000267
Gallium (Ga)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-
Iron (Fe)-Dissolved	mg/L	0.005-0.05		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Lead (Pb)-Dissolved	mg/L	0.00005-0.001		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	mg/L	0.02-0.05		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Magnesium (Mg)-Dissolved	mg/L	0.2-1		640	665	646	758	622	646	689	967	1040
Manganese (Mn)-Dissolved	mg/L	0.00005-0.0005		0.000493	0.000459	0.000434	0.000178	0.000576	0.000562	0.000413	0.0006	0.000849
Mercury (Hg)-Dissolved	mg/L	0.00001		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	0.002-0.005		0.0052	<0.0050	<0.0050	0.0058	<0.0050	<0.0050	0.0053	0.0082	0.0074
Nickel (Ni)-Dissolved	mg/L	0.00005-0.0005		0.00036	0.000369	0.000406	0.000412	0.000367	0.000369	0.000352	0.000377	0.000371
Phosphorus (P)-Dissolved	mg/L	1-3		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Potassium (K)-Dissolved	mg/L	4-20		185	193	187	223	189	197	204	289	324
Rhenium (Re)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-
Rubidium (Rb)-Dissolved	mg/L	0.005		-	-	-	-	-	-	-	-	-
Selenium (Se)-Dissolved	mg/L	0.0004-0.002		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.0005	0.00059	<0.00050
Silicon (Si)-Dissolved	mg/L	0.5		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.5	0.6
Silver (Ag)-Dissolved	mg/L	0.0002-0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Sodium (Na)-Dissolved	mg/L	4-20		4930	5190	5060	5980	4740	5000	5530	8300	8760
Strontium (Sr)-Dissolved	mg/L	0.00005-0.05		3.66	3.58	3.68	4.49	3.6	3.75	3.96	5.59	5.56
Tellurium (Te)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-
Thallium (Tl)-Dissolved	mg/L	0.0005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Thorium (Th)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-
Tin (Sn)-Dissolved	mg/L	0.001-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Titanium (Ti)-Dissolved	mg/L	0.005-0.1		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Tungsten (W)-Dissolved	mg/L	0.001		-	-	-	-	-	-	-	-	-
Uranium (U)-Dissolved	mg/L	0.00005-0.0005		0.00141	0.00142	0.00139	0.00167	0.00124	0.00125	0.00148	0.00158	0.00154
Vanadium (V)-Dissolved	mg/L	0.0005-0.1		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Yttrium (Y)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-
Zinc (Zn)-Dissolved	mg/L	0.0005-0.005		<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050
Zirconium (Zr)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-
Cyanides												
Cyanide, Total	mg/L	0.001-0.005		-	-	-	-	-	-	-	-	-
Radiochemistry												
Radium-226	Bq/L	0.005		-	-	-	-	-	-	-	-	-

Notes:

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of marine aquatic life.

a) Canadian water quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

Appendix 4.2-3. Roberts Bay Water Quality, Doris North Project, 2009-2010

Site				ST5					ST6				
Date Sampled				15-Aug-09					15-Aug-09				
Replicate				1	2	1	1	1	1	2	1	1	1
Depth (m)		Realized	CCME Guideline for the	1	1	5	13	40	1	1	6	14	40
ALS Sample ID	Units	Detection Limits	Protection of Aquatic Life[a]	L806584-12	L806584-14	L806584-15	L806584-13	L806584-21	L806584-20	L806584-1	L806584-2	L806584-4	L806584-3
Physical Tests													
Conductivity	µS/cm	2.0		-	-	-	-	-	-	-	-	-	-
Hardness (as $CaCO_3$)	mg/L	0.86-4.3		-	-	-	-	-	-	-	-	-	-
pH	pH	0.1	7.0-8.7	7.8	7.8	7.79	7.8	7.71	7.82	7.77	7.8	7.81	7.69
Total Suspended Solids	mg/L	3.0	dependent on background levels	4.4	4.4	3.8	5.8	9.8	6.4	5.8	5.8	6.4	10.4
Turbidity	NTU	0.1	dependent on background levels	0.41	0.43	0.36	0.25	0.29	0.38	0.42	0.41	0.24	0.23
Salinity (EC)	g/L	1.0	<10% fluctuation[b]	-	-	-	-	-	-	-	-	-	-
Anions and Nutrients													
Alkalinity, Total (as $CaCO_3$)	mg/L	2.0		-	-	-	-	-	-	-	-	-	-
Ammonia as N	mg/L	0.005-0.01		<0.0050	<0.0050	<0.0050	0.0079	0.008	<0.0050	<0.0050	<0.0050	<0.0050	0.0079
Bromide (Br)	mg/L	0.05-5		37.8	40.2	40.4	58.9	63.9	38	35.2	39.7	57.7	60.8
Chloride (Cl)	mg/L	0.5-25		9670	9560	9640	14800	15700	9450	9790	9680	14500	15400
Fluoride (F)	mg/L	0.4-1		<0.75	<0.75	<0.75	0.76	0.97	<0.75	0.76	<0.75	0.85	0.83
Nitrate+Nitrite-N	mg/L	0.006		<0.0060	<0.0060	<0.0060	<0.0060	0.0728	<0.0060	<0.0060	<0.0060	<0.0060	0.0769
Nitrate (as N)	mg/L	0.006-0.5	3.612[b]	<0.0060	<0.0060	<0.0060	<0.0060	0.0728	<0.0060	<0.0060	<0.0060	<0.0060	0.0769
Nitrite (as N)	mg/L	0.002-0.1		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Ortho Phosphate (as P)	mg/L	0.001		0.0158	0.0150	0.0160	0.0330	0.0461	0.0152	0.0157	0.0157	0.0311	0.0458
Total Phosphorus	mg/L	0.002		0.0159	0.0154	0.0164	0.0332	0.0427	0.0156	0.0161	0.0172	0.0321	0.0437
Silicate (as SiO_2)	mg/L	0.005-0.025		0.662	0.629	0.646	1.16	1.98	0.639	0.669	0.72	1.2	1.95
Sulphate (SO_4)	mg/L	0.5-50		1290	1270	1290	2000	2130	1260	1310	1290	1960	2100
Organic / Inorganic Carbon													
Total Organic Carbon	mg/L	0.5-1		0.91	1.05	1.08	0.82	0.70	0.97	1.21	1.15	1.19	0.97
Total Metals													
Aluminum (Al)-Total	mg/L	0.005-0.01		<0.0050	0.0077	0.0067	<0.0050	<0.0050	0.005	0.0051	0.0064	<0.0050	<0.0050
Antimony (Sb)-Total	mg/L	0.0005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Total	mg/L	0.0002-0.002	0.0125[b]	0.00059	0.00058	0.00067	0.0009	0.00137	0.00064	0.00054	0.0005	0.00074	0.00101
Barium (Ba)-Total	mg/L	0.001-0.005		0.0071	0.0074	0.0076	0.0105	0.011	0.0072	0.0084	0.0076	0.0108	0.0112
Beryllium (Be)-Total	mg/L	0.0005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Bismuth (Bi)-Total	mg/L	0.0005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Boron (B)-Total	mg/L	0.1-1		2.2	2.2	2.3	3.4	3.5	2.1	2.3	2.2	3.4	3.6
Cadmium (Cd)-Total	mg/L	0.00002-0.00012	0.00012	0.000022	0.000021	0.00002	0.000036	0.000068	0.000021	0.000021	0.000022	0.000036	0.000066
Calcium (Ca)-Total	mg/L	0.1-0.5		205	204	194	314	330	187	216	204	320	340
Cesium (Cs)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Chromium (Cr)-Total	mg/L	0.001-0.05	Cr(VI): 0.0015; Cr(III): 0.056[b]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cobalt (Co)-Total	mg/L	0.00005-0.0005		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)-Total	mg/L	0.00005-0.001		0.000383	0.000429	0.000396	0.000359	0.000338	0.000577	0.000394	0.000362	0.000298	0.000284
Gallium (Ga)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Iron (Fe)-Total	mg/L	0.005-0.05		0.0095	0.0121	0.0103	<0.0050	<0.0050	0.0118	0.0083	0.0084	<0.0050	<0.0050
Lead (Pb)-Total	mg/L	0.00005-0.001		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Total	mg/L	0.02-0.5		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Magnesium (Mg)-Total	mg/L	0.2-1		623	633	621	982	1020	593	686	634	987	1040
Manganese (Mn)-Total	mg/L	0.00005-0.0005		0.00114	0.00114	0.0011	0.00112	0.00151	0.00108	0.00105	0.00106	0.00108	0.00131
Mercury (Hg)-Total	mg/L	0.00001	Inorganic Hg: 0.000016[b]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L	0.002-0.005		<0.0050	<0.0050	<0.0050	0.0076	0.0081	<0.0050	<0.0050	<0.0050	0.0076	0.0074
Nickel (Ni)-Total	mg/L	0.00005-0.0005		0.000384	0.000374	0.000383	0.000405	0.00055	0.000472	0.000353	0.00033	0.000373	0.00047
Phosphorus (P)-Total	mg/L	1-3		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Potassium (K)-Total	mg/L	4-20		187	196	187	293	306	175	203	193	293	311
Rhenium (Re)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Rubidium (Rb)-Total	mg/L	0.005		-	-	-	-	-	-	-	-	-	-
Selenium (Se)-Total	mg/L	0.0004-0.002		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Silicon (Si)-Total	mg/L	0.5		<0.50	<0.50	<0.50	0.51	0.87	<0.50	<0.50	<0.50	0.53	0.86
Silver (Ag)-Total	mg/L	0.0002-0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Sodium (Na)-Total	mg/L	4-20		4920	5020	4780	8080	8550	4550	5510	5240	8670	9200
Strontium (Sr)-Total	mg/L	0.00005-0.05		3.71	3.67	3.76	5.58	5.86	3.55	3.88	3.66	5.67	5.87
Tellurium (Te)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Thallium (Tl)-Total	mg/L	0.0005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Thorium (Th)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Tin (Sn)-Total	mg/L	0.001-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Titanium (Ti)-Total	mg/L	0.005-0.1		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Tungsten (W)-Total	mg/L	0.001		-	-	-	-	-	-	-	-	-	-
Uranium (U)-Total	mg/L	0.00005-0.0005		0.00127	0.00127	0.00134	0.00194	0.00183	0.00119	0.00129	0.00135	0.00194	0.00214
Vanadium (V)-Total	mg/L	0.0005-0.1		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Yttrium (Y)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Zinc (Zn)-Total	mg/L	0.0005-0.005		0.00057	<0.00050	<0.00050	0.00061	<0.00050	0.00059	<0.00050	<0.00050	<0.00050	<0.00050
Zirconium (Zr)-Total	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Dissolved Metals													
Aluminum (Al)-Dissolved	mg/L	0.005-0.01		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Antimony (Sb)-Dissolved	mg/L	0.0005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Dissolved	mg/L	0.0002-0.002		0.0005	0.00049	0.00054	0.00082	0.00107	0.00055	0.00055	0.00052	0.00078	0.00119
Barium (Ba)-Dissolved	mg/L	0.001-0.005		0.0075	0.0071	0.0077	0.0143	0.0114	0.0078	0.0084	0.0082	0.0116	0.0121
Beryllium (Be)-Dissolved	mg/L	0.0005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Bismuth (Bi)-Dissolved	mg/L	0.0005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Boron (B)-Dissolved	mg/L	0.1-1		2.3	2.2	2.3	3.4	3.6	2.1	2.4	2.3	3.5	3.6
Cadmium (Cd)-Dissolved	mg/L	0.00002-0.00012		0.000022	0.000021	0.000022	0.000035	0.000071	0.000022	0.000023	0.000024	0.000037	0.000067
Calcium (Ca)-Dissolved	mg/L	0.1-0.5		195	193	191	292	327	199	214	207	329	339
Cesium (Cs)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Chromium (Cr)-Dissolved	mg/L	0.001-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cobalt (Co)-Dissolved	mg/L	0.00005-0.0005		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)-Dissolved	mg/L	0.00005-0.001		0.00037	0.00037	0.000356	0.000281	0.000251	0.000338	0.000353	0.000362	0.00034	0.000326
Gallium (Ga)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Iron (Fe)-Dissolved	mg/L	0.005-0.05		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Lead (Pb)-Dissolved	mg/L	0.00005-0.001		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	mg/L	0.02-0.05		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Magnesium (Mg)-Dissolved	mg/L	0.2-1		616	612	614	920	1010	621	674	645	992	1040
Manganese (Mn)-Dissolved	mg/L	0.00005-0.0005		0.000517	0.000511	0.000424	0.000552	0.00125	0.000579	0.000529	0.000517	0.000624	0.00109
Mercury (Hg)-Dissolved	mg/L	0.00001		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	0.002-0.005		<0.0050	<0.0050	<0.0050	0.0076	0.0082	<0.0050	<0.0050	<0.0050	0.0073	0.0085
Nickel (Ni)-Dissolved	mg/L	0.00005-0.0005		0.000377	0.000356	0.000374	0.0004	0.000525	0.000331	0.000399	0.000402	0.000458	0.000548
Phosphorus (P)-Dissolved	mg/L	1-3		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Potassium (K)-Dissolved	mg/L	4-20		183	187	185	275	298	185	197	191	296	308
Rhenium (Re)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Rubidium (Rb)-Dissolved	mg/L	0.005		-	-	-	-	-	-	-	-	-	-
Selenium (Se)-Dissolved	mg/L	0.0004-0.002		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Silicon (Si)-Dissolved	mg/L	0.5		<0.50	<0.50	<0.50	<0.50	0.86	<0.50	<0.50	<0.50	0.52	0.86
Silver (Ag)-Dissolved	mg/L	0.0002-0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Sodium (Na)-Dissolved	mg/L	4-20		4680	4790	4710	7540	8390	4870	5390	5230	8730	9100
Strontium (Sr)-Dissolved	mg/L	0.00005-0.05		3.77	3.68	3.73	5.42	6.05	3.7	3.86	3.68	5.72	5.96
Tellurium (Te)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Thallium (Tl)-Dissolved	mg/L	0.0005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Thorium (Th)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Tin (Sn)-Dissolved	mg/L	0.001-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Titanium (Ti)-Dissolved	mg/L	0.005-0.1		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Tungsten (W)-Dissolved	mg/L	0.001		-	-	-	-	-	-	-	-	-	-
Uranium (U)-Dissolved	mg/L	0.00005-0.0005		0.00141	0.00134	0.00139	0.00179	0.00177	0.00136	0.00143	0.0014	0.00197	0.00206
Vanadium (V)-Dissolved	mg/L	0.0005-0.1		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Yttrium (Y)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Zinc (Zn)-Dissolved	mg/L	0.0005-0.005		<0.0010	<0.00050	<0.00050	<0.00050	0.00053	<0.00050	<0.0010	<0.0020	<0.0010	<0.0010
Zirconium (Zr)-Dissolved	mg/L	0.0005		-	-	-	-	-	-	-	-	-	-
Cyanides													
Cyanide, Total	mg/L	0.001-0.005		-	-	-	-	-	-	-	-	-	-
Radiochemistry													
Radium-226	Bq/L	0.005		-	-	-	-	-	-	-	-	-	-

Notes:

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of marine aquatic life.

a) Canadian water quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

Appendix 4.2-3. Roberts Bay Water Quality, Doris North Project, 2009-2010

Site				ST4					DWP		RBE		RBW	RBE	
Date Sampled				24-Apr-10					24-Apr-10		25-Apr-10		25-Apr-10	20-Jul-10	
Replicate				1	1	2	1	1	1	1	1	2	1	1	2
Depth (m)		Realized	CCME Guideline for the	2.5	9.5	9.5	17.5	41.5	2.5	11.5	3	3	3	1	1
ALS Sample ID	Units	Detection Limits	Protection of Aquatic Life[a]	L880489-1	L880489-2	L880489-3	L880489-9	L880489-4	L880489-11	L880489-12	L880493-1	L880493-2	L880493-3	L911821-2	L911821-3
Physical Tests															
Conductivity	µS/cm	2.0		-	-	-	-	-	-	-	-	-	-	34000	33900
Hardness (as $CaCO_3$)	mg/L	0.86-4.3		5140	5080	5140	5410	5400	5060	5100	4990	4990	5120	4380	4210
pH	pH	0.1	7.0-8.7	7.72	7.72	7.66	7.63	7.63	7.69	7.73	7.75	7.72	7.73	7.84	7.90
Total Suspended Solids	mg/L	3.0	dependent on background levels	7.0	5.0	14.3	<3.0	10.3	<3.0	6.3	8.3	<3.0	10.3	5.6	6.9
Turbidity	NTU	0.1	dependent on background levels	0.23	0.13	0.14	0.17	0.19	0.16	0.16	0.22	0.19	0.16	0.73	0.71
Salinity (EC)	g/L	1.0	<10% fluctuation[b]	-	-	-	-	-	-	-	26.7	26.5	26.6	21.9	21.8
Anions and Nutrients															
Alkalinity, Total (as $CaCO_3$)	mg/L	2.0		-	-	-	-	-	-	-	120	119	118	104	96.2
Ammonia as N	mg/L	0.005-0.01		0.0098	<0.0050	<0.0050	0.155	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.005	<0.005
Bromide (Br)	mg/L	0.05-5		43.6	44.4	44.6	47.1	45.9	45.5	46.3	42.9	42.2	43.7	34.3	34.2
Chloride (Cl)	mg/L	0.5-25		15100	15300	15300	15600	15600	15200	15300	15200	15200	15200	12700	12700
Fluoride (F)	mg/L	0.4-1		0.91	0.96	0.95	0.91	0.96	0.93	0.91	0.93	0.92	0.95	<0.75	<0.75
Nitrate+Nitrite-N	mg/L	0.006		-	-	-	-	-	-	-	-	-	-	<0.0060	<0.0060
Nitrate (as N)	mg/L	0.006-0.5	3.612[b]	0.0358	0.0669	0.0675	0.0789	0.0821	0.0364	0.0747	0.0252	0.0243	0.0318	<0.0060	<0.0060
Nitrite (as N)	mg/L	0.002-0.1		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	-	-	-	<0.0020	<0.0020
Ortho Phosphate (as P)	mg/L	0.001		0.0369	0.0403	0.0396	0.0462	0.0456	0.0358	0.0440	-	-	-	-	-
Total Phosphorus	mg/L	0.002		0.0382	0.0404	0.0421	0.0454	0.0472	0.0384	0.0425	0.0371	0.0359	0.0379	0.0275	0.0277
Silicate (as SiO_2)	mg/L	0.005-0.025		1.27	1.45	1.45	1.74	2.02	1.31	1.57	-	-	-	-	-
Sulphate (SO_4)	mg/L	0.5-50		2070	2100	2100	2140	2140	2080	2090	2080	2080	2080	1750	1740
Organic / Inorganic Carbon															
Total Organic Carbon	mg/L	0.5-1		1.30	1.10	1.10	1.00	<1.0	1.20	1.20	1.20	1.10	1.20	1.61	1.44
Total Metals															
Aluminum (Al)-Total	mg/L	0.005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.018	<0.010	<0.010	0.0302	0.0248
Antimony (Sb)-Total	mg/L	0.0005-0.01		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Total	mg/L	0.0002-0.002	0.0125[b]	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Barium (Ba)-Total	mg/L	0.001-0.005		0.0114	0.0128	0.0121	0.0141	0.0122	0.0118	0.0133	0.0115	0.0115	0.0112	0.0112	0.0115
Beryllium (Be)-Total	mg/L	0.0005-0.05		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth (Bi)-Total	mg/L	0.0005-0.05		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Total	mg/L	0.1-1		3.61	3.74	3.67	3.91	3.83	3.75	3.78	3.77	3.73	3.81	2.96	2.95
Cadmium (Cd)-Total	mg/L	0.00002-0.00012	0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012
Calcium (Ca)-Total	mg/L	0.1-0.5		338	324	328	326	333	319	315	320	321	331	288	263
Cesium (Cs)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chromium (Cr)-Total	mg/L	0.001-0.05	Cr(VI): 0.0015; Cr(III): 0.056[b]	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt (Co)-Total	mg/L	0.00005-0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Copper (Cu)-Total	mg/L	0.00005-0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Gallium (Ga)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)-Total	mg/L	0.005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Lead (Pb)-Total	mg/L	0.00005-0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Lithium (Li)-Total	mg/L	0.02-0.5		0.158	0.159	0.155	0.164	0.159	0.160	0.161	0.161	0.158	0.162	0.133	0.136
Magnesium (Mg)-Total	mg/L	0.2-1		1070	1030	1040	1050	1060	1020	1010	1020	1020	1040	888	862
Manganese (Mn)-Total	mg/L	0.00005-0.0005		0.00154	0.00121	0.00115	0.00154	0.00253	0.00148	0.00112	0.00233	0.00147	0.00145	0.00267	0.00270
Mercury (Hg)-Total	mg/L	0.00001	Inorganic Hg: 0.000016[b]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L	0.002-0.005		0.0092	0.0089	0.0087	0.0094	0.0091	0.0091	0.0091	0.0087	0.0082	0.0095	0.0078	0.0078
Nickel (Ni)-Total	mg/L	0.00005-0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00067	0.00056
Phosphorus (P)-Total	mg/L	1-3		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Potassium (K)-Total	mg/L	4-20		339	344	342	345	355	342	336	340	339	337	269	259
Rhenium (Re)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Rubidium (Rb)-Total	mg/L	0.005		0.0870	0.0891	0.0863	0.0913	0.0890	0.0888	0.0881	0.0885	0.0877	0.0879	0.0766	0.0774
Selenium (Se)-Total	mg/L	0.0004-0.002		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Silicon (Si)-Total	mg/L	0.5		0.68	0.74	0.65	0.73	0.82	0.60	0.72	0.52	<0.50	0.70	<0.50	<0.50
Silver (Ag)-Total	mg/L	0.0002-0.001		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Sodium (Na)-Total	mg/L	4-20		7830	7870	7790	7910	8050	7790	7680	7760	7720	7690	7640	7340
Strontium (Sr)-Total	mg/L	0.00005-0.05		5.81	5.82	5.76	5.86	5.94	5.80	5.70	5.73	5.71	5.69	5.27	5.05
Tellurium (Te)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thallium (Tl)-Total	mg/L	0.0005-0.01		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thorium (Th)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Tin (Sn)-Total	mg/L	0.001-0.01		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Titanium (Ti)-Total	mg/L	0.005-0.1		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Tungsten (W)-Total	mg/L	0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Uranium (U)-Total	mg/L	0.00005-0.0005		0.00262	0.00262	0.00254	0.00256	0.00263	0.00256	0.00258	0.00247	0.00253	0.00253	0.00215	0.00214
Vanadium (V)-Total	mg/L	0.0005-0.1		0.00079	0.00084	0.00081	0.00075	0.00082	0.00075	0.00070	0.00081	0.00083	0.00074	0.00073	0.00070
Yttrium (Y)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total	mg/L	0.0005-0.005		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium (Zr)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals															
Aluminum (Al)-Dissolved	mg/L	0.005-0.01		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	-	-	-	-
Antimony (Sb)-Dissolved	mg/L	0.0005-0.01		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-	-
Arsenic (As)-Dissolved	mg/L	0.0002-0.002		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	-	-	-	-	-
Barium (Ba)-Dissolved	mg/L	0.001-0.005		0.0114	0.0123	0.0129	0.0142	0.0129	0.0111	0.0134	-	-	-	-	-
Beryllium (Be)-Dissolved	mg/L	0.0005-0.05		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-	-
Bismuth (Bi)-Dissolved	mg/L	0.0005-0.05		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-	-
Boron (B)-Dissolved	mg/L	0.1-1		3.62	3.73	3.66	3.82	3.84	3.73	3.84	-	-	-	-	-
Cadmium (Cd)-Dissolved	mg/L	0.00002-0.00012		<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	-	-	-	-	-
Calcium (Ca)-Dissolved	mg/L	0.1-0.5		331	325	329	343	348	322	325	-	-	-	-	-
Cesium (Cs)-Dissolved	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-	-
Chromium (Cr)-Dissolved	mg/L	0.001-0.05		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-	-	-	-
Cobalt (Co)-Dissolved	mg/L	0.00005-0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-	-
Copper (Cu)-Dissolved	mg/L	0.00005-0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-	-	-	-
Gallium (Ga)-Dissolved	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-	-
Iron (Fe)-Dissolved	mg/L	0.005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	-	-	-	-
Lead (Pb)-Dissolved	mg/L	0.00005-0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-	-	-	-
Lithium (Li)-Dissolved	mg/L	0.02-0.05		0.157	0.160	0.154	0.162	0.157	0.161	0.162	-	-	-	-	-
Magnesium (Mg)-Dissolved	mg/L	0.2-1		1050	1040	1050	1100	1100	1030	1040	-	-	-	-	-
Manganese (Mn)-Dissolved	mg/L	0.00005-0.0005		0.00052	0.00110	0.00070	0.00072	0.00183	<0.00050	0.00121	-	-	-	-	-
Mercury (Hg)-Dissolved	mg/L	0.00001		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	-	-	-	-
Molybdenum (Mo)-Dissolved	mg/L	0.002-0.005		0.0088	0.0099	0.0088	0.0094	0.0090	0.0091	0.0090	-	-	-	-	-
Nickel (Ni)-Dissolved	mg/L	0.00005-0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-	-
Phosphorus (P)-Dissolved	mg/L	1-3		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-
Potassium (K)-Dissolved	mg/L	4-20		346	345	346	349	361	344	345	-	-	-	-	-
Rhenium (Re)-Dissolved	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-	-
Rubidium (Rb)-Dissolved	mg/L	0.005		0.0869	0.0885	0.0856	0.0911	0.0899	0.0881	0.0881	-	-	-	-	-
Selenium (Se)-Dissolved	mg/L	0.0004-0.002		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	-	-	-	-	-
Silicon (Si)-Dissolved	mg/L	0.5		0.61	0.62	0.62	0.85	0.96	<0.50	0.85	-	-	-	-	-
Silver (Ag)-Dissolved	mg/L	0.0002-0.001		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	-	-	-	-
Sodium (Na)-Dissolved	mg/L	4-20		7960	7890	7900	7980	8190	7820	7870	-	-	-	-	-
Strontium (Sr)-Dissolved	mg/L	0.00005-0.05		5.89	5.82	5.84	5.95	6.03	5.82	5.83	-	-	-	-	-
Tellurium (Te)-Dissolved	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-	-
Thallium (Tl)-Dissolved	mg/L	0.0005-0.01		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-	-
Thorium (Th)-Dissolved	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-	-
Tin (Sn)-Dissolved	mg/L	0.001-0.01		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-	-	-	-
Titanium (Ti)-Dissolved	mg/L	0.005-0.1		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-	-	-
Tungsten (W)-Dissolved	mg/L	0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-	-	-	-
Uranium (U)-Dissolved	mg/L	0.00005-0.0005		0.00262	0.00264	0.00249	0.00261	0.00262	0.00257	0.00254	-	-	-	-	-
Vanadium (V)-Dissolved	mg/L	0.0005-0.1		0.00077	0.00083	0.00079	0.00074	0.00081	0.00081	0.00076	-	-	-	-	-
Yttrium (Y)-Dissolved	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-	-
Zinc (Zn)-Dissolved	mg/L	0.0005-0.005		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-	-	-
Zirconium (Zr)-Dissolved	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-	-
Cyanides															
Cyanide, Total	mg/L	0.001-0.005		-	-	-	-	-	-	-	<0.0050	<0.0050	<0.0050	0.0012	0.0014
Radiochemistry															
Radium-226	Bq/L	0.005		-	-	-	-	-	-	-	<0.005	<0.005	<0.005	<0.005	0.007

Notes:

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of marine aquatic life.

a) Canadian water quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

Appendix 4.2-3. Roberts Bay Water Quality, Doris North Project, 2009-2010

Site				RBW		ST4					DWP			
Date Sampled				20-Jul-10		22-Jul-10					22-Jul-10			
Replicate				1	2	1	1	2	1	1	1	2	1	1
Depth (m)		Realized	CCME Guideline for the	1	1	1	6	6	14	40	1	1	6	12
ALS Sample ID	Units	Detection Limits	Protection of Aquatic Life[a]	L911821-4	L911821-5	L912587-1	L912587-2	L912587-5	L912587-3	L912587-4	L912587-6	L912587-9	L912587-7	L912587-8
Physical Tests														
Conductivity	µS/cm	2.0		34200	34300	-	-	-	-	-	-	-	-	-
Hardness (as $CaCO_3$)	mg/L	0.86-4.3		4260	4220	-	-	-	-	-	-	-	-	-
pH	pH	0.1	7.0-8.7	7.87	7.88	7.87	7.88	7.88	7.87	7.80	7.88	7.86	7.89	7.88
Total Suspended Solids	mg/L	3.0	dependent on background levels	<3.0	7.6	11.3	12.0	12.0	14.0	19.3	10.7	12.0	12.7	11.3
Turbidity	NTU	0.1	dependent on background levels	0.45	0.47	0.21	0.23	0.32	0.36	0.58	0.27	0.32	0.22	0.24
Salinity (EC)	g/L	1.0	<10% fluctuation[b]	22.1	22.0	-	-	-	-	-	-	-	-	-
Anions and Nutrients														
Alkalinity, Total (as $CaCO_3$)	mg/L	2.0		103	98.8	-	-	-	-	-	-	-	-	-
Ammonia as N	mg/L	0.005-0.01		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010	<0.010	<0.010
Bromide (Br)	mg/L	0.05-5		35.5	35.0	36.9	39.8	39.0	46.3	47.9	37.3	37.8	37.6	40.1
Chloride (Cl)	mg/L	0.5-25		12700	12700	12800	13300	13400	15800	16500	13200	13500	13400	14100
Fluoride (F)	mg/L	0.4-1		<0.75	0.92	<0.75	<0.75	0.88	0.78	0.80	0.76	<0.75	<0.75	<0.75
Nitrate+Nitrite-N	mg/L	0.006		<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	0.0668	<0.0060	<0.0060	<0.0060	<0.0060
Nitrate (as N)	mg/L	0.006-0.5	3.612[b]	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	0.0668	<0.0060	<0.0060	<0.0060	<0.0060
Nitrite (as N)	mg/L	0.002-0.1		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Ortho Phosphate (as P)	mg/L	0.001		-	-	0.0215	0.0229	0.0225	0.0290	0.0442	0.0214	0.0218	0.0220	0.0240
Total Phosphorus	mg/L	0.002		0.0270	0.0274	0.0260	0.0257	0.0253	0.0335	0.0545	0.0263	0.0265	0.0266	0.0274
Silicate (as SiO_2)	mg/L	0.005-0.025		-	-	0.649	0.716	0.758	0.836	2.11	0.683	0.702	0.736	0.779
Sulphate (SO_4)	mg/L	0.5-50		1750	1750	1750	1810	1830	2160	2250	1800	1840	1820	1910
Organic / Inorganic Carbon														
Total Organic Carbon	mg/L	0.5-1		1.33	1.36	1.26	1.21	1.28	1.14	1.17	1.19	1.17	1.19	1.19
Total Metals														
Aluminum (Al)-Total	mg/L	0.005-0.01		0.0151	0.0226	<0.0050	<0.0050	<0.0050	0.0082	0.0054	<0.0050	0.0058	<0.0050	<0.0050
Antimony (Sb)-Total	mg/L	0.0005-0.01		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Total	mg/L	0.0002-0.002	0.0125[b]	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Barium (Ba)-Total	mg/L	0.001-0.005		0.0114	0.0111	0.0096	0.0100	0.0101	0.0118	0.0127	0.0093	0.0096	0.0101	0.0101
Beryllium (Be)-Total	mg/L	0.0005-0.05		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth (Bi)-Total	mg/L	0.0005-0.05		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Total	mg/L	0.1-1		3.01	3.07	2.84	2.87	3.01	3.47	3.76	2.77	2.95	3.00	3.10
Cadmium (Cd)-Total	mg/L	0.00002-0.00012	0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012
Calcium (Ca)-Total	mg/L	0.1-0.5		285	263	263	257	253	337	335	253	265	267	293
Cesium (Cs)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chromium (Cr)-Total	mg/L	0.001-0.05	Cr(VI): 0.0015; Cr(III): 0.056[b]	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt (Co)-Total	mg/L	0.00005-0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Copper (Cu)-Total	mg/L	0.00005-0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Gallium (Ga)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)-Total	mg/L	0.005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Lead (Pb)-Total	mg/L	0.00005-0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Lithium (Li)-Total	mg/L	0.02-0.5		0.138	0.131	0.115	0.116	0.122	0.143	0.154	0.110	0.118	0.123	0.126
Magnesium (Mg)-Total	mg/L	0.2-1		863	865	872	862	849	1040	1050	840	839	903	924
Manganese (Mn)-Total	mg/L	0.00005-0.0005		0.00225	0.00225	0.00207	0.00215	0.00222	0.00182	0.00292	0.00187	0.00214	0.00210	0.00205
Mercury (Hg)-Total	mg/L	0.00001	Inorganic Hg: 0.000016[b]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L	0.002-0.005		0.0081	0.0078	0.0066	0.0066	0.0068	0.0081	0.0088	0.0064	0.0069	0.0070	0.0072
Nickel (Ni)-Total	mg/L	0.00005-0.0005		0.00055	0.00055	0.00082	0.00068	0.00088	0.00089	0.00095	<0.00050	0.00063	<0.00050	<0.00050
Phosphorus (P)-Total	mg/L	1-3		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Potassium (K)-Total	mg/L	4-20		264	258	258	251	245	306	302	244	249	258	265
Rhenium (Re)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Rubidium (Rb)-Total	mg/L	0.005		0.0805	0.0785	0.0664	0.0661	0.0696	0.0815	0.0890	0.0637	0.0682	0.0700	0.0710
Selenium (Se)-Total	mg/L	0.0004-0.002		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Silicon (Si)-Total	mg/L	0.5		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.95	<0.50	<0.50	<0.50	<0.50
Silver (Ag)-Total	mg/L	0.0002-0.001		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Sodium (Na)-Total	mg/L	4-20		7500	7260	7190	7080	6830	8570	8440	6840	7220	7210	7440
Strontium (Sr)-Total	mg/L	0.00005-0.05		5.18	5.00	4.91	4.84	4.70	5.92	5.78	4.71	4.99	4.95	5.13
Tellurium (Te)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thallium (Tl)-Total	mg/L	0.0005-0.01		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thorium (Th)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Tin (Sn)-Total	mg/L	0.001-0.01		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Titanium (Ti)-Total	mg/L	0.005-0.1		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Tungsten (W)-Total	mg/L	0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Uranium (U)-Total	mg/L	0.00005-0.0005		0.00217	0.00215	0.00200	0.00194	0.00206	0.00238	0.00257	0.00185	0.00199	0.00205	0.00209
Vanadium (V)-Total	mg/L	0.0005-0.1		0.00070	0.00069	0.00061	0.00062	0.00064	0.00075	0.00082	0.00055	0.00059	0.00068	0.00062
Yttrium (Y)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total	mg/L	0.0005-0.005		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium (Zr)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals														
Aluminum (Al)-Dissolved	mg/L	0.005-0.01		-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Antimony (Sb)-Dissolved	mg/L	0.0005-0.01		-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Dissolved	mg/L	0.0002-0.002		-	-	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Barium (Ba)-Dissolved	mg/L	0.001-0.005		-	-	0.0094	0.0096	0.0105	0.0122	0.0125	0.0099	0.0103	0.0096	0.0101
Beryllium (Be)-Dissolved	mg/L	0.0005-0.05		-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth (Bi)-Dissolved	mg/L	0.0005-0.05		-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Dissolved	mg/L	0.1-1		-	-	2.88	2.92	3.03	3.53	3.66	2.96	3.01	2.98	3.11
Cadmium (Cd)-Dissolved	mg/L	0.00002-0.00012		-	-	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	0.00033
Calcium (Ca)-Dissolved	mg/L	0.1-0.5		-	-	286	267	263	356	332	249	270	259	306
Cesium (Cs)-Dissolved	mg/L	0.0005		-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chromium (Cr)-Dissolved	mg/L	0.001-0.05		-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt (Co)-Dissolved	mg/L	0.00005-0.0005		-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Copper (Cu)-Dissolved	mg/L	0.00005-0.001		-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Gallium (Ga)-Dissolved	mg/L	0.0005		-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)-Dissolved	mg/L	0.005-0.05		-	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Lead (Pb)-Dissolved	mg/L	0.00005-0.001		-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Lithium (Li)-Dissolved	mg/L	0.02-0.05		-	-	0.117	0.119	0.120	0.144	0.149	0.120	0.123	0.122	0.125
Magnesium (Mg)-Dissolved	mg/L	0.2-1		-	-	894	876	882	1100	1060	827	853	865	951
Manganese (Mn)-Dissolved	mg/L	0.00005-0.0005		-	-	0.00171	0.00197	0.00189	0.00103	<0.00050	0.00202	0.00211	0.00173	0.00183
Mercury (Hg)-Dissolved	mg/L	0.00001		-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	0.002-0.005		-	-	0.0065	0.0067	0.0070	0.0083	0.0085	0.0069	0.0070	0.0070	0.0072
Nickel (Ni)-Dissolved	mg/L	0.00005-0.0005		-	-	<0.00050	0.00062	<0.00050	<0.00050	0.00054	0.00061	0.00070	0.00055	0.00088
Phosphorus (P)-Dissolved	mg/L	1-3		-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Potassium (K)-Dissolved	mg/L	4-20		-	-	265	258	257	324	304	241	255	247	276
Rhenium (Re)-Dissolved	mg/L	0.0005		-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Rubidium (Rb)-Dissolved	mg/L	0.005		-	-	0.0655	0.0673	0.0697	0.0833	0.0853	0.0686	0.0699	0.0681	0.0723
Selenium (Se)-Dissolved	mg/L	0.0004-0.002		-	-	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Silicon (Si)-Dissolved	mg/L	0.5		-	-	<0.50	<0.50	<0.50	<0.50	0.87	<0.50	<0.50	<0.50	<0.50
Silver (Ag)-Dissolved	mg/L	0.0002-0.001		-	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Sodium (Na)-Dissolved	mg/L	4-20		-	-	7460	7280	7170	8980	8430	6760	7370	6980	7700
Strontium (Sr)-Dissolved	mg/L	0.00005-0.05		-	-	5.08	5.00	4.92	6.16	5.76	4.62	5.05	4.79	5.33
Tellurium (Te)-Dissolved	mg/L	0.0005		-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thallium (Tl)-Dissolved	mg/L	0.0005-0.01		-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thorium (Th)-Dissolved	mg/L	0.0005		-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Tin (Sn)-Dissolved	mg/L	0.001-0.01		-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Titanium (Ti)-Dissolved	mg/L	0.005-0.1		-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Tungsten (W)-Dissolved	mg/L	0.001		-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Uranium (U)-Dissolved	mg/L	0.00005-0.0005		-	-	0.00195	0.00198	0.00204	0.00240	0.00254	0.00203	0.00204	0.00207	0.00209
Vanadium (V)-Dissolved	mg/L	0.0005-0.1		-	-	0.00054	0.00058	0.00060	0.00088	0.00075	0.00058	0.00062	0.00060	0.00061
Yttrium (Y)-Dissolved	mg/L	0.0005		-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved	mg/L	0.0005-0.005		-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium (Zr)-Dissolved	mg/L	0.0005		-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cyanides														
Cyanide, Total	mg/L	0.001-0.005		0.0011	0.0022	-	-	-	-	-	-	-	-	-
Radiochemistry														
Radium-226	Bq/L	0.005		<0.005	<0.005	-	-	-	-	-	-	-	-	-

Notes:

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of marine aquatic life.

a) Canadian water quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

Appendix 4.2-3. Roberts Bay Water Quality, Doris North Project, 2009-2010

Site				DWP			ST4					RBE		RBW	
Date Sampled				15-Aug-10			15-Aug-10					15-Aug-10		15-Aug-10	
Replicate				1	1	1	1	1	2	1	1	1	2	1	2
Depth (m)		Realized	CCME Guideline for the	1	4	10	1	7	7	15	30	1	1	1	1
ALS Sample ID	Units	Detection Limits	Protection of Aquatic Life[a]	L921283-1	L921283-2	L921283-3	L921283-4	L921283-5	L921283-6	L921283-7	L921283-8	L921315-1	L921315-2	L921315-3	L921315-4
Physical Tests															
Conductivity	µS/cm	2.0		-	-	-	-	-	-	-	-	-	-	-	-
Hardness (as $CaCO_3$)	mg/L	0.86-4.3		4300	4380	4400	4400	4410	4370	4950	5190	762	727	4110	4110
pH	pH	0.1	7.0-8.7	7.82	7.89	7.87	7.89	7.89	7.88	7.85	7.81	7.73	7.73	7.90	7.90
Total Suspended Solids	mg/L	3.0	dependent on background levels	7.7	3.7	3.7	<3.0	<3.0	12.3	9.7	7.0	23.7	25.0	16.3	15.7
Turbidity	NTU	0.1	dependent on background levels	0.30	0.29	0.42	0.25	0.23	0.18	0.34	0.30	15.3	15.7	6.51	6.42
Salinity (EC)	g/L	1.0	<10% fluctuation[b]	-	-	-	-	-	-	-	-	4.2	4.3	21.2	21.0
Anions and Nutrients															
Alkalinity, Total (as $CaCO_3$)	mg/L	2.0		-	-	-	-	-	-	-	-	36.5	35.8	103	105
Ammonia as N	mg/L	0.005-0.01		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	0.05-5		36.4	39.8	36.4	39.9	39.8	37.9	43	47	5.0	5.7	31.1	32.7
Chloride (Cl)	mg/L	0.5-25		13100	13200	12900	13100	13000	12800	14700	15400	2280	2340	12000	11700
Fluoride (F)	mg/L	0.4-1		<0.75	<0.75	<0.75	<0.75	<0.75	<0.75	0.76	0.84	<1.0	<1.0	<0.75	<0.75
Nitrate+Nitrite-N	mg/L	0.006		<0.0060	<0.0060	0.0066	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	0.0189	<0.0060	<0.0060	<0.0060
Nitrate (as N)	mg/L	0.006-0.5	3.612[b]	<0.0060	<0.0060	0.0066	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	0.0159	<0.0060	<0.0060	<0.0060
Nitrite (as N)	mg/L	0.002-0.1		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0030	0.0034	<0.0020	<0.0020
Ortho Phosphate (as P)	mg/L	0.001		0.0218	0.0201	0.0202	0.0216	0.0215	0.0214	0.0263	0.0315	-	-	-	-
Total Phosphorus	mg/L	0.002		0.0236	0.0220	0.0236	0.0230	0.0238	0.0243	0.0306	0.0331	0.0385	0.0439	0.0324	0.0309
Silicate (as SiO_2)	mg/L	0.005-0.025		0.686	0.737	0.782	0.667	0.687	0.731	0.847	1.17	-	-	-	-
Sulphate (SO_4)	mg/L	0.5-50		1810	1840	1780	1830	1810	1780	2050	2160	295	303	1670	1610
Organic / Inorganic Carbon															
Total Organic Carbon	mg/L	0.5-1		1.64	1.59	2.03	1.51	1.48	1.52	1.29	1.22	4.93	4.98	2.04	1.99
Total Metals															
Aluminum (Al)-Total	mg/L	0.005-0.01		0.0141	0.0150	0.0252	0.0062	0.0058	0.0053	0.0054	<0.0050	0.562	0.511	0.319	0.288
Antimony (Sb)-Total	mg/L	0.0005-0.01		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Total	mg/L	0.0002-0.002	0.0125[b]	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Barium (Ba)-Total	mg/L	0.001-0.005		0.0107	0.0106	0.0104	0.0105	0.0106	0.0106	0.0121	0.0133	0.0085	0.0073	0.0114	0.0118
Beryllium (Be)-Total	mg/L	0.0005-0.05		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth (Bi)-Total	mg/L	0.0005-0.05		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Total	mg/L	0.1-1		3.37	3.41	3.33	3.38	3.54	3.52	3.99	4.11	0.56	0.57	2.93	3.27
Cadmium (Cd)-Total	mg/L	0.00002-0.00012	0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012
Calcium (Ca)-Total	mg/L	0.1-0.5		289	285	287	289	279	303	321	353	52.1	49.8	266	267
Cesium (Cs)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chromium (Cr)-Total	mg/L	0.001-0.05	Cr(VI): 0.0015; Cr(III): 0.056[b]	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	0.0011	<0.0010	<0.0010
Cobalt (Co)-Total	mg/L	0.00005-0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Copper (Cu)-Total	mg/L	0.00005-0.001		0.0038	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0023	0.0023	0.0011	0.0012
Gallium (Ga)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)-Total	mg/L	0.005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.649	0.616	0.353	0.343
Lead (Pb)-Total	mg/L	0.00005-0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Lithium (Li)-Total	mg/L	0.02-0.5		0.144	0.148	0.146	0.149	0.153	0.154	0.174	0.180	0.025	0.025	0.120	0.134
Magnesium (Mg)-Total	mg/L	0.2-1		875	869	890	885	872	893	986	1090	153	146	838	836
Manganese (Mn)-Total	mg/L	0.00005-0.0005		0.00264	0.00261	0.00264	0.00229	0.00220	0.00215	0.00216	0.00128	0.0154	0.0166	0.00764	0.00823
Mercury (Hg)-Total	mg/L	0.00001	Inorganic Hg: 0.000016[b]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L	0.002-0.005		0.0075	0.0078	0.0073	0.0076	0.0082	0.0078	0.0086	0.0090	<0.0020	<0.0020	0.0064	0.0070
Nickel (Ni)-Total	mg/L	0.00005-0.0005		0.00125	0.00072	0.00127	0.00054	0.00061	<0.00050	0.00069	<0.00050	0.00129	0.00124	0.00096	0.00086
Phosphorus (P)-Total	mg/L	1-3		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Potassium (K)-Total	mg/L	4-20		270	267	271	270	262	283	302	333	48.2	45.9	254	256
Rhenium (Re)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Rubidium (Rb)-Total	mg/L	0.005		0.0724	0.0735	0.0715	0.0736	0.0748	0.0756	0.0871	0.0890	0.0142	0.0148	0.0663	0.0711
Selenium (Se)-Total	mg/L	0.0004-0.002		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Silicon (Si)-Total	mg/L	0.5		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	2.34	1.97	1.12	0.99
Silver (Ag)-Total	mg/L	0.0002-0.001		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Sodium (Na)-Total	mg/L	4-20		7470	7360	7410	7380	7150	7750	8250	9060	1240	1180	7090	7140
Strontium (Sr)-Total	mg/L	0.00005-0.05		5.23	5.13	5.17	5.15	4.99	5.45	5.78	6.36	0.911	0.869	4.95	4.96
Tellurium (Te)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thallium (Tl)-Total	mg/L	0.0005-0.01		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thorium (Th)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Tin (Sn)-Total	mg/L	0.001-0.01		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Titanium (Ti)-Total	mg/L	0.005-0.1		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0294	0.0262	0.0175	0.0167
Tungsten (W)-Total	mg/L	0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Uranium (U)-Total	mg/L	0.00005-0.0005		0.00213	0.00212	0.00211	0.00214	0.00222	0.00214	0.00244	0.00256	<0.00050	<0.00050	0.00187	0.00199
Vanadium (V)-Total	mg/L	0.0005-0.1		0.00066	0.00067	0.00063	0.00063	0.00060	0.00060	0.00078	0.00075	0.00153	0.00141	0.00123	0.00132
Yttrium (Y)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total	mg/L	0.0005-0.005		<0.0050	<0.0050	0.0110	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0069	0.0053	<0.0050	0.0065
Zirconium (Zr)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals															
Aluminum (Al)-Dissolved	mg/L	0.005-0.01		<0.0050	<0.0050	0.0185	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-	-
Antimony (Sb)-Dissolved	mg/L	0.0005-0.01		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-
Arsenic (As)-Dissolved	mg/L	0.0002-0.002		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	-	-	-	-
Barium (Ba)-Dissolved	mg/L	0.001-0.005		0.0105	0.0106	0.0108	0.0103	0.0105	0.0104	0.0111	0.0130	-	-	-	-
Beryllium (Be)-Dissolved	mg/L	0.0005-0.05		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-
Bismuth (Bi)-Dissolved	mg/L	0.0005-0.05		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-
Boron (B)-Dissolved	mg/L	0.1-1		3.33	3.45	3.34	3.38	3.50	3.52	3.86	4.10	-	-	-	-
Cadmium (Cd)-Dissolved	mg/L	0.00002-0.00012		<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012	-	-	-	-
Calcium (Ca)-Dissolved	mg/L	0.1-0.5		284	289	293	291	294	288	326	340	-	-	-	-
Cesium (Cs)-Dissolved	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-
Chromium (Cr)-Dissolved	mg/L	0.001-0.05		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-	-	-
Cobalt (Co)-Dissolved	mg/L	0.00005-0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-
Copper (Cu)-Dissolved	mg/L	0.00005-0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-	-	-
Gallium (Ga)-Dissolved	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-
Iron (Fe)-Dissolved	mg/L	0.005-0.05		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	-	-	-
Lead (Pb)-Dissolved	mg/L	0.00005-0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-	-	-
Lithium (Li)-Dissolved	mg/L	0.02-0.05		0.143	0.149	0.144	0.145	0.149	0.151	0.165	0.176	-	-	-	-
Magnesium (Mg)-Dissolved	mg/L	0.2-1		871	890	892	891	893	887	1000	1050	-	-	-	-
Manganese (Mn)-Dissolved	mg/L	0.00005-0.0005		0.00169	0.00181	0.00214	0.00159	0.00164	0.00157	0.00116	<0.00050	-	-	-	-
Mercury (Hg)-Dissolved	mg/L	0.00001		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	-	-	-
Molybdenum (Mo)-Dissolved	mg/L	0.002-0.005		0.0077	0.0077	0.0076	0.0075	0.0077	0.0078	0.0086	0.0092	-	-	-	-
Nickel (Ni)-Dissolved	mg/L	0.00005-0.0005		0.00051	0.00066	0.00119	0.00053	0.00053	<0.00050	0.00054	<0.00050	-	-	-	-
Phosphorus (P)-Dissolved	mg/L	1-3		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-
Potassium (K)-Dissolved	mg/L	4-20		267	270	275	274	276	273	307	322	-	-	-	-
Rhenium (Re)-Dissolved	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-
Rubidium (Rb)-Dissolved	mg/L	0.005		0.0722	0.0738	0.0733	0.0718	0.0752	0.0748	0.0828	0.0890	-	-	-	-
Selenium (Se)-Dissolved	mg/L	0.0004-0.002		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	-	-	-	-
Silicon (Si)-Dissolved	mg/L	0.5		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	-	-	-
Silver (Ag)-Dissolved	mg/L	0.0002-0.001		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	-	-	-
Sodium (Na)-Dissolved	mg/L	4-20		7330	7410	7500	7450	7560	7400	8360	8720	-	-	-	-
Strontium (Sr)-Dissolved	mg/L	0.00005-0.05		5.12	5.18	5.24	5.21	5.27	5.19	5.86	6.13	-	-	-	-
Tellurium (Te)-Dissolved	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-
Thallium (Tl)-Dissolved	mg/L	0.0005-0.01		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-
Thorium (Th)-Dissolved	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-
Tin (Sn)-Dissolved	mg/L	0.001-0.01		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-	-	-
Titanium (Ti)-Dissolved	mg/L	0.005-0.1		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-	-
Tungsten (W)-Dissolved	mg/L	0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-	-	-
Uranium (U)-Dissolved	mg/L	0.00005-0.0005		0.00212	0.00215	0.00213	0.00216	0.00211	0.00211	0.00239	0.00253	-	-	-	-
Vanadium (V)-Dissolved	mg/L	0.0005-0.1		0.00061	0.00065	0.00062	0.00069	0.00062	0.00068	0.00068	0.00076	-	-	-	-
Yttrium (Y)-Dissolved	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-
Zinc (Zn)-Dissolved	mg/L	0.0005-0.005		<0.0050	<0.0050	0.0113	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-	-
Zirconium (Zr)-Dissolved	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-
Cyanides															
Cyanide, Total	mg/L	0.001-0.005		-	-	-	-	-	-	-	-	0.0047	0.0048	0.0014	0.0019
Radiochemistry															
Radium-226	Bq/L	0.005		-	-	-	-	-	-	-	-	<0.005	<0.005	<0.005	<0.005

Notes:

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of marine aquatic life.

a) Canadian water quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

Appendix 4.2-3. Roberts Bay Water Quality, Doris North Project, 2009-2010

Site				RBE			RBW	ST4				
Date Sampled				30-Sep-10			30-Sep-10	01-Oct-10				
Replicate				1	2	1	1	1	1	1	1	2
Depth (m)		Realized	CCME Guideline for the	1	1	2.5	1	1	18	26	47	47
ALS Sample ID	Units	Detection Limits	Protection of Aquatic Life[a]	L939411-1	L939411-2	L939411-3	L939411-4	L939416-1	L939416-2	L939416-3	L939416-4	L939416-5
Physical Tests												
Conductivity	µS/cm	2.0		37000	37300	37400	37600	-	-	-	-	-
Hardness (as $CaCO_3$)	mg/L	0.86-4.3		4890	4860	4460	4550	4860	5050	4850	5170	5190
pH	pH	0.1	7.0-8.7	7.78	7.82	7.84	7.86	7.88	7.84	7.89	7.80	7.77
Total Suspended Solids	mg/L	3.0	dependent on background levels	20.8	18.2	18.8	18.2	7.0	8.3	17.0	10.3	21.0
Turbidity	NTU	0.1	dependent on background levels	1.05	1.11	0.90	0.59	0.37	0.24	0.30	0.23	0.23
Salinity (EC)	g/L	1.0	<10% fluctuation[b]	-	-	-	-	-	-	-	-	-
Anions and Nutrients												
Alkalinity, Total (as $CaCO_3$)	mg/L	2.0		106	118	113	114	-	-	-	-	-
Ammonia as N	mg/L	0.005-0.01		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0142	0.0164
Bromide (Br)	mg/L	0.05-5		36.6	36.9	36.3	36.3	37.5	41.5	39.2	42.6	42.6
Chloride (Cl)	mg/L	0.5-25		13600	13600	13700	13800	13300	14600	14000	15100	15100
Fluoride (F)	mg/L	0.4-1		0.690	0.689	0.690	0.690	<0.75	0.80	0.75	0.80	0.79
Nitrate+Nitrite-N	mg/L	0.006		-	-	-	-	<0.0060	<0.0060	<0.0060	0.0389	0.0394
Nitrate (as N)	mg/L	0.006-0.5	3.612[b]	<0.50	<0.50	<0.50	<0.50	<0.0060	<0.0060	<0.0060	0.0389	0.0394
Nitrite (as N)	mg/L	0.002-0.1		<0.10	<0.10	<0.10	<0.10	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Ortho Phosphate (as P)	mg/L	0.001		-	-	-	-	0.0218	0.0336	0.0255	0.0419	0.0413
Total Phosphorus	mg/L	0.002		0.0277	0.0273	0.0276	0.0276	0.0265	0.0387	0.0335	0.0462	0.0463
Silicate (as SiO_2)	mg/L	0.005-0.025		-	-	-	-	0.519	1.45	0.651	1.1	1.0
Sulphate (SO_4)	mg/L	0.5-50		1890	1900	1900	1910	1860	2040	1950	2110	2110
Organic / Inorganic Carbon												
Total Organic Carbon	mg/L	0.5-1		1.67	1.62	1.56	1.57	1.69	1.43	1.41	1.25	1.04
Total Metals												
Aluminum (Al)-Total	mg/L	0.005-0.01		0.0275	0.0259	0.0261	0.0169	0.0108	<0.0050	0.0056	<0.0050	<0.0050
Antimony (Sb)-Total	mg/L	0.0005-0.01		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Total	mg/L	0.0002-0.002	0.0125[b]	<0.0020	0.00111	0.00123	0.00113	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Barium (Ba)-Total	mg/L	0.001-0.005		0.0091	0.0091	0.0092	0.0093	0.0088	0.0116	0.0092	0.0131	0.0129
Beryllium (Be)-Total	mg/L	0.0005-0.05		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth (Bi)-Total	mg/L	0.0005-0.05		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Total	mg/L	0.1-1		3.34	3.47	3.46	3.46	3.14	3.51	3.36	3.69	3.65
Cadmium (Cd)-Total	mg/L	0.00002-0.00012	0.00012	<0.00012	0.000040	0.000043	0.000043	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012
Calcium (Ca)-Total	mg/L	0.1-0.5		338	336	298	311	304	331	298	340	325
Cesium (Cs)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chromium (Cr)-Total	mg/L	0.001-0.05	Cr(VI): 0.0015; Cr(III): 0.056[b]	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt (Co)-Total	mg/L	0.00005-0.0005		<0.00050	0.000070	0.000062	0.000056	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Copper (Cu)-Total	mg/L	0.00005-0.001		<0.0010	0.000953	0.000687	0.000665	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Gallium (Ga)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)-Total	mg/L	0.005-0.05		<0.050	0.064	0.063	0.045	<0.050	<0.050	<0.050	<0.050	<0.050
Lead (Pb)-Total	mg/L	0.00005-0.001		<0.0010	0.000052	0.000051	<0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Lithium (Li)-Total	mg/L	0.02-0.5		0.135	0.135	0.134	0.133	0.132	0.142	0.135	0.148	0.145
Magnesium (Mg)-Total	mg/L	0.2-1		982	976	901	917	1020	976	946	1040	1000
Manganese (Mn)-Total	mg/L	0.00005-0.0005		0.00252	0.00302	0.00293	0.00275	0.00226	0.00166	0.00202	0.00142	0.00135
Mercury (Hg)-Total	mg/L	0.00001	Inorganic Hg: 0.000016[b]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L	0.002-0.005		0.0075	0.0080	0.0079	0.0081	0.0078	0.0084	0.0081	0.0087	0.0086
Nickel (Ni)-Total	mg/L	0.00005-0.0005		<0.00050	0.000663	0.000643	0.000659	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Total	mg/L	1-3		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Potassium (K)-Total	mg/L	4-20		310	306	278	286	275	296	267	320	293
Rhenium (Re)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Rubidium (Rb)-Total	mg/L	0.005		0.0816	0.0818	0.0822	0.0825	0.0797	0.0876	0.0841	0.0904	0.0891
Selenium (Se)-Total	mg/L	0.0004-0.002		<0.0020	<0.00040	<0.00040	<0.00040	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Silicon (Si)-Total	mg/L	0.5		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.58	0.56
Silver (Ag)-Total	mg/L	0.0002-0.001		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Sodium (Na)-Total	mg/L	4-20		9010	8890	7980	8280	8110	8780	7860	9350	8590
Strontium (Sr)-Total	mg/L	0.00005-0.05		5.26	5.49	5.29	5.39	5.36	5.75	5.17	6.23	5.72
Tellurium (Te)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thallium (Tl)-Total	mg/L	0.0005-0.01		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thorium (Th)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Tin (Sn)-Total	mg/L	0.001-0.01		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Titanium (Ti)-Total	mg/L	0.005-0.1		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Tungsten (W)-Total	mg/L	0.001		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Uranium (U)-Total	mg/L	0.00005-0.0005		0.00219	0.00194	0.00196	0.00193	0.00213	0.00236	0.00225	0.00241	0.00236
Vanadium (V)-Total	mg/L	0.0005-0.1		0.00069	0.00075	0.00075	0.00076	0.00072	0.00076	0.00075	0.00074	0.00078
Yttrium (Y)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total	mg/L	0.0005-0.005		<0.0050	<0.0013	<0.0012	0.00276	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium (Zr)-Total	mg/L	0.0005		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals												
Aluminum (Al)-Dissolved	mg/L	0.005-0.01		-	-	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Antimony (Sb)-Dissolved	mg/L	0.0005-0.01		-	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Dissolved	mg/L	0.0002-0.002		-	-	-	-	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Barium (Ba)-Dissolved	mg/L	0.001-0.005		-	-	-	-	0.0085	0.0112	0.0089	0.0131	0.0131
Beryllium (Be)-Dissolved	mg/L	0.0005-0.05		-	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth (Bi)-Dissolved	mg/L	0.0005-0.05		-	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Dissolved	mg/L	0.1-1		-	-	-	-	3.21	3.47	3.41	3.70	3.71
Cadmium (Cd)-Dissolved	mg/L	0.00002-0.00012		-	-	-	-	<0.00012	<0.00012	<0.00012	<0.00012	<0.00012
Calcium (Ca)-Dissolved	mg/L	0.1-0.5		-	-	-	-	306	334	321	339	335
Cesium (Cs)-Dissolved	mg/L	0.0005		-	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chromium (Cr)-Dissolved	mg/L	0.001-0.05		-	-	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt (Co)-Dissolved	mg/L	0.00005-0.0005		-	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Copper (Cu)-Dissolved	mg/L	0.00005-0.001		-	-	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Gallium (Ga)-Dissolved	mg/L	0.0005		-	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)-Dissolved	mg/L	0.005-0.05		-	-	-	-	<0.050	<0.050	<0.050	<0.050	<0.050
Lead (Pb)-Dissolved	mg/L	0.00005-0.001		-	-	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Lithium (Li)-Dissolved	mg/L	0.02-0.05		-	-	-	-	0.130	0.141	0.138	0.148	0.147
Magnesium (Mg)-Dissolved	mg/L	0.2-1		-	-	-	-	993	1030	982	1050	1060
Manganese (Mn)-Dissolved	mg/L	0.00005-0.0005		-	-	-	-	0.00159	0.00058	0.00145	0.00055	0.00051
Mercury (Hg)-Dissolved	mg/L	0.00001		-	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	0.002-0.005		-	-	-	-	0.0077	0.0084	0.0082	0.0087	0.0086
Nickel (Ni)-Dissolved	mg/L	0.00005-0.0005		-	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Dissolved	mg/L	1-3		-	-	-	-	<1.0	<1.0	<1.0	<1.0	<1.0
Potassium (K)-Dissolved	mg/L	4-20		-	-	-	-	297	309	295	309	301
Rhenium (Re)-Dissolved	mg/L	0.0005		-	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Rubidium (Rb)-Dissolved	mg/L	0.005		-	-	-	-	0.0801	0.0871	0.0837	0.0907	0.0910
Selenium (Se)-Dissolved	mg/L	0.0004-0.002		-	-	-	-	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Silicon (Si)-Dissolved	mg/L	0.5		-	-	-	-	<0.50	<0.50	<0.50	0.59	0.59
Silver (Ag)-Dissolved	mg/L	0.0002-0.001		-	-	-	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Sodium (Na)-Dissolved	mg/L	4-20		-	-	-	-	8680	9050	8630	9010	8950
Strontium (Sr)-Dissolved	mg/L	0.00005-0.05		-	-	-	-	5.78	6.00	5.75	6.02	5.92
Tellurium (Te)-Dissolved	mg/L	0.0005		-	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thallium (Tl)-Dissolved	mg/L	0.0005-0.01		-	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thorium (Th)-Dissolved	mg/L	0.0005		-	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Tin (Sn)-Dissolved	mg/L	0.001-0.01		-	-	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Titanium (Ti)-Dissolved	mg/L	0.005-0.1		-	-	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Tungsten (W)-Dissolved	mg/L	0.001		-	-	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Uranium (U)-Dissolved	mg/L	0.00005-0.0005		-	-	-	-	0.00220	0.00237	0.00226	0.00244	0.00248
Vanadium (V)-Dissolved	mg/L	0.0005-0.1		-	-	-	-	0.00067	0.00073	0.00072	0.00078	0.00076
Yttrium (Y)-Dissolved	mg/L	0.0005		-	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved	mg/L	0.0005-0.005		-	-	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium (Zr)-Dissolved	mg/L	0.0005		-	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cyanides												
Cyanide, Total	mg/L	0.001-0.005		0.0014	0.0015	0.0013	0.0014	-	-	-	-	-
Radiochemistry												
Radium-226	Bq/L	0.005		<0.005	<0.005	<0.005	<0.005	-	-	-	-	-

Notes:

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of marine aquatic life.

a) Canadian water quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

Appendix 4.2-4

Roberts Bay Sediment Quality, Doris North Project, 2009-2010

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Appendix 4.2-4. Roberts Bay Sediment Quality, Doris North Project, 2009-2010

Site			CCME Guidelines for the Protection of Aquatic Life[a]		ST7			ST8			ST2		
Date Sampled					16-Aug-09			16-Aug-09			16-Aug-09		
Replicate		Realized Detection Limits			1	2	3	1	2	3	1	2	3
Depth (m)					2	2	2	8	8	8	7	7	7
ALS Sample ID	Units		ISQG[b]	PEL[c]	L808890-13	L808890-14	L808890-15	L808890-10	L808890-11	L808890-12	L808890-16	L808890-17	L808890-18
Physical Tests													
Moisture	%	0.10			18.0	23.1	19.6	35.5	39.5	37.4	35.7	37.4	29.9
pH	pH	0.10			7.52	7.90	7.92	7.68	7.80	7.88	7.91	7.81	8.00
Particle Size													
% Gravel (>2mm)	%	0.1-1.0			<1.0	<1.0	<1.0	<1.0	2.0	3.0	3.0	<1.0	1.0
% Sand (2.0mm - 0.063mm)	%	0.1-1.0			97	96	97	36	36	41	42	42	37
% Silt (0.063mm - 4um)	%	0.1-1.0			1.0	3.0	2.0	40	39	36	35	33	39
% Clay (<4um)	%	0.1-1.0			1.0	1.0	1.0	24	23	19	20	25	24
Leachable Anions & Nutrients													
Total Nitrogen by LECO	%	0.020			<0.020	0.025	0.023	0.08	0.086	0.108	0.077	0.091	0.083
Organic / Inorganic Carbon													
Total Organic Carbon	%	0.10			<0.10	<0.10	<0.10	0.46	0.48	0.63	0.45	0.48	0.22
Plant Available Nutrients													
Available Ammonium (as N)	mg/kg	0.8-2.4			<0.80	1.24	0.97	6.49	29.3	17.3	7.4	7.12	6.94
Available Nitrate (as N)	mg/kg	2.0-6.0			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Nitrite (as N)	mg/kg	0.4-1.2			<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Available Phosphate (as P)	mg/kg	1.0-4.0			3.6	19.5	7.5	20.6	22.8	23.7	17.8	18.9	18.7
Metals													
Aluminum (Al)	mg/kg	50			4690	4590	4650	12500	12700	12300	12200	13800	12700
Antimony (Sb)	mg/kg	10			<10	<10	<10	<10	<10	<10	<10	<10	<10
Arsenic (As)	mg/kg	0.05-0.5	7.24	41.6	3.62	2.36	3.49	3.39	3.41	3.83	2.76	3.34	2.59
Barium (Ba)	mg/kg	1			9.8	11.3	9.6	63.6	64.8	61.7	58.5	68.4	61.9
Beryllium (Be)	mg/kg	0.5			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Bismuth (Bi)	mg/kg	20			<20	<20	<20	<20	<20	<20	<20	<20	<20
Cadmium (Cd)	mg/kg	0.1	0.7	4.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Calcium (Ca)	mg/kg	50			2880	2810	2710	7240	6620	7290	5860	5440	6170
Chromium (Cr)	mg/kg	2	52.3	160	23.7	22.6	19.8	35.7	36	34.4	35.4	39.9	35.7
Cobalt (Co)	mg/kg	2			5.8	5.5	5.4	7.7	7.6	7.2	7.3	8	7.9
Copper (Cu)	mg/kg	1	18.7	108	11.7	9.7	9.7	19.3	19.1	18.4	16.6	19.0	17.4
Iron (Fe)	mg/kg	50			18000	15200	13500	19900	20000	19700	19400	21200	19800
Lead (Pb)	mg/kg	2	30.2	112	2.7	2.5	2.2	5.2	5.4	5.2	5.0	5.7	5.1
Lithium (Li)	mg/kg	2			7.4	7.8	7.7	25.4	25.5	24.6	24.1	28	25.1
Magnesium (Mg)	mg/kg	50			3820	3760	3840	9900	9900	9560	9430	10600	9870
Manganese (Mn)	mg/kg	1			126	115	114	220	223	220	216	237	233
Mercury (Hg)	mg/kg	0.005	0.13	0.70	<0.0050	<0.0050	<0.0050	0.0076	0.0076	0.0066	0.0075	0.0081	0.0066
Molybdenum (Mo)	mg/kg	0.2			0.22	0.26	0.27	0.81	0.74	0.63	0.96	1.13	1.12
Nickel (Ni)	mg/kg	5			10.7	10.4	10.7	17.6	17.8	17.1	17.2	19.2	18.9
Phosphorus (P)	mg/kg	50			379	432	342	712	719	726	663	658	663
Potassium (K)	mg/kg	200			560	650	590	3990	4030	3860	3690	4430	3870
Selenium (Se)	mg/kg	0.5			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Silver (Ag)	mg/kg	0.1			<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg	200			1050	1400	1230	6010	5710	5300	4850	5410	4960
Strontium (Sr)	mg/kg	0.5			11.3	11.4	11.2	36.6	36.4	41.9	31.1	29.5	35.2
Sulphur (S)	mg/kg	100			560	450	440	820	720	610	550	710	650
Thallium (Tl)	mg/kg	0.5			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Tin (Sn)	mg/kg	5			<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Titanium (Ti)	mg/kg	1			539	476	463	873	876	869	862	985	905
Uranium (U)	mg/kg	0.05											
Vanadium (V)	mg/kg	2			47.8	37.8	33.3	46.4	46.3	45.6	46.4	51.5	48.4
Zinc (Zn)	mg/kg	1	124	271	14.2	13.7	13.5	37.1	37.2	35.5	35.7	40.4	37.4
Hydrocarbons													
EPH10-19	mg/kg	40-200			-	-	-	-	-	-	-	-	-
EPH19-32	mg/kg	40-200			-	-	-	-	-	-	-	-	-
LEPH	mg/kg	40-200			-	-	-	-	-	-	-	-	-
HEPH	mg/kg	40-200			-	-	-	-	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons													
Acenaphthene	mg/kg	0.005	0.00671	0.0889	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acenaphthylene	mg/kg	0.005	0.00587	0.128	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Anthracene	mg/kg	0.004	0.0469	0.245	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Benz(a)anthracene	mg/kg	0.01	0.0748	0.693	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	mg/kg	0.01	0.0888	0.763	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b)fluoranthene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(g,h,i)perylene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	mg/kg	0.01	0.108	0.846	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	mg/kg	0.005	0.00622	0.135	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Fluoranthene	mg/kg	0.01	0.113	1.494	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	mg/kg	0.01	0.0212	0.144	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Methylnaphthalene	mg/kg	0.01	0.0202	0.201	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	mg/kg	0.01	0.0346	0.391	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	mg/kg	0.01	0.0867	0.544	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Pyrene	mg/kg	0.01	0.153	1.398	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Total PAHs	mg/kg	0.04			<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Surrogate: d10-Acenaphthene (SS)	%				107	108	117	101	118	105	88	82	89
Surrogate: d12-Chrysene (SS)	%				88	87	102	94	103	101	93	103	94
Surrogate: d8-Naphthalene (SS)	%				95	93	112	106	111	110	87	79	89
Surrogate: d10-Phenanthrene (SS)	%				93	93	105	103	107	106	101	102	100

Notes:

Shaded cells indicate values that exceed CCME guidelines for the protection of marine aquatic life.

a) Canadian sediment quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011

b) ISQG = Interim Sediment Quality Guideline

c) PEL = Probable Effects Level

Appendix 4.2-4. Roberts Bay Sediment Quality, Doris North Project, 2009-2010

Site			CCME Guidelines for the Protection of Aquatic Life[a]		ST9			ST10			ST11		
Date Sampled					16-Aug-09			16-Aug-09			16-Aug-09		
Replicate		Realized Detection Limits			1	2	3	1	2	3	1	2	3
Depth (m)					2	2	2	13	13	13	8	8	8
ALS Sample ID	Units		ISQG[b]	PEL[c]	L808890-7	L808890-8	L808890-9	L808890-1	L808890-2	L808890-3	L808890-4	L808890-5	L808890-6
Physical Tests													
Moisture	%	0.10			30.9	22.8	26.9	44.4	41.6	44.2	28.9	26.0	24.4
pH	pH	0.10			7.77	7.61	8.00	7.39	7.43	7.51	7.48	7.75	7.80
Particle Size													
% Gravel (>2mm)	%	0.1-1.0			4.0	3.0	3.0	<1.0	<1.0	1.0	1.0	10	5.0
% Sand (2.0mm - 0.063mm)	%	0.1-1.0			41	55	55	5.0	6.0	7.0	73	72	70
% Silt (0.063mm - 4um)	%	0.1-1.0			25	21	18	48	48	46	15	9.0	12
% Clay (<4um)	%	0.1-1.0			30	22	24	46	45	45	11	8.0	13
Leachable Anions & Nutrients													
Total Nitrogen by LECO	%	0.020			0.062	0.051	0.039	0.111	0.111	0.112	0.021	0.132	0.067
Organic / Inorganic Carbon													
Total Organic Carbon	%	0.10			0.36	0.24	0.21	0.62	0.57	0.58	<0.10	0.75	0.36
Plant Available Nutrients													
Available Ammonium (as N)	mg/kg	0.8-2.4			1.24	1.51	1.09	3.27	8.19	8.59	2.53	3.89	5.22
Available Nitrate (as N)	mg/kg	2.0-6.0			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Nitrite (as N)	mg/kg	0.4-1.2			<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Available Phosphate (as P)	mg/kg	1.0-4.0			9.0	8.6	20.4	12.1	14.1	16.8	17.4	21.3	22.8
Metals													
Aluminum (Al)	mg/kg	50			16500	12100	14300	22300	21100	21200	8780	7770	9010
Antimony (Sb)	mg/kg	10			<10	<10	<10	<10	<10	<10	<10	<10	<10
Arsenic (As)	mg/kg	0.05-0.5	7.24	41.6	4.67	3.4	3.92	4.55	4.52	4.24	2.8	2.65	2.53
Barium (Ba)	mg/kg	1			83.7	54.6	67.9	116	109	110	36.8	32.5	37.9
Beryllium (Be)	mg/kg	0.5			<0.50	<0.50	<0.50	0.62	0.59	0.58	<0.50	<0.50	<0.50
Bismuth (Bi)	mg/kg	20			<20	<20	<20	<20	<20	<20	<20	<20	<20
Cadmium (Cd)	mg/kg	0.1	0.7	4.2	0.11	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Calcium (Ca)	mg/kg	50			6520	4270	6460	7340	6790	6480	3250	4330	3930
Chromium (Cr)	mg/kg	2	52.3	160	44.2	33.4	40	59.3	56.5	57.6	28.2	23.2	26
Cobalt (Co)	mg/kg	2			9.8	8	9.3	12.2	11.5	11.7	5.7	5.5	5.6
Copper (Cu)	mg/kg	1	18.7	108	22.4	17.2	28.5	28.1	27.4	27.8	12.1	11.5	11.2
Iron (Fe)	mg/kg	50			24000	19100	22300	30600	29400	29600	14200	13200	14800
Lead (Pb)	mg/kg	2	30.2	112	6.4	4.4	5.4	9.7	8.2	8.4	3.2	3.1	3.4
Lithium (Li)	mg/kg	2			33.3	23.7	28.7	44.7	42.6	43.4	17.1	14.9	17.2
Magnesium (Mg)	mg/kg	50			12500	9540	11600	16900	16100	16300	7360	6290	7090
Manganese (Mn)	mg/kg	1			265	216	275	348	333	334	152	153	169
Mercury (Hg)	mg/kg	0.005	0.13	0.70	<0.0050	<0.0050	<0.0050	0.0116	0.0102	0.0102	<0.0050	0.006	0.0064
Molybdenum (Mo)	mg/kg	0.2			1.24	0.87	0.85	2.43	2.22	2.54	1.1	0.83	0.81
Nickel (Ni)	mg/kg	5			23.2	19.5	22.5	28.9	27.2	28.0	15.8	12.4	13.9
Phosphorus (P)	mg/kg	50			519	428	465	736	726	724	417	476	461
Potassium (K)	mg/kg	200			5110	3360	4090	7320	6960	7000	2400	2030	2480
Selenium (Se)	mg/kg	0.5			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Silver (Ag)	mg/kg	0.1			0.11	<0.10	<0.10	0.15	0.13	0.13	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg	200			4240	2720	2920	9310	9020	8370	4080	3290	4010
Strontium (Sr)	mg/kg	0.5			34.9	21	26.3	45.8	41.8	39.7	18.6	21.5	20.1
Sulphur (S)	mg/kg	100			1370	1280	1080	980	1120	1120	1210	710	1020
Thallium (Tl)	mg/kg	0.5			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Tin (Sn)	mg/kg	5			<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Titanium (Ti)	mg/kg	1			1030	804	891	1400	1340	1350	593	548	644
Uranium (U)	mg/kg	0.05											
Vanadium (V)	mg/kg	2			54	42.3	49.7	73.5	70.9	71.8	32.8	31.6	35.2
Zinc (Zn)	mg/kg	1	124	271	48.6	36.9	44.1	64.6	61.4	63.1	26	22.7	26.1
Hydrocarbons													
EPH10-19	mg/kg	40-200			-	-	-	-	-	-	-	-	-
EPH19-32	mg/kg	40-200			-	-	-	-	-	-	-	-	-
LEPH	mg/kg	40-200			-	-	-	-	-	-	-	-	-
HEPH	mg/kg	40-200			-	-	-	-	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons													
Acenaphthene	mg/kg	0.005	0.00671	0.0889	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acenaphthylene	mg/kg	0.005	0.00587	0.128	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Anthracene	mg/kg	0.004	0.0469	0.245	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Benz(a)anthracene	mg/kg	0.01	0.0748	0.693	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	mg/kg	0.01	0.0888	0.763	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b)fluoranthene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(g,h,i)perylene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	mg/kg	0.01	0.108	0.846	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	mg/kg	0.005	0.00622	0.135	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Fluoranthene	mg/kg	0.01	0.113	1.494	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	mg/kg	0.01	0.0212	0.144	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Methylnaphthalene	mg/kg	0.01	0.0202	0.201	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	mg/kg	0.01	0.0346	0.391	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	mg/kg	0.01	0.0867	0.544	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Pyrene	mg/kg	0.01	0.153	1.398	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Total PAHs	mg/kg	0.04			<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Surrogate: d10-Acenaphthene (SS)	%				105	102	111	103	103	111	118	105	114
Surrogate: d12-Chrysene (SS)	%				104	103	98	82	86	112	97	88	92
Surrogate: d8-Naphthalene (SS)	%				113	118	116	94	106	111	103	109	101
Surrogate: d10-Phenanthrene (SS)	%				107	107	104	89	95	118	101	95	96

Notes:

Shaded cells indicate values that exceed CCME guidelines for the protection of marine aquatic life.

a) Canadian sediment quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011

b) ISQG = Interim Sediment Quality Guideline

c) PEL = Probable Effects Level

Appendix 4.2-4. Roberts Bay Sediment Quality, Doris North Project, 2009-2010

Site			CCME Guidelines for the Protection of Aquatic Life[a]		RTF1			DW3			DW2		
Date Sampled					17-Aug-09			17-Aug-09			17-Aug-09		
Replicate		Realized Detection Limits			1	2	3	1	2	3	1	2	3
Depth (m)					3	3	3	1	1	1	13	13	13
ALS Sample ID	Units		ISQG[b]	PEL[c]	L808851-19	L808851-20	L808851-21	L808851-7	L808851-8	L808851-9	L808851-4	L808851-5	L808851-6
Physical Tests													
Moisture	%	0.10			24.8	18.7	23.6	18.7	18.5	18.7	35.5	37.2	36.3
pH	pH	0.10			8.25	8.40	7.73	7.33	7.26	7.50	7.66	7.79	7.60
Particle Size													
% Gravel (>2mm)	%	0.1-1.0			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	<1.0
% Sand (2.0mm - 0.063mm)	%	0.1-1.0			95	98	99	98	98	99	47	57	57
% Silt (0.063mm - 4um)	%	0.1-1.0			3.0	1.0	1.0	1.0	1.0	1.0	26	22	22
% Clay (<4um)	%	0.1-1.0			2.0	1.0	1.0	1.0	1.0	<1.0	27	21	21
Leachable Anions & Nutrients													
Total Nitrogen by LECO	%	0.020			0.042	0.039	0.026	0.021	<0.020	0.024	0.082	0.086	0.072
Organic / Inorganic Carbon													
Total Organic Carbon	%	0.10			0.16	0.11	<0.10	<0.10	<0.10	<0.10	0.45	0.4	0.38
Plant Available Nutrients													
Available Ammonium (as N)	mg/kg	0.8-2.4			2.37	1.33	1.1	0.86	<0.80	<0.80	2.58	2.41	4.4
Available Nitrate (as N)	mg/kg	2.0-6.0			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Nitrite (as N)	mg/kg	0.4-1.2			<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Available Phosphate (as P)	mg/kg	1.0-4.0			18.1	12.3	6.1	2.5	3.5	3.1	20	20.3	24
Metals													
Aluminum (Al)	mg/kg	50			5070	4830	5840	4070	3770	3820	14000	11500	12200
Antimony (Sb)	mg/kg	10			<10	<10	<10	<10	<10	<10	<10	<10	<10
Arsenic (As)	mg/kg	0.05-0.5	7.24	41.6	0.64	2.46	0.72	0.66	0.84	0.59	3.26	2.37	2.49
Barium (Ba)	mg/kg	1			13	10	11.8	12.8	10.9	7.8	70	56.9	58.7
Beryllium (Be)	mg/kg	0.5			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Bismuth (Bi)	mg/kg	20			<20	<20	<20	<20	<20	<20	<20	<20	<20
Cadmium (Cd)	mg/kg	0.1	0.7	4.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Calcium (Ca)	mg/kg	50			2130	2080	2620	2060	1830	1820	4980	4260	4420
Chromium (Cr)	mg/kg	2	52.3	160	16.1	14.5	18	13.5	11.7	11.2	39.7	32.9	35.3
Cobalt (Co)	mg/kg	2			3.5	3.7	4.5	3.1	2.9	2.8	7.8	6.6	7
Copper (Cu)	mg/kg	1	18.7	108	8.2	8.3	10	5.5	5.4	4.7	16.1	12.8	13.7
Iron (Fe)	mg/kg	50			9350	9070	11200	7720	6670	6820	19800	16800	17400
Lead (Pb)	mg/kg	2	30.2	112	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	5.1	4.4	4.5
Lithium (Li)	mg/kg	2			9.3	8.5	10	6.7	6.5	6.5	27.9	23.3	24.9
Magnesium (Mg)	mg/kg	50			4170	4150	4870	2830	2660	2770	10700	8940	9370
Manganese (Mn)	mg/kg	1			104	103	126	80.4	72.8	73.9	223	189	197
Mercury (Hg)	mg/kg	0.005	0.13	0.70	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.008	0.0073	0.0081
Molybdenum (Mo)	mg/kg	0.2			0.31	0.25	0.25	0.3	0.27	0.34	1.33	1.05	1.19
Nickel (Ni)	mg/kg	5			10.1	9.7	12.2	7.3	6.6	7.0	18.8	16.3	16.6
Phosphorus (P)	mg/kg	50			302	253	265	364	313	304	608	536	546
Potassium (K)	mg/kg	200			840	740	790	550	520	540	4550	3700	3970
Selenium (Se)	mg/kg	0.5			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Silver (Ag)	mg/kg	0.1			<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg	200			1680	2370	1500	1280	990	1610	6990	6430	6170
Strontium (Sr)	mg/kg	0.5			10.1	9.41	10.6	9.2	8.51	8.48	28.7	23.9	24.8
Sulphur (S)	mg/kg	100			520	450	430	570	480	480	1060	810	840
Thallium (Tl)	mg/kg	0.5			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Tin (Sn)	mg/kg	5			<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Titanium (Ti)	mg/kg	1			313	279	431	366	329	320	924	781	831
Uranium (U)	mg/kg	0.05											
Vanadium (V)	mg/kg	2			18.7	17	23.7	16.5	14.1	14.1	47.1	39.4	41.3
Zinc (Zn)	mg/kg	1	124	271	15.4	14.9	17.1	10.7	10.5	10.1	42.2	34.9	36
Hydrocarbons													
EPH10-19	mg/kg	40-200			<200	<200	<200	<200	<200	<200	<200	<200	<200
EPH19-32	mg/kg	40-200			<200	<200	<200	<200	<200	<200	<200	<200	<200
LEPH	mg/kg	40-200			<200	<200	<200	<200	<200	<200	<200	<200	<200
HEPH	mg/kg	40-200			<200	<200	<200	<200	<200	<200	<200	<200	<200
Polycyclic Aromatic Hydrocarbons													
Acenaphthene	mg/kg	0.005	0.00671	0.0889	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acenaphthylene	mg/kg	0.005	0.00587	0.128	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Anthracene	mg/kg	0.004	0.0469	0.245	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Benz(a)anthracene	mg/kg	0.01	0.0748	0.693	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	mg/kg	0.01	0.0888	0.763	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b)fluoranthene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(g,h,i)perylene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	mg/kg	0.01	0.108	0.846	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	mg/kg	0.005	0.00622	0.135	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Fluoranthene	mg/kg	0.01	0.113	1.494	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	mg/kg	0.01	0.0212	0.144	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Methylnaphthalene	mg/kg	0.01	0.0202	0.201	0.015	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	mg/kg	0.01	0.0346	0.391	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	mg/kg	0.01	0.0867	0.544	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Pyrene	mg/kg	0.01	0.153	1.398	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Total PAHs	mg/kg	0.04			<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Surrogate: d10-Acenaphthene (SS)	%				107	118	104	98	104	113	101	104	107
Surrogate: d12-Chrysene (SS)	%				86	92	104	84	96	96	99	97	97
Surrogate: d8-Naphthalene (SS)	%				96	106	100	95	97	118	94	97	103
Surrogate: d10-Phenanthrene (SS)	%				93	99	109	92	102	104	106	103	105

Notes:

Shaded cells indicate values that exceed CCME guidelines for the protection of marine aquatic life.

a) Canadian sediment quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011

b) ISQG = Interim Sediment Quality Guideline

c) PEL = Probable Effects Level

Appendix 4.2-4. Roberts Bay Sediment Quality, Doris North Project, 2009-2010

Site			CCME Guidelines for the Protection of Aquatic Life[a]		DW1			TF1			P1		
Date Sampled					17-Aug-09			16-Aug-09			15-Aug-10		
Replicate		Realized Detection Limits			1	2	3	1	2	3	1	2	3
Depth (m)					13	13	13	2	2	2	5.5	5.5	5.5
ALS Sample ID	Units		ISQG[b]	PEL[c]	L808851-1	L808851-2	L808851-3	L808890-19	L808890-20	L808890-21	L921344-7	L921344-8	L921344-9
Physical Tests													
Moisture	%	0.10			38.9	44.9	43.0	18.3	20.4	19.1	23.2	30.3	23.0
pH	pH	0.10			7.45	7.60	7.47	7.12	7.35	7.25	8.04	7.93	8.00
Particle Size													
% Gravel (>2mm)	%	0.1-1.0			4.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	<0.10	<0.10
% Sand (2.0mm - 0.063mm)	%	0.1-1.0			44	33	37	99	98	99	87.5	73.9	82.7
% Silt (0.063mm - 4um)	%	0.1-1.0			29	31	30	1.0	1.0	<1.0	9.90	21.9	13.8
% Clay (<4um)	%	0.1-1.0			24	36	33	1.0	1.0	1.0	2.56	4.21	3.49
Leachable Anions & Nutrients													
Total Nitrogen by LECO	%	0.020			0.141	0.113	0.098	0.021	<0.020	0.024	0.027	0.039	0.030
Organic / Inorganic Carbon													
Total Organic Carbon	%	0.10			0.83	0.62	0.63	<0.10	<0.10	<0.10	0.20	0.31	0.21
Plant Available Nutrients													
Available Ammonium (as N)	mg/kg	0.8-2.4			42.5	4.4	5.23	0.82	0.81	<0.80	3.4	6.0	3.3
Available Nitrate (as N)	mg/kg	2.0-6.0			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0	<4.3	<4.3
Nitrite (as N)	mg/kg	0.4-1.2			<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<1.0	<0.86	<0.86
Available Phosphate (as P)	mg/kg	1.0-4.0			26.7	21.9	20.9	2.6	3	3.1	18.0	12.5	16.1
Metals													
Aluminum (Al)	mg/kg	50			13200	17300	15600	4530	4650	4170	4800	5640	4960
Antimony (Sb)	mg/kg	10			<10	<10	<10	<10	<10	<10	<10	<10	<10
Arsenic (As)	mg/kg	0.05-0.5	7.24	41.6	3.1	3.52	2.81	1.13	1.07	1.38	2.14	2.62	2.06
Barium (Ba)	mg/kg	1			64.9	90.3	79.2	13.9	16.7	17.9	17.1	24.6	17.5
Beryllium (Be)	mg/kg	0.5			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Bismuth (Bi)	mg/kg	20			<20	<20	<20	<20	<20	<20	<20	<20	<20
Cadmium (Cd)	mg/kg	0.1	0.7	4.2	<0.10	0.23	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Calcium (Ca)	mg/kg	50			4570	6380	5060	2510	2770	2530	2450	2760	2410
Chromium (Cr)	mg/kg	2	52.3	160	37.5	47.6	44.5	22.5	24	19.3	17.2	18.4	16.7
Cobalt (Co)	mg/kg	2			7.5	9.5	8.8	4.8	5.0	5.0	4.1	4.1	4.1
Copper (Cu)	mg/kg	1	18.7	108	15.1	19.9	17.5	8.5	7.9	7.5	9.2	10.4	9.1
Iron (Fe)	mg/kg	50			19000	23800	21900	15900	17800	15600	10500	11400	10400
Lead (Pb)	mg/kg	2	30.2	112	5.8	6.5	5.6	3.1	3.2	2.7	<2.0	2.1	<2.0
Lithium (Li)	mg/kg	2			26.1	35.1	31.2	7.2	7.2	6.7	8.1	10.2	8.8
Magnesium (Mg)	mg/kg	50			10200	13400	12100	3370	3390	3390	3910	4640	4130
Manganese (Mn)	mg/kg	1			210	267	247	113	121	113	96.9	106	98.8
Mercury (Hg)	mg/kg	0.005	0.13	0.70	0.0112	0.0114	0.0099	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Molybdenum (Mo)	mg/kg	0.2			1.22	1.47	1.32	0.3	0.37	0.37	0.44	0.66	0.50
Nickel (Ni)	mg/kg	5			18.5	22.7	21.3	9.6	9.7	9.6	9.4	10.0	9.6
Phosphorus (P)	mg/kg	50			600	682	611	411	488	466	409	474	397
Potassium (K)	mg/kg	200			4170	5860	5140	530	530	480	980	1440	1050
Selenium (Se)	mg/kg	0.5			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Silver (Ag)	mg/kg	0.1			0.11	0.11	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg	200			6590	9980	8010	1360	1190	1140	2290	3080	2290
Strontium (Sr)	mg/kg	0.5			26.5	37.1	30.1	10.9	11.9	9.75	11.9	14.4	11.7
Sulphur (S)	mg/kg	100			1570	1170	1060	590	590	810	560	800	700
Thallium (Tl)	mg/kg	0.5			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Tin (Sn)	mg/kg	5			<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Titanium (Ti)	mg/kg	1			879	1100	1020	542	595	496	364	410	364
Uranium (U)	mg/kg	0.05											
Vanadium (V)	mg/kg	2			45	56.9	51.8	41.3	47.7	38.1	22.2	22.4	21.4
Zinc (Zn)	mg/kg	1	124	271	40.2	52.4	47	12.9	14.2	13.3	14.1	18.0	14.7
Hydrocarbons													
EPH10-19	mg/kg	40-200			<200	<200	<200	-	-	-	<40	<40	<40
EPH19-32	mg/kg	40-200			<200	<200	<200	-	-	-	<40	60.0	62.3
LEPH	mg/kg	40-200			<200	<200	<200	-	-	-	<40	<40	<40
HEPH	mg/kg	40-200			<200	<200	<200	-	-	-	<40	60	62
Polycyclic Aromatic Hydrocarbons													
Acenaphthene	mg/kg	0.005	0.00671	0.0889	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acenaphthylene	mg/kg	0.005	0.00587	0.128	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Anthracene	mg/kg	0.004	0.0469	0.245	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Benz(a)anthracene	mg/kg	0.01	0.0748	0.693	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	mg/kg	0.01	0.0888	0.763	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b)fluoranthene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(g,h,i)perylene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	mg/kg	0.01	0.108	0.846	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	mg/kg	0.005	0.00622	0.135	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Fluoranthene	mg/kg	0.01	0.113	1.494	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	mg/kg	0.01	0.0212	0.144	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Methylnaphthalene	mg/kg	0.01	0.0202	0.201	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	mg/kg	0.01	0.0346	0.391	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	mg/kg	0.01	0.0867	0.544	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Pyrene	mg/kg	0.01	0.153	1.398	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Total PAHs	mg/kg	0.04			<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	-	-	-
Surrogate: d10-Acenaphthene (SS)	%				78	87	99	95	95	107	89	84	85
Surrogate: d12-Chrysene (SS)	%				85	87	104	97	96	101	104	104	104
Surrogate: d8-Naphthalene (SS)	%				77	82	98	94	93	104	89	83	85
Surrogate: d10-Phenanthrene (SS)	%				88	92	109	102	98	105	97	99	98

Notes:

Shaded cells indicate values that exceed CCME guidelines for the protection of marine aquatic life.

a) Canadian sediment quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011

b) ISQG = Interim Sediment Quality Guideline

c) PEL = Probable Effects Level

Appendix 4.2-4. Roberts Bay Sediment Quality, Doris North Project, 2009-2010

Site			CCME Guidelines for the Protection of Aquatic Life[a]		P2			P3			P4		
Date Sampled					15-Aug-10			15-Aug-10			15-Aug-10		
Replicate		Realized Detection Limits			1	2	3	1	2	3	1	2	3
Depth (m)					3	3	3	3.5	3.5	3.5	5	5	5
ALS Sample ID	Units		ISQG[b]	PEL[c]	L921344-11	L921344-13	L921344-14	L921344-17	L921344-18	L921344-20	L921344-1	L921344-4	L921344-5
Physical Tests													
Moisture	%	0.10			25.7	26.2	27.2	20.6	38.8	17.1	23.5	35.3	35.0
pH	pH	0.10			7.95	7.60	7.60	7.63	7.38	7.95	7.40	7.77	7.45
Particle Size													
% Gravel (>2mm)	%	0.1-1.0			<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
% Sand (2.0mm - 0.063mm)	%	0.1-1.0			92.8	80.1	<0.10	93.7	72.5	87.2	74.9	76.6	74.3
% Silt (0.063mm - 4um)	%	0.1-1.0			4.60	10.8	98.8	3.81	17.7	7.50	20.7	19.6	20.9
% Clay (<4um)	%	0.1-1.0			2.64	9.05	1.22	2.54	9.84	5.35	4.45	3.82	4.79
Leachable Anions & Nutrients													
Total Nitrogen by LECO	%	0.020			0.027	0.028	<0.020	<0.020	0.034	<0.020	0.054	0.052	0.061
Organic / Inorganic Carbon													
Total Organic Carbon	%	0.10			0.19	0.18	<0.10	<0.10	0.29	0.10	0.42	0.36	0.43
Plant Available Nutrients													
Available Ammonium (as N)	mg/kg	0.8-2.4			3.0	1.8	<1.6	<1.3	2.9	1.4	4.9	4.7	4.5
Available Nitrate (as N)	mg/kg	2.0-6.0			<3.0	<3.8	<3.8	<3.0	<4.3	<3.0	<6.0	<5.0	<6.0
Nitrite (as N)	mg/kg	0.4-1.2			<0.60	<0.75	<0.75	<0.60	<0.86	<0.60	<1.2	<1.0	<1.2
Available Phosphate (as P)	mg/kg	1.0-4.0			19.5	11.1	12.9	8.6	12.2	9.4	30.4	29.9	41.9
Metals													
Aluminum (Al)	mg/kg	50			5640	9200	5990	6080	9860	7710	6400	6010	7010
Antimony (Sb)	mg/kg	10			<10	<10	<10	<10	<10	<10	<10	<10	<10
Arsenic (As)	mg/kg	0.05-0.5	7.24	41.6	1.29	1.93	0.949	1.22	2.34	1.62	2.11	1.72	2.12
Barium (Ba)	mg/kg	1			16.2	35.9	12.5	17.3	39.7	26.7	27.4	25.0	31.0
Beryllium (Be)	mg/kg	0.5			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Bismuth (Bi)	mg/kg	20			<20	<20	<20	<20	<20	<20	<20	<20	<20
Cadmium (Cd)	mg/kg	0.1	0.7	4.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Calcium (Ca)	mg/kg	50			1710	3120	2000	2010	3370	2920	2650	2480	2570
Chromium (Cr)	mg/kg	2	52.3	160	17.0	31.1	21.6	17.8	31.3	24.5	19.1	18.2	21.4
Cobalt (Co)	mg/kg	2			3.9	6.4	4.4	4.3	6.7	5.3	4.0	3.9	4.5
Copper (Cu)	mg/kg	1	18.7	108	7.3	12.5	7.8	9.6	12.9	10.1	7.2	7.1	8.2
Iron (Fe)	mg/kg	50			9490	15600	10700	10300	15700	12400	10300	9510	11400
Lead (Pb)	mg/kg	2	30.2	112	<2.0	4.7	<2.0	<2.0	3.3	2.4	2.6	2.2	2.6
Lithium (Li)	mg/kg	2			9.5	16.5	9.6	10.3	17.7	13.3	11.3	10.4	13.1
Magnesium (Mg)	mg/kg	50			4600	6860	4990	4850	8030	6300	4990	4750	5620
Manganese (Mn)	mg/kg	1			103	171	118	115	185	151	117	103	124
Mercury (Hg)	mg/kg	0.005	0.13	0.70	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0064	<0.0050	0.0065
Molybdenum (Mo)	mg/kg	0.2			0.37	0.55	0.20	0.47	0.61	0.47	0.56	0.66	0.68
Nickel (Ni)	mg/kg	5			10.5	15.9	12.1	11.5	16.1	13.9	10.3	10.1	11.6
Phosphorus (P)	mg/kg	50			286	379	284	279	386	313	474	462	534
Potassium (K)	mg/kg	200			1040	2190	820	1100	2460	1640	1630	1530	1950
Selenium (Se)	mg/kg	0.5			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Silver (Ag)	mg/kg	0.1			<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg	200			2240	2430	2070	2240	3520	2220	3270	3780	4250
Strontium (Sr)	mg/kg	0.5			10.1	17.1	9.86	10.7	22.5	14.4	17.1	15.9	16.5
Sulphur (S)	mg/kg	100			550	520	400	420	890	600	680	710	680
Thallium (Tl)	mg/kg	0.5			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Tin (Sn)	mg/kg	5			<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Titanium (Ti)	mg/kg	1			325	664	355	395	678	540	449	426	443
Uranium (U)	mg/kg	0.05											
Vanadium (V)	mg/kg	2			19.4	35.6	22.3	19.7	34.0	25.7	23.6	22.3	25.8
Zinc (Zn)	mg/kg	1	124	271	16.5	28.0	18.7	18.5	30.9	23.1	18.7	18.8	22.1
Hydrocarbons													
EPH10-19	mg/kg	40-200			<40	<40	<40	<40	<40	<40	<40	<40	<40
EPH19-32	mg/kg	40-200			44.4	<40	<40	<40	<40	<40	47.5	45.1	91.5
LEPH	mg/kg	40-200			<40	<40	<40	<40	<40	<40	<40	<40	<40
HEPH	mg/kg	40-200			44	<40	<40	<40	<40	<40	47	45	92
Polycyclic Aromatic Hydrocarbons													
Acenaphthene	mg/kg	0.005	0.00671	0.0889	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acenaphthylene	mg/kg	0.005	0.00587	0.128	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Anthracene	mg/kg	0.004	0.0469	0.245	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Benz(a)anthracene	mg/kg	0.01	0.0748	0.693	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	mg/kg	0.01	0.0888	0.763	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b)fluoranthene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(g,h,i)perylene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	mg/kg	0.01	0.108	0.846	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	mg/kg	0.005	0.00622	0.135	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Fluoranthene	mg/kg	0.01	0.113	1.494	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	mg/kg	0.01	0.0212	0.144	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	mg/kg	0.01			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Methylnaphthalene	mg/kg	0.01	0.0202	0.201	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	mg/kg	0.01	0.0346	0.391	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	mg/kg	0.01	0.0867	0.544	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Pyrene	mg/kg	0.01	0.153	1.398	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Total PAHs	mg/kg	0.04			-	-	-	-	-	-	-	-	-
Surrogate: d10-Acenaphthene (SS)	%				86	89	82	90	88	86	83	80	86
Surrogate: d12-Chrysene (SS)	%				77	96	93	105	103	104	100	97	100
Surrogate: d8-Naphthalene (SS)	%				87	90	83	90	88	88	84	82	87
Surrogate: d10-Phenanthrene (SS)	%				84	92	87	99	96	97	93	91	95

Notes:

Shaded cells indicate values that exceed CCME guidelines for the protection of marine aquatic life.

a) Canadian sediment quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011

b) ISQG = Interim Sediment Quality Guideline

c) PEL = Probable Effects Level

Appendix 4.2-4. Roberts Bay Sediment Quality, Doris North Project, 2009-2010

Site			CCME Guidelines for the Protection of Aquatic Life[a]		RBE			RBW		
Date Sampled					15-Aug-10			17-Aug-10		
Replicate		Realized Detection Limits			1	2	3	1	2	3
Depth (m)					4.7	4.7	4.7	3.9	3.9	3.9
ALS Sample ID	Units		ISQG[b]	PEL[c]	L921370-2	L921370-3	L921370-5	L923230-2	L923230-3	L923230-6
Physical Tests										
Moisture	%	0.10			18.5	18.5	19.1	22.3	32.8	34.0
pH	pH	0.10			6.95	7.09	7.02	7.73	7.42	7.84
Particle Size										
% Gravel (>2mm)	%	0.1-1.0			<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
% Sand (2.0mm - 0.063mm)	%	0.1-1.0			90.7	91.4	96.4	72.8	67.6	68.8
% Silt (0.063mm - 4um)	%	0.1-1.0			7.03	8.17	2.78	23.0	27.2	27.3
% Clay (<4um)	%	0.1-1.0			2.30	0.45	0.82	4.17	5.24	3.87
Leachable Anions & Nutrients										
Total Nitrogen by LECO	%	0.020			<0.020	<0.020	<0.020	0.052	0.052	0.054
Organic / Inorganic Carbon										
Total Organic Carbon	%	0.10			0.17	<0.10	<0.10	0.37	0.40	0.50
Plant Available Nutrients										
Available Ammonium (as N)	mg/kg	0.8-2.4			0.95	1.16	1.12	5.82	3.58	9.86
Available Nitrate (as N)	mg/kg	2.0-6.0			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Nitrite (as N)	mg/kg	0.4-1.2			<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Available Phosphate (as P)	mg/kg	1.0-4.0			4.4	4.3	3.9	13.5	17.2	11.1
Metals										
Aluminum (Al)	mg/kg	50			4720	3670	3580	6330	7270	6840
Antimony (Sb)	mg/kg	10			<10	<10	<10	<10	<10	<10
Arsenic (As)	mg/kg	0.05-0.5	7.24	41.6	1.18	1.00	1.50	2.51	3.28	2.82
Barium (Ba)	mg/kg	1			15.2	8.8	9.0	26.5	30.6	29.1
Beryllium (Be)	mg/kg	0.5			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Bismuth (Bi)	mg/kg	20			<20	<20	<20	<20	<20	<20
Cadmium (Cd)	mg/kg	0.1	0.7	4.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Calcium (Ca)	mg/kg	50			2140	2000	1850	3030	3200	3180
Chromium (Cr)	mg/kg	2	52.3	160	14.7	12.4	11.4	22.1	23.7	23.6
Cobalt (Co)	mg/kg	2			4.3	3.9	4.0	4.6	5.2	5.2
Copper (Cu)	mg/kg	1	18.7	108	11.2	11.1	13.1	12.5	13.6	13.7
Iron (Fe)	mg/kg	50			10100	9510	8440	13400	13800	14400
Lead (Pb)	mg/kg	2	30.2	112	<2.0	<2.0	<2.0	2.4	2.8	2.8
Lithium (Li)	mg/kg	2			9.0	7.3	7.2	11.3	13.1	12.5
Magnesium (Mg)	mg/kg	50			3830	2980	3010	5260	6020	5880
Manganese (Mn)	mg/kg	1			90.9	79.6	76.3	118	131	127
Mercury (Hg)	mg/kg	0.005	0.13	0.70	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Molybdenum (Mo)	mg/kg	0.2			0.23	<0.20	<0.20	0.68	0.69	0.84
Nickel (Ni)	mg/kg	5			8.2	6.6	6.9	10.7	11.9	12.1
Phosphorus (P)	mg/kg	50			294	316	293	574	524	576
Potassium (K)	mg/kg	200			960	540	540	1530	1830	1770
Selenium (Se)	mg/kg	0.5			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Silver (Ag)	mg/kg	0.1			<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg	200			2130	970	1000	2810	3700	3770
Strontium (Sr)	mg/kg	0.5			11.6	8.65	7.93	16.9	18.7	18.3
Sulphur (S)	mg/kg	100			590	540	570	670	750	1030
Thallium (Tl)	mg/kg	0.5			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Tin (Sn)	mg/kg	5			<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Titanium (Ti)	mg/kg	1			440	356	326	533	579	561
Uranium (U)	mg/kg	0.05			0.467	0.949	0.433	0.542	0.590	0.577
Vanadium (V)	mg/kg	2			23.6	22.7	19.0	30.0	31.5	31.8
Zinc (Zn)	mg/kg	1	124	271	16.0	12.3	11.3	20.5	24.2	22.6
Hydrocarbons										
EPH10-19	mg/kg	40-200			-	-	-	-	-	-
EPH19-32	mg/kg	40-200			-	-	-	-	-	-
LEPH	mg/kg	40-200			-	-	-	-	-	-
HEPH	mg/kg	40-200			-	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons										
Acenaphthene	mg/kg	0.005	0.00671	0.0889	-	-	-	-	-	-
Acenaphthylene	mg/kg	0.005	0.00587	0.128	-	-	-	-	-	-
Anthracene	mg/kg	0.004	0.0469	0.245	-	-	-	-	-	-
Benz(a)anthracene	mg/kg	0.01	0.0748	0.693	-	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0.01	0.0888	0.763	-	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.01			-	-	-	-	-	-
Benzo(g,h,i)perylene	mg/kg	0.01			-	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0.01			-	-	-	-	-	-
Chrysene	mg/kg	0.01	0.108	0.846	-	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.005	0.00622	0.135	-	-	-	-	-	-
Fluoranthene	mg/kg	0.01	0.113	1.494	-	-	-	-	-	-
Fluorene	mg/kg	0.01	0.0212	0.144	-	-	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg	0.01			-	-	-	-	-	-
2-Methylnaphthalene	mg/kg	0.01	0.0202	0.201	-	-	-	-	-	-
Naphthalene	mg/kg	0.01	0.0346	0.391	-	-	-	-	-	-
Phenanthrene	mg/kg	0.01	0.0867	0.544	-	-	-	-	-	-
Pyrene	mg/kg	0.01	0.153	1.398	-	-	-	-	-	-
Total PAHs	mg/kg	0.04			-	-	-	-	-	-
Surrogate: d10-Acenaphthene (SS)	%				-	-	-	-	-	-
Surrogate: d12-Chrysene (SS)	%				-	-	-	-	-	-
Surrogate: d8-Naphthalene (SS)	%				-	-	-	-	-	-
Surrogate: d10-Phenanthrene (SS)	%				-	-	-	-	-	-

Notes:

Shaded cells indicate values that exceed CCME guidelines for the protection of marine aquatic life.

a) Canadian sediment quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011

b) ISQG = Interim Sediment Quality Guideline

c) PEL = Probable Effects Level

Appendix 4.3-1

Roberts Bay Phytoplankton Biomass (as Chlorophyll *a*), Doris North Project, 2009-2010

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Appendix 4.3-1. Roberts Bay Phytoplankton Biomass (as Chlorophyll a), Doris North Project, 2009-2010

Station ID		ST0	ST0	ST0	ST1	ST1	ST1	ST2	ST2	ST2	ST2	ST2	ST2
Depth		1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	4 m	4 m	4 m
Replicate		1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled	DL	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09
Chlorophyll *a* (µg/L)	0.04	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	0.051	0.087	0.192

Station ID		ST3	ST3	ST3	ST3	ST3	ST3	ST3	ST3	ST3	ST4	ST4	ST4
Depth		1 m	1 m	1 m	4 m	4 m	4 m	9 m	9 m	9 m	1 m	1 m	1 m
Replicate		1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled	DL	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09
Chlorophyll *a* (µg/L)	0.04	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	0.049	0.041	0.046	<0.040	<0.040	<0.040

Station ID		ST4	ST4	ST4	ST4	ST4	ST4	ST4	ST4	ST4	ST5	ST5	ST5
Depth		6 m	6 m	6 m	14 m	14 m	14 m	30 m	30 m	30 m	1 m	1 m	1 m
Replicate		1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled	DL	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09
Chlorophyll *a* (µg/L)	0.04	<0.040	<0.040	<0.040	<0.040	0.043	0.043	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040

Station ID		ST5	ST5	ST5	ST5	ST5	ST5	ST5	ST5	ST5	ST6	ST6	ST6
Depth		5 m	5 m	5 m	13 m	13 m	13 m	40 m	40 m	40 m	1 m	1 m	1 m
Replicate		1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled	DL	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09
Chlorophyll *a* (µg/L)	0.04	<0.040	<0.040	<0.040	<0.040	<0.040	0.045	<0.040	0.049	0.045	<0.040	<0.040	<0.040

Station ID		ST6	ST6	ST6	ST6	ST6	ST6	ST6	ST6	ST6
Depth		6 m	6 m	6 m	14 m	14 m	14 m	40 m	40 m	40 m
Replicate		1	2	3	1	2	3	1	2	3
Date Sampled	DL	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09	15-Aug-09
Chlorophyll *a* (µg/L)	0.04	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	0.057	0.041

Site ID		ST4	ST4	ST4	ST4	ST4	ST4	ST4	ST4	ST4	ST4	ST4	ST4
Depth		1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m
Replicate		1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled	DL	23-Apr-10	23-Apr-10	23-Apr-10	22-Jul-10	22-Jul-10	22-Jul-10	17-Aug-10	17-Aug-10	17-Aug-10	01-Oct-10	01-Oct-10	01-Oct-10
Chlorophyll *a* (µg/L)	0.010	0.224	0.165	0.079	0.124	0.093	0.105	0.122	0.119	0.093	0.118	0.462	0.443

Site ID		DWP	DWP	DWP	DWP	DWP	DWP	DWP	DWP	DWP	DWP	DWP	DWP
Depth		1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m
Replicate		1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled	DL	24-Apr-10	24-Apr-10	24-Apr-10	22-Jul-10	22-Jul-10	22-Jul-10	17-Aug-10	17-Aug-10	17-Aug-10	28-Sep-10	28-Sep-10	28-Sep-10
Chlorophyll *a* (µg/L)	0.010	0.625	0.375	0.495	0.107	0.111	0.137	0.108	0.185	0.130	0.195	0.208	0.067

Site ID		RBW	RBW	RBW	RBW	RBW	RBW	RBW	RBW	RBW	RBW	RBW	RBW
Depth		1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m
Replicate		1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled	DL	24-Apr-10	24-Apr-10	24-Apr-10	20-Jul-10	20-Jul-10	20-Jul-10	17-Aug-10	17-Aug-10	17-Aug-10	30-Sep-10	30-Sep-10	30-Sep-10
Chlorophyll *a* (µg/L)	0.010	0.921	0.510	0.357	0.200	0.186	0.184	1.21	1.37	1.30	0.296	0.327	0.212

Site ID		RBE	RBE	RBE	RBE	RBE	RBE	RBE	RBE	RBE	RBE	RBE	RBE
Depth		1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m
Replicate		1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled	DL	24-Apr-10	24-Apr-10	24-Apr-10	20-Jul-10	20-Jul-10	20-Jul-10	17-Aug-10	17-Aug-10	17-Aug-10	30-Sep-10	30-Sep-10	30-Sep-10
Chlorophyll *a* (µg/L)	0.010	0.408	0.713	0.173	0.250	0.203	0.153	5.58	5.33	10.0	0.779	0.107	0.623

Note: DL = detection limit.

Appendix 4.3-2

Roberts Bay Phytoplankton Taxonomy (as Biomass), Doris North Project, 2009-2010

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Appendix 4.3-2. Roberts Bay Phytoplankton Taxonomy (as Biomass), Doris North Project, 2009-2010

Site		ST0			ST1			ST2		
Date	Trophic	14-Aug-09			14-Aug-09			14-Aug-09		
Replicate	Category	1	2	3	1	2	3	1	2	3
Bacillariophyta - Diatoms										
Asterionella formosa	A									
Chaetoceros compressus	A			0.75	0.17					
Chaetoceros curvisetus	A									
Chaetoceros decipiens	A				0.28		1.12	0.56		
Chaetoceros lasciniosus	A									
Chaetoceros sp. large	A									
Chaetoceros spp.	A									
Cylindrotheca closterium	A			0.06						0.02
Fragilariopsis cylindrus	A									
Leptocylindrus danicus	A									
Lycmophora abreviata	A									0.28
Lycmophora hyalina	A									
Melosira varians	A			0.55	2.20					
Navicula spp.	A	0.06	0.06					0.06		
Pseudo-nitszchia cf. *delicatissima*	A	0.05	0.05	0.05		0.09			0.02	0.02
Rhizosolenia chunii	A									
Rhizosolenia hebetata	A									
Skeletonema costatum	A									
Synedra ulna	A	0.10	0.39	0.39	0.20		0.10	0.10		0.10
Thalassionema nitszchioides	A						0.06			
Thalassiosira cf. aestivalis	A									
Total Diatom Biomass		**0.21**	**0.50**	**1.80**	**2.84**	**0.09**	**1.28**	**0.72**	**0.02**	**0.43**
Pyrrhophyta - Dinoflagellates										
Alexandrium cf. *ostenfeldii*	A	0.38	0.63	0.13	0.13	0.88	0.13	0.75	1.01	0.88
Alexandrium spp.	A									
Ceratium arcticum	A	0.94	1.88	0.94			0.47		0.94	0.47
Ceratium furca	A									
Ceratium lineatum	A		0.13							
Cochlodinium cf. *citron*	H							0.45		
Corythodinium sp.	M									
Dinophysis acuminata	M		0.12		0.18					0.06
Dinophysis acuta	M	1.43	1.78	0.71		0.36	0.18	0.53	1.60	0.36
Dinophysis rotundata	M									
Gymnodinium sp. (medium)	A					0.64				1.28
Gymnodinium spp. (small)	A/H	0.17								
Gymnodinium verior	M									
Gyrodinium estuariale	H		0.18		0.55					
Gyrodinium sp.	H	0.13	0.13	0.09	0.22	0.09	0.04	0.09	0.13	
Katodinium glaucum	H	1.80	1.20	1.20	1.80	0.60		0.60		0.60
Minuscula bipes	M									
Protoceratium reticulatum	A									
Protoperidinium pellucidum	H	0.09	0.09		0.09					0.09
Protoperidinium spp.	H									
Total Dinoflagellate Biomass		**4.93**	**6.15**	**3.07**	**2.97**	**2.57**	**0.82**	**2.43**	**3.69**	**3.73**
Cryptophyta										
Cryptomonads	M	0.76	0.76	1.01	0.50	0.50	0.25	0.50	0.50	0.50
Total Cryptophyta Biomass		**0.76**	**0.76**	**1.01**	**0.50**	**0.50**	**0.25**	**0.50**	**0.50**	**0.50**
Cyanophyta - Cyanobacteria										
Nodularia spp.	A	0.04	0.02	0.03	0.03			0.02	0.01	
Oscillatoria spp.	A	0.02		0.02	0.01	0.01	0.01		0.01	0.01
Total Cyanobacteria Biomass		**0.06**	**0.02**	**0.05**	**0.04**	**0.01**	**0.01**	**0.02**	**0.02**	**0.01**
Others										
Dinobryon balticum	M	1.01	1.00	1.31	1.95	1.15	0.85	1.13	1.70	1.29
Ebria tripartita	H	2.61	1.74	1.74	0.87	0.87	0.87	0.87	1.74	1.74
Myrionecta rubra	M			0.86					1.72	
Scenedesmus sp.	A									
Total Other Biomass		**3.62**	**2.74**	**3.91**	**2.82**	**2.02**	**1.72**	**2.00**	**5.16**	**3.03**
Total Phytoplankton Biomass		**9.58**	**10.16**	**9.84**	**9.17**	**5.19**	**4.08**	**5.67**	**9.39**	**7.71**

Notes:

Units are µg C/L

A= autotrophic, H= heterotrophic, M= mixotrophic.

Appendix 4.3-2. Roberts Bay Phytoplankton Taxonomy (as Biomass), Doris North Project, 2009-2010

Site		ST3			ST4			ST5		
Date	Trophic	14-Aug-09			14-Aug-09			14-Aug-09		
Replicate	Category	1	2	3	1	2	3	1	2	3
Bacillariophyta - Diatoms										
Asterionella formosa	A									
Chaetoceros compressus	A		0.66							
Chaetoceros curvisetus	A									
Chaetoceros decipiens	A		1.12				0.56			0.03
Chaetoceros lasciniosus	A									
Chaetoceros sp. large	A									
Chaetoceros spp.	A									
Cylindrotheca closterium	A	0.02					0.02		0.06	0.02
Fragilariopsis cylindrus	A				0.24				0.48	
Leptocylindrus danicus	A									
Lycmophora abreviata	A	0.57			0.28			0.57		0.57
Lycmophora hyalina	A		0.57			0.28			0.04	
Melosira varians	A	1.10								
Navicula spp.	A		0.13					0.13		
Pseudo-nitszchia cf. *delicatissima*	A		0.02	0.02	0.07	0.05		0.07	0.02	
Rhizosolenia chunii	A									
Rhizosolenia hebetata	A									
Skeletonema costatum	A									
Synedra ulna	A	0.20	0.20	0.10	0.10	0.30	0.20	0.10	0.49	0.10
Thalassionema nitszchioides	A									
Thalassiosira cf. aestivalis	A									
Total Diatom Biomass		**1.89**	**2.70**	**0.12**	**0.70**	**0.63**	**0.78**	**0.87**	**1.10**	**0.71**
Pyrrhophyta - Dinoflagellates										
Alexandrium cf. *ostenfeldii*	A	0.25	0.25	0.38	0.25	0.25	0.38	0.13	0.25	0.25
Alexandrium spp.	A									
Ceratium arcticum	A		0.94	0.47					0.47	
Ceratium furca	A									
Ceratium lineatum	A									
Cochlodinium cf. *citron*	H									
Corythodinium sp.	M									
Dinophysis acuminata	M				0.12	0.12		0.18	0.12	
Dinophysis acuta	M			0.71		0.71	0.53	0.36	0.36	0.36
Dinophysis rotundata	M									
Gymnodinium sp. (medium)	A							0.06		0.03
Gymnodinium spp. (small)	A/H	0.50	0.17	0.17			0.17		0.17	
Gymnodinium verior	M									
Gyrodinium estuariale	H	4.03	0.37				0.55			0.18
Gyrodinium sp.	H	0.13	0.09	0.18	0.13	0.13	0.22	0.18	0.04	0.04
Katodinium glaucum	H		2.40		1.20	1.20		1.20		1.20
Minuscula bipes	M									
Protoceratium reticulatum	A							0.40		
Protoperidinium pellucidum	H		0.09			0.09	0.09	0.09	0.09	0.09
Protoperidinium spp.	H									
Total Dinoflagellate Biomass		**4.92**	**4.31**	**1.91**	**1.70**	**2.51**	**1.95**	**2.58**	**1.50**	**2.16**
Cryptophyta										
Cryptomonads	M	0.50	0.76	0.25	0.76	0.76	1.01	0.76	0.50	0.76
Total Cryptophyta Biomass		**0.50**	**0.76**	**0.25**	**0.76**	**0.76**	**1.01**	**0.76**	**0.50**	**0.76**
Cyanophyta - Cyanobacteria										
Nodularia spp.	A	0.04		0.03	0.04	0.05	0.03	0.03	0.03	0.06
Oscillatoria spp.	A		0.01	0.02	0.02	0.01	0.02	0.01	0.07	0.03
Total Cyanobacteria Biomass		**0.04**	**0.01**	**0.04**	**0.06**	**0.06**	**0.05**	**0.03**	**0.09**	**0.08**
Others										
Dinobryon balticum	M	0.59	0.87	0.88	1.28	1.16	1.16	1.60	1.83	1.51
Ebria tripartita	H	0.87	0.87	1.74	1.74		1.74	0.87	2.61	1.74
Myrionecta rubra	M	1.72			0.86			0.86	0.86	
Scenedesmus sp.	A									
Total Other Biomass		**3.19**	**1.74**	**2.62**	**3.88**	**1.16**	**2.90**	**3.33**	**5.30**	**3.25**
Total Phytoplankton Biomass		**10.54**	**9.51**	**4.94**	**7.10**	**5.11**	**6.69**	**7.57**	**8.49**	**6.96**

Notes:

Units are µg C/L

A= autotrophic, H= heterotrophic, M= mixotrophic.

Appendix 4.3-2. Roberts Bay Phytoplankton Taxonomy (as Biomass), Doris North Project, 2009-2010

Site		ST6			ST4			ST4		
Date	Trophic	14-Aug-09			17-Aug-10			30-Sep-10		
Replicate	Category	1	2	3	1	2	3	1	2	3
Bacillariophyta - Diatoms										
Asterionella formosa	A	0.02		0.05						
Chaetoceros compressus	A									
Chaetoceros curvisetus	A	0.24		0.12				0.60		
Chaetoceros decipiens	A			0.03						
Chaetoceros lasciniosus	A							0.75	0.32	0.43
Chaetoceros sp. large	A									0.02
Chaetoceros spp.	A					0.10			0.10	
Cylindrotheca closterium	A							0.02		
Fragilariopsis cylindrus	A									
Leptocylindrus danicus	A				1.75	3.37	3.10	46.10	43.68	47.45
Lycmophora abreviata	A								0.03	
Lycmophora hyalina	A									
Melosira varians	A									
Navicula spp.	A									
Pseudo-nitszchia cf. *delicatissima*	A			0.02	0.02			0.07	0.14	0.17
Rhizosolenia chunii	A									
Rhizosolenia hebetata	A				0.16	0.28	0.52	0.28	0.40	0.16
Skeletonema costatum	A									
Synedra ulna	A		0.10	0.10						
Thalassionema nitszchioides	A							0.06	0.18	0.18
Thalassiosira cf. aestivalis	A							0.24	0.24	0.12
Total Diatom Biomass		**0.26**	**0.10**	**0.31**	**1.94**	**3.75**	**3.62**	**48.13**	**45.08**	**48.52**
Pyrrhophyta - Dinoflagellates										
Alexandrium cf. *ostenfeldii*	A	0.38	1.13	0.63						
Alexandrium spp.	A				0.39	0.39	0.26			
Ceratium arcticum	A			0.47	1.45	2.42	4.36	1.94		1.94
Ceratium furca	A									
Ceratium lineatum	A									
Cochlodinium cf. *citron*	H				0.31		0.31			0.31
Corythodinium sp.	M					0.02				
Dinophysis acuminata	M		0.12				0.06		0.12	
Dinophysis acuta	M	1.25	1.25			0.18		0.37		
Dinophysis rotundata	M									
Gymnodinium sp. (medium)	A									
Gymnodinium spp. (small)	A/H							0.05	0.04	0.03
Gymnodinium verior	M								0.06	
Gyrodinium estuariale	H	0.18	0.37		0.38					0.19
Gyrodinium sp.	H		0.09	0.09	0.09	0.09				
Katodinium glaucum	H									
Minuscula bipes	M							0.01	0.01	
Protoceratium reticulatum	A	0.79	0.79	1.19	1.64	2.04	1.23			0.20
Protoperidinium pellucidum	H			0.27						
Protoperidinium spp.	H				0.13	0.06	0.03		0.19	0.03
Total Dinoflagellate Biomass		**2.60**	**3.75**	**2.65**	**4.39**	**5.21**	**6.25**	**2.37**	**0.42**	**2.71**
Cryptophyta										
Cryptomonads	M	0.50	0.50	0.50	1.76	3.78	1.76	1.26	1.01	1.26
Total Cryptophyta Biomass		**0.50**	**0.50**	**0.50**	**1.76**	**3.78**	**1.76**	**1.26**	**1.01**	**1.26**
Cyanophyta - Cyanobacteria										
Nodularia spp.	A			0.01						
Oscillatoria spp.	A	0.04	0.01	0.01	0.03	0.03	0.05	0.03	0.04	0.03
Total Cyanobacteria Biomass		**0.04**	**0.01**	**0.02**	**0.03**	**0.03**	**0.05**	**0.03**	**0.04**	**0.03**
Others										
Dinobryon balticum	M	3.23	3.68	3.31	0.04	0.04	0.02			
Ebria tripartita	H	0.87	0.87	1.74						
Myrionecta rubra	M	0.86	1.72	0.86						
Scenedesmus sp.	A									
Total Other Biomass		**4.96**	**6.27**	**5.91**	**0.04**	**0.04**	**0.02**	**0**	**0**	**0**
Total Phytoplankton Biomass		**8.37**	**10.63**	**9.39**	**8.15**	**12.80**	**11.71**	**51.79**	**46.56**	**52.52**

Notes:

Units are µg C/L

A= autotrophic, H= heterotrophic, M= mixotrophic.

Appendix 4.3-3

Roberts Bay Phytoplankton Taxonomy (as Abundance), Doris North Project, 2009-2010

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Appendix 4.3-3. Roberts Bay Phytoplankton Taxonomy (as Abundance), Doris North Project, 2009-2010

Site		ST0			ST1			ST2		
Date	Trophic	14-Aug-09			14-Aug-09			14-Aug-09		
Replicate	Category	1	2	3	1	2	3	1	2	3
Bacillariophyta - Diatoms										
Asterionella formosa	A									
Chaetoceros compressus	A			7,630	1,696					
Chaetoceros curvisetus	A									
Chaetoceros decipiens	A				848		3,391	1,696		
Chaetoceros lasciniosus	A									
Chaetoceros sp. large	A									
Chaetoceros spp.	A									
Cylindrotheca closterium	A			2,543						848
Fragilariopsis cylindrus	A									
Leptocylindrus danicus	A									
Lycmophora abreviata	A									848
Lycmophora hyalina	A									
Melosira varians	A			848	3,391					
Navicula spp.	A	848	848					848		
Pseudo-nitszchia cf. *delicatissima*	A	1,696	1,696	1,696		3,391			848	848
Rhizosolenia chunii	A									
Rhizosolenia hebetata	A									
Skeletonema costatum	A									
Synedra ulna	A	848	3,391	3,391	1,696		848	848		848
Thalassionema nitszchioides	A						848			
Thalassiosira cf. aestivalis	A									
Total Diatom Abundance		**3,391**	**5,935**	**16,108**	**7,630**	**3,391**	**5,087**	**3,391**	**848**	**3,391**
Pyrrhophyta - Dinoflagellates										
Alexandrium cf. *ostenfeldii*	A	117	194	39	39	272	39	233	311	272
Alexandrium spp.	A									
Ceratium arcticum	A	78	155	78			39		78	39
Ceratium furca	A									
Ceratium lineatum	A		39							
Cochlodinium cf. *citron*	H							233		
Corythodinium sp.	M									
Dinophysis acuminata	M		78		117					39
Dinophysis acuta	M	311	388	155		78	39	117	350	78
Dinophysis rotundata	M									
Gymnodinium sp. (medium)	A					848				1,696
Gymnodinium spp. (small)	A/H	848								
Gymnodinium verior	M									
Gyrodinium estuariale	H		39		117					
Gyrodinium sp.	H	2,543	2,543	1,696	4,239	1,696	848	1,696	2,543	
Katodinium glaucum	H	2,543	1,696	1,696	2,543	848		848		848
Minuscula bipes	M									
Protoceratium reticulatum	A									
Protoperidinium pellucidum	H	848	848		848					848
Protoperidinium spp.	H									
Total Dinoflagellate Abundance		**7,287**	**5,980**	**3,663**	**7,902**	**3,741**	**964**	**3,126**	**3,281**	**3,818**
Cryptophyta										
Cryptomonads	M	68,672	68,672	91,562	45,781	45,781	22,891	45,781	45,781	45,781
Total Cryptophyta Abundance		**68,672**	**68,672**	**91,562**	**45,781**	**45,781**	**22,891**	**45,781**	**45,781**	**45,781**
Cyanophyta - Cyanobacteria										
Nodularia spp.	A	4,239	1,696	3,391	3,391			1,696	848	
Oscillatoria spp.	A	1,696		1,696	848	848	848		848	848
Total Cyanobacteria Abundance		**5,935**	**1,696**	**5,087**	**4,239**	**848**	**848**	**1,696**	**1,696**	**848**
Others										
Dinobryon balticum	M	72,063	71,215	93,258	139,039	82,237	61,042	80,541	121,235	92,410
Ebria tripartita	H	2,543	1,696	1,696	848	848	848	848	1,696	1,696
Myrionecta rubra	M			848					1,696	
Scenedesmus sp.	A									
Total Other Abundance		**74,606**	**72,911**	**95,801**	**139,887**	**83,084**	**61,889**	**81,389**	**124,627**	**94,106**
Total Phytoplankton Abundance		**159,891**	**155,193**	**212,222**	**205,439**	**136,845**	**91,679**	**135,383**	**176,232**	**147,944**

Notes:

Units are Cells/L.

A= autotrophic, H= heterotrophic, M= mixotrophic.

Appendix 4.3-3. Roberts Bay Phytoplankton Taxonomy (as Abundance), Doris North Project, 2009-2010

Site		ST3			ST4			ST5		
Date	Trophic	14-Aug-09			14-Aug-09			14-Aug-09		
Replicate	Category	1	2	3	1	2	3	1	2	3
Bacillariophyta - Diatoms										
Asterionella formosa	A									
Chaetoceros compressus	A		6,782							
Chaetoceros curvisetus	A									
Chaetoceros decipiens	A		3,391				1,696			78
Chaetoceros lasciniosus	A									
Chaetoceros sp. large	A									
Chaetoceros spp.	A									
Cylindrotheca closterium	A	848					848		2,543	848
Fragilariopsis cylindrus	A				848				1,696	
Leptocylindrus danicus	A									
Lycmophora abreviata	A	1,696			848			1,696		1,696
Lycmophora hyalina	A		1,696			848			117	
Melosira varians	A	1,696								
Navicula spp.	A		1,696					1,696		
Pseudo-nitszchia cf. *delicatissima*	A		848	848	2,543	1,696		2,543	848	
Rhizosolenia chunii	A									
Rhizosolenia hebetata	A									
Skeletonema costatum	A									
Synedra ulna	A	1,696	1,696	848	848	2,543	1,696	848	4,239	848
Thalassionema nitszchioides	A									
Thalassiosira cf. aestivalis	A									
Total Diatom Abundance		**5,935**	**16,108**	**1,696**	**5,087**	**5,087**	**4,239**	**6,782**	**9,442**	**3,469**
Pyrrhophyta - Dinoflagellates										
Alexandrium cf. *ostenfeldii*	A	78	78	117	78	78	117	39	78	78
Alexandrium spp.	A									
Ceratium arcticum	A		78	39					39	
Ceratium furca	A									
Ceratium lineatum	A									
Cochlodinium cf. *citron*	H									
Corythodinium sp.	M									
Dinophysis acuminata	M				78	78		117	78	
Dinophysis acuta	M			155		155	117	78	78	78
Dinophysis rotundata	M									
Gymnodinium sp. (medium)	A							78		39
Gymnodinium spp. (small)	A/H	2,543	848	848			848		848	
Gymnodinium verior	M									
Gyrodinium estuariale	H	848	78				117			39
Gyrodinium sp.	H	2,543	1,696	3,391	2,543	2,543	4,239	3,391	848	848
Katodinium glaucum	H		3,391		1,696	1,696		1,696		1,696
Minuscula bipes	M									
Protoceratium reticulatum	A							78		
Protoperidinium pellucidum	H		848			848	848	848	848	848
Protoperidinium spp.	H									
Total Dinoflagellate Abundance		**6,012**	**7,015**	**4,550**	**4,394**	**5,397**	**6,284**	**6,323**	**2,815**	**3,624**
Cryptophyta										
Cryptomonads	M	45,781	68,672	22,891	68,672	68,672	91,562	68,672	45,781	68,672
Total Cryptophyta Abundance		**45,781**	**68,672**	**22,891**	**68,672**	**68,672**	**91,562**	**68,672**	**45,781**	**68,672**
Cyanophyta - Cyanobacteria										
Nodularia spp.	A	4,239		2,543	4,239	5,087	3,391	2,543	2,543	5,935
Oscillatoria spp.	A		848	1,696	1,696	848	1,696	848	6,782	2,543
Total Cyanobacteria Abundance		**4,239**	**848**	**4,239**	**5,935**	**5,935**	**5,087**	**3,391**	**9,326**	**8,478**
Others										
Dinobryon balticum	M	42,390	61,889	62,737	91,562	83,084	83,084	114,453	130,561	107,671
Ebria tripartita	H	848	848	1,696	1,696		1,696	848	2,543	1,696
Myrionecta rubra	M	1,696			848			848	848	
Scenedesmus sp.	A									
Total Other Abundance		**44,933**	**62,737**	**64,433**	**94,106**	**83,084**	**84,780**	**116,149**	**133,952**	**109,366**
Total Phytoplankton Abundance		**106,900**	**155,380**	**97,808**	**178,193**	**168,175**	**191,952**	**201,317**	**201,317**	**193,609**

Notes:

Units are Cells/L.

A= autotrophic, H= heterotrophic, M= mixotrophic.

Appendix 4.3-3. Roberts Bay Phytoplankton Taxonomy (as Abundance), Doris North Project, 2009-2010

Site		ST6			ST4			ST4		
Date	Trophic	14-Aug-09			17-Aug-10			30-Sep-10		
Replicate	Category	1	2	3	1	2	3	1	2	3
Bacillariophyta - Diatoms										
Asterionella formosa	A	848		1,696						
Chaetoceros compressus	A									
Chaetoceros curvisetus	A	1,696		848				4,239		
Chaetoceros decipiens	A			78						
Chaetoceros lasciniosus	A							5,935	2,543	3,391
Chaetoceros sp. large	A									40
Chaetoceros spp.	A					848			848	
Cylindrotheca closterium	A							848		
Fragilariopsis cylindrus	A									
Leptocylindrus danicus	A				11,021	21,195	19,499	289,948	274,687	298,426
Lycmophora abreviata	A								80	
Lycmophora hyalina	A									
Melosira varians	A									
Navicula spp.	A									
Pseudo-nitszchia cf. *delicatissima*	A			848	848			2,543	5,087	5,935
Rhizosolenia chunii	A									
Rhizosolenia hebetata	A				160	280	520	280	400	160
Skeletonema costatum	A									
Synedra ulna	A		848	848						
Thalassionema nitszchioides	A							848	2,543	2,543
Thalassiosira cf. aestivalis	A							240	240	120
Total Diatom Abundance		**2,543**	**848**	**4,317**	**12,029**	**22,323**	**20,019**	**304,880**	**286,429**	**310,615**
Pyrrhophyta - Dinoflagellates										
Alexandrium cf. *ostenfeldii*	A	117	350	194						
Alexandrium spp.	A				120	120	80			
Ceratium arcticum	A			39	120	200	360	160		160
Ceratium furca	A									
Ceratium lineatum	A									
Cochlodinium cf. *citron*	H				160		160			160
Corythodinium sp.	M					40				
Dinophysis acuminata	M		78				40		80	
Dinophysis acuta	M	272	272			40		80		
Dinophysis rotundata	M									
Gymnodinium sp. (medium)	A									
Gymnodinium spp. (small)	A/H							280	200	160
Gymnodinium verior	M								80	
Gyrodinium estuariale	H	39	78		80					40
Gyrodinium sp.	H		1,696	1,696	1,696	1,696				
Katodinium glaucum	H									
Minuscula bipes	M							40	40	
Protoceratium reticulatum	A	155	155	233	320	400	240			40
Protoperidinium pellucidum	H			117						
Protoperidinium spp.	H				160	80	40		240	40
Total Dinoflagellate Abundance		**583**	**2,628**	**2,278**	**2,656**	**2,576**	**920**	**560**	**640**	**600**
Cryptophyta										
Cryptomonads	M	45,781	45,781	45,781	160,234	343,359	160,234	114,453	91,562	114,453
Total Cryptophyta Abundance		**45,781**	**45,781**	**45,781**	**160,234**	**343,359**	**160,234**	**114,453**	**91,562**	**114,453**
Cyanophyta - Cyanobacteria										
Nodularia spp.	A			848						
Oscillatoria spp.	A	4,239	848	848	2,543	3,391	5,087	3,391	4,239	3,391
Total Cyanobacteria Abundance		**4,239**	**848**	**1,696**	**2,543**	**3,391**	**5,087**	**3,391**	**4,239**	**3,391**
Others										
Dinobryon balticum	M	230,602	262,818	236,536	2,543	2,543	1,696			
Ebria tripartita	H	848	848	1,696						
Myrionecta rubra	M	848	1,696	848						
Scenedesmus sp.	A									
Total Other Abundance		**232,297**	**265,361**	**239,080**	**2,543**	**2,543**	**1,696**	**0**	**0**	**0**
Total Phytoplankton Abundance		**285,443**	**315,466**	**293,151**	**180,006**	**374,192**	**187,956**	**423,284**	**382,870**	**429,059**

Notes:

Units are Cells/L.

A= autotrophic, H= heterotrophic, M= mixotrophic.

Appendix 4.3-4

Roberts Bay Zooplankton Taxonomy (as Abundance), Doris North Project, 2009

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Appendix 4.3-4. Roberts Bay Zooplankton Taxonomy (as Abundance), Doris North Project, 2009

Sampling Site		ST0			ST1			ST2			ST3		
Sampling Date		10-Aug-09			10-Aug-09			10-Aug-09			10-Aug-09		
Replicate		1	2	3	1	2	3	1	2	3	1	2	3
Species/group	Stage												
CNIDARIA													
Aeginopsis laurentii	L												
Aeginopsis laurentii	juv												
Aeginopsis laurentii	A												
Aglantha digitale	L	2.9			16.4	3.6	15.5	17.4					
Aglantha digitale	juv	0.4	3.1	4.8	8.2	7.3	31.0	1.7		4.4	1.5	5.0	6.8
Aglantha digitale	A												
Euphysa flammea						0.2						0.2	
Halitholus cirratus			0.2										
Obelia sp.													1.4
Sarsia tubulosa													
CTENOPHORA													
Ctenophora	damaged												
Mertensia ovum		7.2	24.7	17.7	27.8	47.4	26.3	10.5	19.8	8.8	8.9	23.6	17.7
POLYCHAETA													
Polychaeta	L*	5.8	61.8	24.2	32.7	31.0	77.5	26.1	198.4	30.7	13.4	38.7	20.5
Polychaeta	juv	11.5	6.2	14.5	18.0	12.7	6.2	13.9	19.8	11.7	4.5	3.4	5.5
CLADOCERA													
Podon leuckarti	F	72.2	170.1	177.1	114.5	145.7	48.0	104.6	215.0	161.0	118.9	185.1	95.4
Evadne nordmanni	F	1,443.2	2,628.3	2,898.7	1,962.9	2,003.5	2,634.5	1,742.6	2,480.3	3,073.5	877.2	639.6	1,227.1
COPEPODA													
Calanoida	nauplius	43.3	15.5	80.5	16.4	36.4	18.6	52.3	49.6	58.5	44.6	84.2	27.3
Acartia longiremis	M	187.6	201.0	193.2	245.4	273.2	278.9	487.9	463.0	526.9	475.7	420.8	300.0
Acartia longiremis	F	129.9	154.6	322.1	179.9	255.0	186.0	313.7	231.5	204.9	267.6	151.5	300.0
Acartia longiremis	V	230.9	463.8	418.7	1,635.7	1,821.3	945.3	714.5	711.0	731.8	579.8	622.8	586.3
Acartia longiremis	IV	389.7	773.0	805.2	1,308.6	728.5	1,022.8	2,439.6	1,653.5	2,341.7	1,784.0	1,026.7	1,090.8
Acartia longiremis	III	2,020.5	1,700.7	2,254.5	5,888.7	3,642.7	4,494.2	4,530.7	2,480.3	3,658.9	3,716.8	2,524.7	3,408.7
Acartia longiremis	II	577.3	927.6	644.2	1,962.9	1,274.9	1,549.7	1,568.3	1,653.5	1,024.5	1,189.4	1,514.8	1,227.1
Acartia longiremis	I	43.3	309.2	48.3	147.2	182.1	619.9	122.0	181.9	87.8	89.2	67.3	122.7
Calanus sp.	IV							0.2					
Calanus sp.	III	0.4		3.2	9.8	14.6	6.2	1.7	14.9	11.7	3.0	5.0	4.1
Calanus sp.	II	2.9	12.4	1.6	8.2	12.7	7.7	3.5	49.6	4.4	1.5	1.7	2.7
Calanus sp.	I												1.4
Centropages abdominalis	M	40.4	54.1	69.2	55.6	78.3	91.4	38.3	215.0	190.3	61.0	82.5	62.7
Centropages abdominalis	F	34.6	29.4	64.4	22.9	21.9	32.5	27.9	43.0	29.3	28.2	23.6	32.7
Centropages abdominalis	V	202.1	97.4	306.0	212.6	382.5	371.9	853.9	1,570.9	863.5	579.8	858.4	504.5
Centropages abdominalis	IV	86.6	139.1	193.2	98.1	200.3	155.0	540.2	727.6	570.8	446.0	420.8	327.2
Centropages abdominalis	III	86.6	30.9	112.7	212.6	218.6	186.0	226.5	231.5	219.5	237.9	286.1	231.8
Centropages abdominalis	II	43.3	30.9	32.2	49.1	72.9	170.5	69.7	66.1	87.8	133.8	168.3	81.8
Centropages abdominalis	I			32.2	16.4	1.8				29.3			
Eurytemora herdmani	M		17.0	19.3	1.6		1.5			1.5		1.7	
Eurytemora herdmani	F	4.3	23.2	33.8	1.6	9.1	3.1		1.7		1.5		2.7
Eurytemora herdmani	V			1.6								16.8	
Eurytemora herdmani	IV			1.6			1.5						
Eurytemora herdmani	III		3.1	32.2	16.4	3.6	4.6		16.5		1.5		
Eurytemora herdmani	II									1.5			
Pseudocalanus minutus	M	28.9	15.5	3.2		18.2	15.5		6.6			16.8	
Pseudocalanus minutus	F	173.2	139.1	225.5	670.7	382.5	480.4	435.6	1,174.0	1,317.2	267.6	185.1	204.5
Pseudocalanidae	V		3.1	4.8	3.3	36.4	15.5	1.7	33.1	58.5	14.9	16.8	13.6
Pseudocalanidae	IV	28.9	30.9	16.1	11.5	109.3	155.0	87.1	198.4	102.4	178.4	134.7	95.4
Pseudocalanidae	III	303.1	201.0	338.2	1,145.0	1,274.9	480.4	156.8	380.3	161.0	862.3	774.3	477.2
Pseudocalanidae	II	144.3	231.9	289.9	490.7	728.5	248.0	139.4	132.3	58.5	297.3	218.8	136.3
Pseudocalanidae	I			16.1	16.4	182.1				14.6	14.9		
Tortanus discaudatus	M				3.3	3.6	4.6		1.7				
Tortanus discaudatus	F				1.6					1.5			
Tortanus discaudatus	V	17.3	23.2	17.7	163.6	1,092.8	186.0	88.9	231.5	263.4	89.2	101.0	122.7
Tortanus discaudatus	IV	33.2	26.3	38.6	130.9	1,457.1	124.0	139.4	248.0	351.3	118.9	218.8	95.4
Tortanus discaudatus	III	72.2	24.7	22.5	26.2	910.7	62.0	36.6	132.3	175.6	44.6	50.5	95.4
Tortanus discaudatus	II	28.9	10.8	48.3	14.7	12.7	7.7	69.7	33.1	29.3	44.6	33.7	1.4
Tortanus discaudatus	I		4.6	48.3	4.9	7.3	3.1	52.3	16.5	14.6	14.9		1.4
Aetididae	IV												
Aetididae	III												
Derjuginia tolli	V												
Harpacticoida	cop		3.1										
Harpacticus sp.	F		3.1				3.1		1.7				
Tisbe furcata	F												
Cyclopoida													
Oithona similis	M												
Oithona similis	F												
Oithona similis	V												
Oncaea borealis	F												
CIRRIPEDIA													
Cirripedia	nauplius											1.7	1.4
Cirripedia	cypris		3.1		3.3	1.8	4.6	1.7	3.3	7.3	1.5		
ISOPODA													
Isopoda													
AMPHIPODA													
Hyperia galba													
Gammarellus homari	juv						0.2						
EUPHAUSIACEA													
Euphausiacea	calyptopis				1.6								
Euphausiacea	furcilia			1.6			0.2			1.5			
DECAPODA													
Hippolytidae	zoea												
Brachyura	zoea	21.6	38.7	29.0	4.1	2.9	3.4	3.5	10.3	23.4	3.7	10.3	4.4
MOLLUSCA													
Bivalvia	veliger		1.5	16.1	49.1	14.6	27.9	22.7	13.2	10.2	4.5	5.0	2.7
Gastropoda	veliger						1.5						
Limacina helicina	veliger	8.7	37.1	35.4	9.8	16.4	20.1	27.9	74.4	117.1	1.3	18.5	12.3
ECHINODERMATA													
Echinodermata	pluteus							1.7					1.4
CHAETOGNATHA													
Sagitta elegans			0.2		0.2		0.2			0.1	0.1		
LARVACEA													
Fritillaria borealis			1.5								1.5		
Oikopleura vanhoeffeni													
FISH													
Clupea pallasi	L	0.1	0.2	0.2	0.3	1.8	0.9	1.9	2.1	1.9	1.6	2.2	2.2
Liparus sp.	L												
Gadidae	L									0.1		0.2	
Pleuronectidae	L						0.2		0.3			0.2	
Total		**6,527**	**8,677**	**9,959**	**17,021**	**17,734**	**14,830**	**15,173**	**15,985**	**16,642**	**12,626**	**10,959**	**10,955**

Notes:

Units are organisms/m³.

A = adult, cop = copepodite (juvenile copepod), dam = damaged, E = egg, F = female, juv = juvenile, L = larva (first juvenile of homometabolous insect), L = larva too small to be identified further, M = male, P = pupa (second juvenile of homometabolous insect), I to V = first through fifth copepodite stages, zoea = first stages of decapods, megalopa = middle stages of decapods, veliger = larval stages of molluscs, pluteus = larval stages of echinoderms, nauplius = first stage of many crustaceans, cypris = middle stage of barnacles, calyptopis = first stages of euphausids, furcilia = middle stage of euphausids.*

Appendix 4.3-4. Roberts Bay Zooplankton Taxonomy (as Abundance), Doris North Project, 2009

Sampling Site		ST4			ST5			ST6		
Sampling Date		10-Aug-09			10-Aug-09			10-Aug-09		
Replicate		1	2	3	1	2	3	1	2	3
Species/group	Stage									
CNIDARIA										
Aeginopsis laurentii	L					15.3				
Aeginopsis laurentii	juv	0.1	0.3	3.0	0.2		1.6	3.2	4.6	3.3
Aeginopsis laurentii	A					0.2				
Aglantha digitale	L					1.5	11.4		31.0	16.3
Aglantha digitale	juv	25.6	3.3	1.5	7.6	0.2	0.2	9.7	62.0	4.9
Aglantha digitale	A								0.2	
Euphysa flammea							0.2			
Halitholus cirratus						0.2				
Obelia sp.										
Sarsia tubulosa				0.1						
CTENOPHORA										
Ctenophora	damaged	0.1	0.2	0.1						
Mertensia ovum		0.5	9.8	5.9	3.0	4.6	6.5	4.8	0.5	4.9
POLYCHAETA										
Polychaeta	L*	423.1	425.6	281.0	909.1	336.2	163.0	321.8	170.5	195.8
Polychaeta	juv	26.9	42.6	34.0	90.9	107.0	130.4	80.5	124.0	146.9
CLADOCERA										
Podon leuckarti	F	51.3	49.1	73.9	10.6	7.6	8.2	3.2	62.0	8.2
Evadne nordmanni	F	333.3	212.8	369.7	242.4	229.2	244.6	19.3	77.5	17.9
COPEPODA										
Calanoida	nauplius	115.4	65.5	103.5	197.0	275.1	179.3	64.4	186.0	228.4
Acartia longiremis	M	179.5	163.7	295.8	166.7	320.9	358.7	144.8	93.0	130.5
Acartia longiremis	F	346.2	605.7	532.4	394.0	489.0	538.0	257.5	526.9	277.4
Acartia longiremis	V	1,025.6	458.4	399.3	424.3	382.0	440.2	531.0	635.4	815.8
Acartia longiremis	IV	641.0	834.9	887.3	1,212.2	916.9	896.7	1,045.9	790.4	979.0
Acartia longiremis	III	1,666.6	1,031.4	1,478.9	1,363.7	2,292.2	3,097.6	1,770.0	1,859.7	1,794.9
Acartia longiremis	II	282.0	278.3	473.2	242.4	412.6	407.6	1,287.3	217.0	261.1
Acartia longiremis	I	102.6	81.9	118.3	30.3	122.3	65.2	32.2	31.0	65.3
Calanus sp.	IV	1.3	1.6	0.3	1.5			3.2		
Calanus sp.	III	6.4	3.3	4.4	10.6	4.6	3.3	0.2	3.1	6.5
Calanus sp.	II	2.6	4.9		1.5		1.6	3.2	1.5	3.3
Calanus sp.	I					15.3				
Centropages abdominalis	M	128.2	68.8	192.3	71.2	152.8	66.8	160.9	124.0	277.4
Centropages abdominalis	F	64.1	54.0	88.7	65.2	91.7	40.8	112.6	93.0	130.5
Centropages abdominalis	V	179.5	196.5	207.0	90.9	91.7	130.4	144.8	62.0	65.3
Centropages abdominalis	IV	76.9	49.1	177.5	60.6	30.6	32.6	16.1	15.5	32.6
Centropages abdominalis	III	12.8	49.1	29.6	45.5	30.6	97.8	16.1		
Centropages abdominalis	II	51.3	16.4	59.2		30.6	48.9			
Centropages abdominalis	I	12.8			15.2					
Eurytemora herdmani	M	12.8		14.8	15.2	15.3				
Eurytemora herdmani	F					15.3		16.1		3.3
Eurytemora herdmani	V						32.6			
Eurytemora herdmani	IV					30.6				
Eurytemora herdmani	III	25.6	32.7		30.3	30.6	32.6	16.1		16.3
Eurytemora herdmani	II									
Pseudocalanus minutus	M				1.5		16.3			
Pseudocalanus minutus	F	833.3	1,015.0	1,478.9	727.3	748.8	1,027.1	965.4	836.8	1,468.5
Pseudocalanidae	V	25.6	16.4	14.8					31.0	0.0
Pseudocalanidae	IV	256.4	278.3	739.5	197.0	244.5	293.5	193.1	387.4	97.9
Pseudocalanidae	III	1,666.6	1,964.5	1,626.8	1,060.7	1,833.8	1,304.3	2,413.6	1,084.8	979.0
Pseudocalanidae	II	1,410.2	1,309.7	1,478.9	1,363.7	916.9	978.2	1,126.4	1,239.8	1,142.2
Pseudocalanidae	I	76.9	229.2	1,183.1	363.7	916.9	342.4	337.9	929.8	391.6
Tortanus discaudatus	M	5.1	3.3	7.4	4.5	1.5	81.5	17.7	10.8	11.4
Tortanus discaudatus	F									
Tortanus discaudatus	V	76.9	98.2	281.0	39.4	107.0	114.1	177.0	155.0	97.9
Tortanus discaudatus	IV	51.3	81.9	207.0	45.5	107.0	16.3	48.3	77.5	65.3
Tortanus discaudatus	III	12.8	16.4	118.3		30.6	32.6		15.5	
Tortanus discaudatus	II			44.4	15.2	30.6				
Tortanus discaudatus	I	12.8		14.8			16.3			
Aetididae	IV	1.3	1.6				0.8		0.2	
Aetididae	III	1.3	0.2		1.5					
Derjuginia tolli	V									0.2
Harpacticoida	cop									
Harpacticus sp.	F									
Tisbe furcata	F				1.5	15.3	1.6			1.6
Cyclopoida										
Oithona similis	M	12.8			45.5		16.3	16.1		
Oithona similis	F	38.5	65.5	118.3	257.6	213.9	179.3	160.9	108.5	81.6
Oithona similis	V	102.6	32.7	14.8	15.2	15.3		48.3	15.5	
Oncaea borealis	F		16.4							
CIRRIPEDIA										
Cirripedia	nauplius	294.9	229.2	295.8	439.4	366.8	326.1	144.8	248.0	146.9
Cirripedia	cypris			5.9	1.5	1.5	1.6	1.6	1.5	3.3
ISOPODA										
Isopoda									0.2	
AMPHIPODA										
Hyperia galba				0.3				0.2		
Gammarellus homari	juv									
EUPHAUSIACEA										
Euphausiacea	calyptopis									
Euphausiacea	furcilia	1.3	0.5			1.5	0.2	3.2	1.5	0.0
DECAPODA										
Hippolytidae	zoea	0.1		0.3		0.2	0.2	0.5	0.2	1.5
Brachyura	zoea	4.0	4.6	3.1	2.1	3.1	3.3	0.2	1.5	1.3
MOLLUSCA										
Bivalvia	veliger	3.8	3.3	8.9	15.2	16.8	0.0	1.6	3.1	6.5
Gastropoda	veliger	0.1				0.2	0.2	1.6		
Limacina helicina	veliger		6.5	8.9	15.2	3.1				1.6
ECHINODERMATA										
Echinodermata	pluteus							16.1		
CHAETOGNATHA										
Sagitta elegans		9.0	5.4	14.8	9.1	3.8	2.6	20.9	11.0	14.7
LARVACEA										
Fritillaria borealis		1,025.6	1,637.1	1,774.7	2,121.3	1,375.3	1,304.3	836.7	1,084.8	1,468.5
Oikopleura vanhoeffeni		14.1	9.8	13.3	10.6	12.2	8.2	27.4	8.7	21.2
FISH										
Clupea pallasi	L	1.0	2.6	0.9	0.3	0.6	0.8	0.2	0.3	0.2
Liparus sp.	L					0.2				
Gadidae	L									
Pleuronectidae	L									
Total		**11,732**	**11,765**	**15,286**	**12,456**	**13,418**	**13,104**	**12,624**	**11,424**	**11,488**

Notes:

Units are organisms/m³.

A = adult, cop = copepodite (juvenile copepod), dam = damaged, E = egg, F = female, juv = juvenile, L = larva (first juvenile of homometabolous insect), L = larva too small to be identified further, M = male, P = pupa (second juvenile of homometabolous insect), I to V = first through fifth copepodite stages, zoea = first stages of decapods, megalopa = middle stages of decapods, veliger = larval stages of molluscs, pluteus = larval stages of echinoderms, nauplius = first stage of many crustaceans, cypris = middle stage of barnacles, calyptopis = first stages of euphausids, furcilia = middle stage of euphausids.*

Appendix 4.3-5

Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

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Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	DW1			DW2			DW3		
Sampling Date	17-Aug-09			17-Aug-09			17-Aug-09		
Replicate	1	2	3	1	2	3	1	2	3
Sampling Depth (m)	13	13	13	13	13	13	1	1	1
TAXA									
NEMERTEA									
Nemertea Indet.	78.6	78.6	78.6	78.6	78.6				
Anopla									
Anopla Indet.				78.6					
Cerebratulus sp.									
Heteronemertea Indet.									
Lineidae									
ANNELIDA									
Polychaeta Errantia									
Eteone longa									
Eteone sp.						78.6			
Eulalia nr. bilineata				78.6					
Harmothoe imbricata Cmplx.					78.6				
Hesionidae Indet.					78.6				
Lumbrineridae Indet.									
Lumbrineris sp.		235.8		235.8		78.6			
Naineris quadricuspida									
Nephtys ciliata				78.6	78.6				
Nephtys nr. neotena	5,817.6	14,858.5	6,996.9	9,984.3	2,044.0	10,691.8			78.6
Nephtys sp.									
Nereimyra sp.									
Pholoe sp.	78.6	2,437.1	2,122.6	78.6	864.8	78.6			
Pholoides asperus									
Phyllodoce groenlandica									
Polynoidae Indet.									
Sigalionidae Indet.									
Sthenelais sp.									
Polychaeta Sedentaria									
Amastigos acutus									
Ampharete sp.									
Aphelochaeta monilaris									
Aphelochaeta sp.									
Aricidea sp.	78.6	628.9	78.6	393.1		235.8			
Axiothella sp.									
Brada villosa	157.2		235.8		393.1				
Capitella capitata Cmplx.									
Capitellidae Indet.									
Cirratulidae Indet.	3,380.5	2,830.2	2,358.5	3,223.3	864.8	5,031.4			78.6
Cirratulus sp.	78.6				78.6				
Cossura sp.									
Euclymeninae Indet.									
Flabelligeridae Indet.				78.6					
Leitoscoloplos sp.	1,493.7	943.4	157.2	2,279.9	628.9	1,179.2			
Levinsenia gracilis									
Malacoceros sp.									
Maldane sp.									
Marenzelleria arctia									
Mediomastus sp.				78.6	157.2				
Notomastus sp.									
Orbiniidae									

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	DW1			DW2			DW3		
Sampling Date	17-Aug-09			17-Aug-09			17-Aug-09		
Replicate	1	2	3	1	2	3	1	2	3
Sampling Depth (m)	13	13	13	13	13	13	1	1	1
TAXA									
Paraonidae Indet.									
Pectinaria granulata		235.8	78.6						
Pectinaria sp.									
Polydora sp.									
Prionospio sp.				393.1	235.8				
Sabellidae Indet.									
Scalibregma sp.				78.6					
Scolelepis sp.									
Spio sp.								78.6	
Spionidae Indet.									
Spiophanes sp.									
Terebellides stroemi		235.8		157.2					
Travisia forbesii									
Oligochaeta									
Enchytraeidae Indet.									
Oligochaeta Indet.									
ARTHROPODA									
Amphipoda									
Americhelidium sp.									
Boeckosimus affinis	78.6								
Corophium sp.									
Gammaracanthus loricatus									
Gammarus sp.									
Guernea nordenskioldi					235.8				
Haploops sp.						78.6			
Lagunogammarus setosus									
Lysianassidae Indet.									
Monoculodes sp.									
Monoculopsis sp.									
Oedicerotidae Indet.					314.5				
Pontoporeia femorata			550.3	78.6	235.8	314.5			
Protomedeia sp.									
Stenothoidae				78.6					
Copepoda									
Harpacticoida				78.6			27,122.6	47,956.0	393.1
Ostracoda									
Ostracoda Indet.				78.6					
Cumacea									
Eudorella pacifica									
Diastylis rathkeii	1,336.5	5,817.6	2,908.8	1,100.6	2,122.6				157.2
Diastylis sp.					471.7	157.2			
Leucon sp.		235.8	471.7		235.8	78.6			
Tanaidacea									
Tanaidacea Indet.		78.6	78.6	314.5	550.3				
Isopoda									
Isopoda Indet.					550.3				
Saduria entomon									78.6
Decapoda									
Natantia megalops									

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	DW1			DW2			DW3		
Sampling Date	17-Aug-09			17-Aug-09			17-Aug-09		
Replicate	1	2	3	1	2	3	1	2	3
Sampling Depth (m)	13	13	13	13	13	13	1	1	1
TAXA									
MOLLUSCA									
Gastropoda									
Alvania sp.									
Cylichna sp.	235.8	393.1	157.2	314.5		157.2			
Gastropoda Indet.		157.2			78.6	78.6			
Bivalvia									
Astarte borealis	1,336.5		628.9	471.7	235.8	471.7			
Axinopsida orbiculata									
Clinocardium ciliatum									
Cyrtodaria kurriana									
Hiatella arctica									
Axinopsida orbiculata									
Lyonsia sp.									
Macoma balthica							78.6		
Macoma calcarea	78.6			78.6	550.3				
Macoma sp.									
Musculus niger					78.6				
Musculus sp.					78.6				
Mya truncata									
Portlandia arctica						78.6			
Rochefortia tumida									
Serripes groenlandicus									
Tellina sp.									
Thyasira sp.					78.6				
Yoldiella sp.									
ECHINODERMATA									
Holothuroidea									
Holothuroidea Indet.									
Asteroidea									
Asteroidea Indet.									
Ophiuroidea									
Ophiura sp.		78.6							
UROCHORDATA									
Ascidiacea									
Rhizomogula globularis									
OTHER:									
Teleostei eggs					943.4				
Teleostei larvae									
Unidentified invertebrate eggs									
Calanoid copepod									
Nematoda (counts <50/estimates >50)	550.3	707.5	1,022.0	471.7	3,695.0	235.8	39,308.2	86,478.0	550.3
TOTAL	**14,230**	**29,245**	**16,903**	**19,890**	**11,399**	**18,789**	**27,201**	**48,035**	**786**

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	RTF1			TF1			ST2		
Sampling Date	17-Aug-09			16-Aug-09			16-Aug-09		
Replicate	1	2	3	1	2	3	1	2	3
Sampling Depth (m)	3	3	3	2	2	2	7	7	7
TAXA									
NEMERTEA									
Nemertea Indet.	1,336.5	864.8							
Anopla									
Anopla Indet.									
Cerebratulus sp.									
Heteronemertea Indet.									
Lineidae									
ANNELIDA									
Polychaeta Errantia									
Eteone longa		157.2							
Eteone sp.									
Eulalia nr. bilineata									
Harmothoe imbricata Cmplx.	235.8	157.2							
Hesionidae Indet.									
Lumbrineridae Indet.									
Lumbrineris sp.									
Naineris quadricuspida									
Nephtys ciliata									
Nephtys nr. neotena		393.1	235.8		157.2				
Nephtys sp.									
Nereimyra sp.	157.2	78.6							
Pholoe sp.		393.1	78.6						
Pholoides asperus									
Phyllodoce groenlandica									
Polynoidae Indet.					78.6				
Sigalionidae Indet.		78.6							
Sthenelais sp.									
Polychaeta Sedentaria									
Amastigos acutus	78.6		78.6						
Ampharete sp.									
Aphelochaeta monilaris									
Aphelochaeta sp.									
Aricidea sp.			78.6						
Axiothella sp.									
Brada villosa									
Capitella capitata Cmplx.									
Capitellidae Indet.									
Cirratulidae Indet.			471.7						
Cirratulus sp.									
Cossura sp.									
Euclymeninae Indet.									
Flabelligeridae Indet.									
Leitoscoloplos sp.									
Levinsenia gracilis									
Malacoceros sp.									
Maldane sp.									
Marenzelleria arctia									
Mediomastus sp.	157.2	786.2	78.6						
Notomastus sp.									
Orbiniidae			235.8						

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	RTF1			TF1			ST2		
Sampling Date	17-Aug-09			16-Aug-09			16-Aug-09		
Replicate	1	2	3	1	2	3	1	2	3
Sampling Depth (m)	3	3	3	2	2	2	7	7	7
TAXA									
Paraonidae Indet.			78.6						
Pectinaria granulata									
Pectinaria sp.									
Polydora sp.									
Prionospio sp.					78.6				
Sabellidae Indet.									
Scalibregma sp.									
Scolelepis sp.									
Spio sp.	864.8	393.1	628.9						
Spionidae Indet.					78.6				
Spiophanes sp.									
Terebellides stroemi									
Travisia forbesii									
Oligochaeta									
Enchytraeidae Indet.									
Oligochaeta Indet.	2,201.3	707.5	78.6						
ARTHROPODA									
Amphipoda									
Americhelidium sp.									
Boeckosimus affinis	1,965.4	471.7			78.6				
Corophium sp.		78.6							
Gammaracanthus loricatus									
Gammarus sp.									
Guernea nordenskioldi									
Haploops sp.									
Lagunogammarus setosus	157.2	78.6							
Lysianassidae Indet.									
Monoculodes sp.									
Monoculopsis sp.	628.9	393.1							
Oedicerotidae Indet.									
Pontoporeia femorata							157.2	628.9	
Protomedeia sp.									
Stenothoidae									
Copepoda									
Harpacticoida	30,110.1	707.5	15,959.1	16,981.1	3,459.1	24,292.5			
Ostracoda									
Ostracoda Indet.									
Cumacea									
Eudorella pacifica									
Diastylis rathkeii							393.1	235.8	235.8
Diastylis sp.						78.6			
Leucon sp.									
Tanaidacea									
Tanaidacea Indet.									
Isopoda									
Isopoda Indet.									
Saduria entomon	550.3	235.8		78.6		78.6			
Decapoda									
Natantia megalops									

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	RTF1			TF1			ST2		
Sampling Date	17-Aug-09			16-Aug-09			16-Aug-09		
Replicate	1	2	3	1	2	3	1	2	3
Sampling Depth (m)	3	3	3	2	2	2	7	7	7
TAXA									
MOLLUSCA									
Gastropoda									
Alvania sp.									
Cylichna sp.							78.6		78.6
Gastropoda Indet.									
Bivalvia									
Astarte borealis							628.9	550.3	1,179.2
Axinopsida orbiculata									
Clinocardium ciliatum									
Cyrtodaria kurriana									
Hiatella arctica							471.7	235.8	707.5
Axinopsida orbiculata									
Lyonsia sp.									
Macoma balthica	28,223.3	29,245.3	314.5				157.2	78.6	78.6
Macoma calcarea								235.8	78.6
Macoma sp.									
Musculus niger									
Musculus sp.									
Mya truncata									
Portlandia arctica							235.8	157.2	235.8
Rochefortia tumida									
Serripes groenlandicus									
Tellina sp.									
Thyasira sp.									
Yoldiella sp.									
ECHINODERMATA									
Holothuroidea									
Holothuroidea Indet.									
Asteroidea									
Asteroidea Indet.									
Ophiuroidea									
Ophiura sp.									
UROCHORDATA									
Ascidiacea									
Rhizomogula globularis		78.6							
OTHER:									
Teleostei eggs	57,232.7	5,817.6	471.7						
Teleostei larvae	3,144.7	471.7							
Unidentified invertebrate eggs									
Calanoid copepod			78.6						
Nematoda (counts <50/estimates >50)	134,434.0	19,654.1	53,459.1	7,861.6	628.9	12,578.6			
TOTAL	**66,667**	**35,299**	**18,318**	**17,060**	**3,931**	**24,450**	**2,123**	**2,123**	**2,594**

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	ST7			ST8			ST9		
Sampling Date	16-Aug-09			16-Aug-09			16-Aug-09		
Replicate	1	2	3	1	2	3	1	2	3
Sampling Depth (m)	2	2	2	8	8	8	2	2	2
TAXA									
NEMERTEA									
Nemertea Indet.									
Anopla									
Anopla Indet.									
Cerebratulus sp.									
Heteronemertea Indet.									
Lineidae									
ANNELIDA									
Polychaeta Errantia									
Eteone longa									
Eteone sp.									
Eulalia nr. bilineata									
Harmothoe imbricata Cmplx.									
Hesionidae Indet.									
Lumbrineridae Indet.									
Lumbrineris sp.									
Naineris quadricuspida									
Nephtys ciliata									
Nephtys nr. neotena									707.5
Nephtys sp.									
Nereimyra sp.									
Pholoe sp.									
Pholoides asperus									
Phyllodoce groenlandica									
Polynoidae Indet.									
Sigalionidae Indet.									
Sthenelais sp.									
Polychaeta Sedentaria									
Amastigos acutus									
Ampharete sp.									
Aphelochaeta monilaris									
Aphelochaeta sp.									
Aricidea sp.									
Axiothella sp.									
Brada villosa									
Capitella capitata Cmplx.									
Capitellidae Indet.									
Cirratulidae Indet.	78.6	78.6							
Cirratulus sp.									
Cossura sp.									
Euclymeninae Indet.									
Flabelligeridae Indet.									
Leitoscoloplos sp.									
Levinsenia gracilis									
Malacoceros sp.									
Maldane sp.									
Marenzelleria arctia									
Mediomastus sp.									
Notomastus sp.									
Orbiniidae									

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	ST7			ST8			ST9		
Sampling Date	16-Aug-09			16-Aug-09			16-Aug-09		
Replicate	1	2	3	1	2	3	1	2	3
Sampling Depth (m)	2	2	2	8	8	8	2	2	2
TAXA									
Paraonidae Indet.									
Pectinaria granulata									
Pectinaria sp.									
Polydora sp.									
Prionospio sp.									
Sabellidae Indet.									
Scalibregma sp.									
Scolelepis sp.	393.1	1,100.6	1,022.0						
Spio sp.									
Spionidae Indet.									
Spiophanes sp.									
Terebellides stroemi									
Travisia forbesii									
Oligochaeta									
Enchytraeidae Indet.									
Oligochaeta Indet.									
ARTHROPODA									
Amphipoda									
Americhelidium sp.									
Boeckosimus affinis									
Corophium sp.									
Gammaracanthus loricatus									
Gammarus sp.									
Guernea nordenskioldi									
Haploops sp.									
Lagunogammarus setosus									
Lysianassidae Indet.									
Monoculodes sp.									
Monoculopsis sp.									
Oedicerotidae Indet.									
Pontoporeia femorata				157.2		864.8			
Protomedeia sp.									
Stenothoidae									
Copepoda									
Harpacticoida	1,179.2	4,088.1	3,537.7						
Ostracoda									
Ostracoda Indet.									
Cumacea									
Eudorella pacifica									
Diastylis rathkeii			78.6						
Diastylis sp.									
Leucon sp.									
Tanaidacea									
Tanaidacea Indet.									
Isopoda									
Isopoda Indet.									
Saduria entomon					78.6		78.6	78.6	
Decapoda									
Natantia megalops									

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	ST7			ST8			ST9		
Sampling Date	16-Aug-09			16-Aug-09			16-Aug-09		
Replicate	1	2	3	1	2	3	1	2	3
Sampling Depth (m)	2	2	2	8	8	8	2	2	2
TAXA									
MOLLUSCA									
Gastropoda									
Alvania sp.									
Cylichna sp.					78.6	235.8			
Gastropoda Indet.									
Bivalvia									
Astarte borealis				235.8	235.8	78.6			
Axinopsida orbiculata									
Clinocardium ciliatum						78.6			
Cyrtodaria kurriana									
Hiatella arctica						157.2			
Axinopsida orbiculata									
Lyonsia sp.									
Macoma balthica			314.5						
Macoma calcarea				471.7	157.2	78.6			
Macoma sp.				78.6					
Musculus niger									
Musculus sp.									
Mya truncata									
Portlandia arctica					78.6	157.2			
Rochefortia tumida									
Serripes groenlandicus									
Tellina sp.									
Thyasira sp.									
Yoldiella sp.									
ECHINODERMATA									
Holothuroidea									
Holothuroidea Indet.									
Asteroidea									
Asteroidea Indet.									
Ophiuroidea									
Ophiura sp.									
UROCHORDATA									
Ascidiacea									
Rhizomogula globularis									
OTHER:									
Teleostei eggs									
Teleostei larvae									
Unidentified invertebrate eggs									
Calanoid copepod									
Nematoda (counts <50/estimates >50)	1,022.0	3,223.3	2,908.8						
TOTAL	**1,651**	**5,267**	**4,953**	**943**	**629**	**1,651**	**79**	**79**	**708**

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	ST10			ST11			P1		
Sampling Date	16-Aug-09			16-Aug-09			15-Aug-10		
Replicate	1	2	3	1	2	3	1	2	3
Sampling Depth (m)	13	13	13	8	8	8	5.5	5.5	5.5
TAXA									
NEMERTEA									
Nemertea Indet.			157.2						
Anopla									
Anopla Indet.	157.2	78.6							
Cerebratulus sp.									
Heteronemertea Indet.	78.6				235.8	78.6			
Lineidae									
ANNELIDA									
Polychaeta Errantia									
Eteone longa									
Eteone sp.									
Eulalia nr. bilineata									
Harmothoe imbricata Cmplx.				78.6			78.6		
Hesionidae Indet.						78.6			
Lumbrineridae Indet.									
Lumbrineris sp.					78.6				
Naineris quadricuspida									
Nephtys ciliata		78.6						78.6	
Nephtys nr. neotena	314.5	157.2		1,493.7	2,908.8	6,289.3			
Nephtys sp.							2,830.2	11,478.0	9,119.5
Nereimyra sp.									
Pholoe sp.			78.6	393.1	314.5	707.5			235.8
Pholoides asperus									
Phyllodoce groenlandica									
Polynoidae Indet.							78.6		
Sigalionidae Indet.									
Sthenelais sp.						78.6			
Polychaeta Sedentaria									
Amastigos acutus							78.6		78.6
Ampharete sp.									
Aphelochaeta monilaris									628.9
Aphelochaeta sp.					393.1				
Aricidea sp.									
Axiothella sp.									
Brada villosa									
Capitella capitata Cmplx.									
Capitellidae Indet.					78.6				
Cirratulidae Indet.	157.2			235.8					
Cirratulus sp.									
Cossura sp.							78.6		
Euclymeninae Indet.						78.6			
Flabelligeridae Indet.									
Leitoscoloplos sp.	78.6	78.6	157.2	1,493.7	1,650.9	3,066.0	943.4	393.1	4,402.5
Levinsenia gracilis	7,625.8	1,179.2	4,088.1						
Malacoceros sp.									
Maldane sp.							78.6		
Marenzelleria arctia									
Mediomastus sp.	78.6							78.6	
Notomastus sp.									
Orbiniidae									

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	ST10			ST11			P1		
Sampling Date	16-Aug-09			16-Aug-09			15-Aug-10		
Replicate	1	2	3	1	2	3	1	2	3
Sampling Depth (m)	13	13	13	8	8	8	5.5	5.5	5.5
TAXA									
Paraonidae Indet.					78.6				
Pectinaria granulata						157.2		1,886.8	471.7
Pectinaria sp.		78.6						1,572.3	314.5
Polydora sp.									78.6
Prionospio sp.					78.6				
Sabellidae Indet.									
Scalibregma sp.					157.2				
Scolelepis sp.									
Spio sp.									
Spionidae Indet.									
Spiophanes sp.									
Terebellides stroemi									
Travisia forbesii									
Oligochaeta									
Enchytraeidae Indet.									
Oligochaeta Indet.									
ARTHROPODA									
Amphipoda									
Americhelidium sp.									
Boeckosimus affinis									
Corophium sp.									
Gammaracanthus loricatus									
Gammarus sp.								78.6	
Guernea nordenskioldi									
Haploops sp.									
Lagunogammarus setosus									
Lysianassidae Indet.									
Monoculodes sp.					78.6				
Monoculopsis sp.									
Oedicerotidae Indet.									
Pontoporeia femorata	235.8	78.6	78.6		393.1	157.2		78.6	78.6
Protomedeia sp.						78.6			
Stenothoidae	78.6								
Copepoda									
Harpacticoida									
Ostracoda									
Ostracoda Indet.							157.2	6,525.2	628.9
Cumacea									
Eudorella pacifica									
Diastylis rathkeii	7,861.6	1,965.4	2,515.7	235.8	393.1	471.7			
Diastylis sp.				235.8					
Leucon sp.									
Tanaidacea									
Tanaidacea Indet.	157.2		78.6	78.6	235.8	235.8			
Isopoda									
Isopoda Indet.									
Saduria entomon									
Decapoda									
Natantia megalops									

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	ST10			ST11			P1		
Sampling Date	16-Aug-09			16-Aug-09			15-Aug-10		
Replicate	1	2	3	1	2	3	1	2	3
Sampling Depth (m)	13	13	13	8	8	8	5.5	5.5	5.5
TAXA									
MOLLUSCA									
Gastropoda									
Alvania sp.				78.6					
Cylichna sp.					235.8	78.6	157.2	393.1	786.2
Gastropoda Indet.			157.2						
Bivalvia									
Astarte borealis	235.8	1,022.0	471.7	393.1	235.8	1,886.8	314.5		707.5
Axinopsida orbiculata		78.6	157.2						
Clinocardium ciliatum									
Cyrtodaria kurriana									
Hiatella arctica				157.2	157.2		550.3		78.6
Axinopsida orbiculata									
Lyonsia sp.	78.6								
Macoma balthica				235.8	235.8	550.3	314.5	78.6	235.8
Macoma calcarea	157.2	157.2	157.2	157.2	78.6	550.3			78.6
Macoma sp.	157.2								
Musculus niger							78.6		
Musculus sp.		78.6	393.1				235.8		
Mya truncata				78.6	235.8				
Portlandia arctica	2,279.9	1,415.1	3,852.2	393.1	1,100.6	157.2			
Rochefortia tumida									
Serripes groenlandicus		78.6		157.2		78.6			
Tellina sp.									
Thyasira sp.				78.6					
Yoldiella sp.	471.7	628.9	550.3						
ECHINODERMATA									
Holothuroidea									
Holothuroidea Indet.		78.6			78.6				
Asteroidea									
Asteroidea Indet.									
Ophiuroidea									
Ophiura sp.			78.6						
UROCHORDATA									
Ascidiacea									
Rhizomogula globularis							235.8		
OTHER:									
Teleostei eggs									
Teleostei larvae									
Unidentified invertebrate eggs									
Calanoid copepod									
Nematoda (counts <50/estimates >50)				78.6	157.2				
TOTAL	**20,204**	**7,233**	**12,972**	**5,975**	**9,434**	**14,780**	**6,211**	**22,642**	**17,925**

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	P2			P3			P4		
Sampling Date	15-Aug-10			15-Aug-10			15-Aug-10		
Replicate	1	2	3	1	2	3	1	2	3
Sampling Depth (m)	3	3	3	3.5	3.5	3.5	5	5	5
TAXA									
NEMERTEA									
Nemertea Indet.				78.6					
Anopla									
Anopla Indet.	235.8	393.1							
Cerebratulus sp.		393.1							
Heteronemertea Indet.									
Lineidae		78.6							
ANNELIDA									
Polychaeta Errantia									
Eteone longa					78.6	78.6			
Eteone sp.									
Eulalia nr. bilineata									
Harmothoe imbricata Cmplx.				78.6		78.6	78.6		
Hesionidae Indet.						78.6			
Lumbrineridae Indet.									
Lumbrineris sp.									
Naineris quadricuspida									
Nephtys ciliata		78.6							
Nephtys nr. neotena									
Nephtys sp.	550.3	314.5	235.8	1,022.0	471.7	864.8	7,861.6	16,509.4	5,896.2
Nereimyra sp.									
Pholoe sp.							78.6		
Pholoides asperus									
Phyllodoce groenlandica									
Polynoidae Indet.									
Sigalionidae Indet.									
Sthenelais sp.									
Polychaeta Sedentaria									
Amastigos acutus									
Ampharete sp.									
Aphelochaeta monilaris									
Aphelochaeta sp.									
Aricidea sp.							78.6		78.6
Axiothella sp.									
Brada villosa									
Capitella capitata Cmplx.									
Capitellidae Indet.									
Cirratulidae Indet.									
Cirratulus sp.									
Cossura sp.									
Euclymeninae Indet.									
Flabelligeridae Indet.									
Leitoscoloplos sp.						78.6	2,673.0	471.7	1,100.6
Levinsenia gracilis									
Malacoceros sp.									
Maldane sp.									
Marenzelleria arctia			78.6	78.6					
Mediomastus sp.		471.7		78.6		314.5	157.2		
Notomastus sp.									
Orbiniidae									

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	P2			P3			P4		
Sampling Date	15-Aug-10			15-Aug-10			15-Aug-10		
Replicate	1	2	3	1	2	3	1	2	3
Sampling Depth (m)	3	3	3	3.5	3.5	3.5	5	5	5
TAXA									
Paraonidae Indet.							157.2		
Pectinaria granulata				707.5	314.5	235.8	78.6		
Pectinaria sp.								78.6	
Polydora sp.									
Prionospio sp.							235.8	78.6	78.6
Sabellidae Indet.									
Scalibregma sp.									
Scolelepis sp.	78.6	314.5	157.2						
Spio sp.									
Spionidae Indet.									
Spiophanes sp.	157.2								
Terebellides stroemi						157.2			
Travisia forbesii									
Oligochaeta									
Enchytraeidae Indet.									
Oligochaeta Indet.									
ARTHROPODA									
Amphipoda									
Americhelidium sp.					78.6				
Boeckosimus affinis									
Corophium sp.									
Gammaracanthus loricatus									
Gammarus sp.									
Guernea nordenskioldi									
Haploops sp.									
Lagunogammarus setosus									
Lysianassidae Indet.									
Monoculodes sp.									
Monoculopsis sp.									
Oedicerotidae Indet.									
Pontoporeia femorata				235.8		78.6			
Protomedeia sp.									
Stenothoidae									
Copepoda									
Harpacticoida		78.6							
Ostracoda									
Ostracoda Indet.		78.6							
Cumacea									
Eudorella pacifica									
Diastylis rathkeii									
Diastylis sp.									
Leucon sp.									
Tanaidacea									
Tanaidacea Indet.									
Isopoda									
Isopoda Indet.									
Saduria entomon		78.6		78.6	235.8		157.2	78.6	
Decapoda									
Natantia megalops									

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	P2			P3			P4		
Sampling Date	15-Aug-10			15-Aug-10			15-Aug-10		
Replicate	1	2	3	1	2	3	1	2	3
Sampling Depth (m)	3	3	3	3.5	3.5	3.5	5	5	5
TAXA									
MOLLUSCA									
Gastropoda									
Alvania sp.									
Cylichna sp.						78.6	78.6		
Gastropoda Indet.									
Bivalvia									
Astarte borealis									235.8
Axinopsida orbiculata									
Clinocardium ciliatum									
Cyrtodaria kurriana									
Hiatella arctica									
Axinopsida orbiculata									
Lyonsia sp.									
Macoma balthica	1,022.0	7,783.0	1,257.9	2,437.1	14,072.3	2,044.0	314.5	550.3	78.6
Macoma calcarea									
Macoma sp.									
Musculus niger									
Musculus sp.									
Mya truncata									
Portlandia arctica							157.2		628.9
Rochefortia tumida				78.6					
Serripes groenlandicus									
Tellina sp.									
Thyasira sp.									
Yoldiella sp.									
ECHINODERMATA									
Holothuroidea									
Holothuroidea Indet.									
Asteroidea									
Asteroidea Indet.									
Ophiuroidea									
Ophiura sp.									
UROCHORDATA									
Ascidiacea									
Rhizomogula globularis									
OTHER:									
Teleostei eggs									
Teleostei larvae									
Unidentified invertebrate eggs	550.3	6,053.5							
Calanoid copepod									
Nematoda (counts <50/estimates >50)									
TOTAL	**2,044**	**10,063**	**1,730**	**4,874**	**15,252**	**4,088**	**12,107**	**17,767**	**8,097**

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	RBE					RBW				
Sampling Date	15-Aug-10					15-Aug-10				
Replicate	1	2	3	4	5	1	2	3	4	5
Sampling Depth (m)	4.7	4.7	4.7	4.7	4.7	3.9	3.9	3.9	3.9	3.9
TAXA										
NEMERTEA										
Nemertea Indet.										
Anopla										
Anopla Indet.										
Cerebratulus sp.										
Heteronemertea Indet.										
Lineidae										
ANNELIDA										
Polychaeta Errantia										
Eteone longa		235.8	78.6	78.6						
Eteone sp.										
Eulalia nr. bilineata										
Harmothoe imbricata Cmplx.										157.2
Hesionidae Indet.								78.6		
Lumbrineridae Indet.										
Lumbrineris sp.										
Naineris quadricuspida										
Nephtys ciliata										
Nephtys nr. neotena										
Nephtys sp.	78.6					16,745.3	19,968.6	29,795.6	22,012.6	30,031.4
Nereimyra sp.										
Pholoe sp.							235.8	78.6	78.6	78.6
Pholoides asperus						78.6		786.2	393.1	157.2
Phyllodoce groenlandica						78.6	157.2			78.6
Polynoidae Indet.										
Sigalionidae Indet.										
Sthenelais sp.										
Polychaeta Sedentaria										
Amastigos acutus										
Ampharete sp.										
Aphelochaeta monilaris										
Aphelochaeta sp.										
Aricidea sp.								157.2	157.2	78.6
Axiothella sp.						78.6				78.6
Brada villosa										
Capitella capitata Cmplx.										
Capitellidae Indet.										
Cirratulidae Indet.										
Cirratulus sp.										
Cossura sp.										
Euclymeninae Indet.										
Flabelligeridae Indet.										
Leitoscoloplos sp.						1,179.2	1,100.6	2,201.3	1,729.6	1,965.4
Levinsenia gracilis										
Malacoceros sp.										
Maldane sp.										
Marenzelleria arctia	550.3	393.1	1,179.2	1,257.9	471.7	78.6		78.6		
Mediomastus sp.						78.6	78.6	550.3	471.7	235.8
Notomastus sp.							235.8			
Orbiniidae										

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	RBE					RBW				
Sampling Date	15-Aug-10					15-Aug-10				
Replicate	1	2	3	4	5	1	2	3	4	5
Sampling Depth (m)	4.7	4.7	4.7	4.7	4.7	3.9	3.9	3.9	3.9	3.9
TAXA										
Paraonidae Indet.									78.6	
Pectinaria granulata						157.2	314.5	235.8	157.2	628.9
Pectinaria sp.						864.8	1,179.2	1,100.6	550.3	864.8
Polydora sp.										
Prionospio sp.								78.6		
Sabellidae Indet.										
Scalibregma sp.										
Scolelepis sp.										
Spio sp.						157.2		78.6		314.5
Spionidae Indet.										
Spiophanes sp.										
Terebellides stroemi										
Travisia forbesii										
Oligochaeta										
Enchytraeidae Indet.	78.6					157.2				
Oligochaeta Indet.										
ARTHROPODA										
Amphipoda										
Americhelidium sp.										
Boeckosimus affinis										
Corophium sp.										
Gammaracanthus loricatus							78.6			
Gammarus sp.										
Guernea nordenskioldi										
Haploops sp.										
Lagunogammarus setosus										
Lysianassidae Indet.							78.6			
Monoculodes sp.										
Monoculopsis sp.										
Oedicerotidae Indet.										
Pontoporeia femorata						78.6		78.6		
Protomedeia sp.										
Stenothoidae										
Copepoda										
Harpacticoida	157.2		78.6	157.2					78.6	
Ostracoda										
Ostracoda Indet.							78.6			
Cumacea										
Eudorella pacifica										
Diastylis rathkeii										
Diastylis sp.										
Leucon sp.										
Tanaidacea										
Tanaidacea Indet.										
Isopoda										
Isopoda Indet.										
Saduria entomon							157.2	471.7	157.2	314.5
Decapoda										
Natantia megalops							78.6	78.6		78.6

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-5. Roberts Bay Benthos Taxonomy (as Density), Doris North Project, 2009-2010

Sampling Site	RBE					RBW				
Sampling Date	15-Aug-10					15-Aug-10				
Replicate	1	2	3	4	5	1	2	3	4	5
Sampling Depth (m)	4.7	4.7	4.7	4.7	4.7	3.9	3.9	3.9	3.9	3.9
TAXA										
MOLLUSCA										
Gastropoda										
Alvania sp.										
Cylichna sp.						393.1	235.8	2,044.0	1,179.2	943.4
Gastropoda Indet.										
Bivalvia										
Astarte borealis						78.6			157.2	78.6
Axinopsida orbiculata										
Clinocardium ciliatum										
Cyrtodaria kurriana										
Hiatella arctica										
Axinopsida orbiculata										
Lyonsia sp.										
Macoma balthica						157.2	786.2	1,808.2	864.8	393.1
Macoma calcarea										
Macoma sp.										
Musculus niger								78.6		
Musculus sp.										
Mya truncata										
Portlandia arctica										
Rochefortia tumida										
Serripes groenlandicus										
Tellina sp.										
Thyasira sp.										
Yoldiella sp.										
ECHINODERMATA										
Holothuroidea										
Holothuroidea Indet.										
Asteroidea										
Asteroidea Indet.										
Ophiuroidea										
Ophiura sp.										
UROCHORDATA										
Ascidiacea										
Rhizomogula globularis										78.6
OTHER:										
Teleostei eggs										
Teleostei larvae										
Unidentified invertebrate eggs										
Calanoid copepod										
Nematoda (counts <50/estimates >50)	314.5	628.9	393.1	1,022.0	707.5	78.6			78.6	
TOTAL	**865**	**629**	**1,336**	**1,494**	**472**	**20,362**	**24,764**	**39,780**	**28,066**	**36,557**

Notes:

Units are organisms/m².

Teleostei eggs and larvae, unidentified invertebrate eggs, calanoid copepods, and nematodes were excluded from total density.

Appendix 4.3-6

Detailed Habitat Data for Southwestern Roberts Bay, Doris North Project, 2009

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Appendix 4.3-6. Detailed Habitat Data for Southwestern Roberts Bay, Doris North Project, 2009

Habitat Number	Habitat Unit Length (m)	UTMs				Area	Fines	Gravel	Cobble	Boulder	Bedrock	Fines	Gravel	Cobble	Boulder	Bedrock
		Start		End		(m^2)	(%)	(%)	(%)	(%)	(%)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)
1	16	432291	7563280	432278	7563287	80	0	10	20	20	50	0	8	16	16	40
2	35	432278	7563287	432244	7563292	188	5	15	60	15	0	9	28	113	28	0
3	37	432244	7563292	432215	7563307	197	5	10	70	15	0	10	20	138	30	0
4	17	432215	7563307	432206	7563321	72	0	5	60	35	0	0	4	43	25	0
5	35	432206	7563321	432198	7563352	197	0	70	27	3	0	0	138	53	6	0
6	59	432198	7563352	432183	7563404	238	0	5	75	5	15	0	12	179	12	36
7	10	432183	7563404	432175	7563410	34	0	20	40	40	0	0	7	13	13	0
8	31	432175	7563410	432158	7563434	100	0	5	30	50	15	0	5	30	50	15
9	5	432158	7563434	432156	7563439	12	0	0	0	0	100	0	0	0	0	12
10	69	432156	7563439	432097	7563467	230	0	2	65	25	3	0	5	149	57	7
11	22	432097	7563467	432075	7563471	80	0	0	20	75	5	0	0	16	60	4
12	8	432075	7563471	432068	7563473	43	0	25	40	30	5	0	11	17	13	2
13	28	432068	7563473	432043	7563462	145	40	10	40	10	0	58	14	58	14	0
14	26	432043	7563462	432030	7563441	72	20	10	30	40	0	14	7	22	29	0
15	19	432030	7563441	432020	7563424	31	30	20	30	15	0	9	6	9	5	0
16	22	432020	7563424	432000	7563418	20	70	30	0	0	0	14	6	0	0	0
17	52	432000	7563418	431949	7563423	43	50	50	0	0	0	22	22	0	0	0
18	48	431949	7563423	431907	7563447	121	50	35	15	0	0	60	42	18	0	0
19	111	431907	7563447	431927	7563549	418	20	5	70	5	0	84	21	293	21	0
20	36	431927	7563549	431938	7563583	232	30	10	60	0	0	70	23	139	0	0
21	-	-	-	-	-	49,570	100	0	0	0	0	49,570	0	0	0	0
					Total	**2,553**	-	-	-	-	-	**350**	**378**	**1,307**	**379**	**116**
					Total (%)		-	-	-	-	-	**14**	**15**	**51**	**15**	**5**

Note:

Habitat Unit 21 is the offshore habitat assessed at this location.

Total area does not include offshore habitat values.

Appendix 4.3-7

Detailed Habitat Data for Northwestern Roberts Bay, Doris North Project, 2009

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Appendix 4.3-7. Detailed Habitat Data for Northwestern Roberts Bay, Doris North Project, 2009

Habitat Number	Habitat Unit Length (m)	UTMs				Area	Fines	Gravel	Cobble	Boulder	Bedrock	Fines	Gravel	Cobble	Boulder	Bedrock
		Start		End												
						(m^2)	(%)	(%)	(%)	(%)	(%)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)
1	89	431263	7565254	431182	7565221	600	0	10	85	5	0	0	60	510	30	0
2	15	431182	7565221	431172	7565211	97	10	25	65	1	0	10	24	63	1	0
3	18	431172	7565211	431156	7565202	52	20	5	74	1	0	10	3	39	1	0
4	8	431156	7565202	431148	7565203	25	25	25	50	0	0	6	6	13	0	0
5	31	431148	7565203	431122	7565216	116	60	40	0	0	0	70	47	0	0	0
6	6	431122	7565216	431117	7565218	14	85	15	0	0	0	12	2	0	0	0
7	66	431117	7565218	431080	7565265	209	35	15	45	5	0	73	31	94	10	0
8	8	431080	7565265	431076	7565272	19	85	0	10	5	0	16	0	2	1	0
9	32	431076	7565272	431073	7565303	85	0	2	0	2	95	0	2	0	2	81
10	53	431073	7565303	431068	7565354	186	30	25	40	5	0	56	47	74	9	0
11	7	431068	7565354	431067	7565361	18	20	35	40	5	0	4	6	7	1	0
12	119	431067	7565361	431111	7565466	478	20	35	40	5	0	96	167	191	24	0
13	45	431111	7565466	431136	7565504	226	30	25	35	10	0	68	57	79	23	0
14	23	431136	7565504	431154	7565517	78	35	40	25	1	0	27	31	19	1	0
15	46	431154	7565517	431195	7565499	160	35	20	35	0	10	56	32	56	0	16
16	421	431195	7565499	431327	7565836	1,812	0	0	0	0	100	0	0	0	0	1,812
17	-	-	-	-	-	23,695	100	0	0	0	0	23,695	0	0	0	0
					Total	**4,176**	-	-	-	-	-	**504**	**515**	**1,147**	**102**	**1,909**
					Total (%)		-	-	-	-	-	**12**	**12**	**27**	**2**	**46**

Note:

Habitat Unit 17 is the offshore habitat assessed at this location.

Total area does not include offshore habitat values.

Appendix 4.3-8

Detailed Habitat Data for Various Sites in Roberts Bay, Doris North Project, 2010

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Appendix 4.3-8(a). Detailed Habitat Data for Southwestern Roberts Bay, Doris North Project, 2010

Habitat Number	Habitat Unit Length (m)	UTMs Start (from S)		UTMs End (from N)		Area (m^2)	Organics (%)	Fines (%)	Gravel (%)	Cobble (%)	Boulder (%)	Bedrock (%)	Fines (m^2)	Gravel (m^2)	Cobble (m^2)	Boulder (m^2)	Bedrock (m^2)
1	435	431577	7564182	431618	7564300	10,467	0	70	10	10	5	5	7,327	1,047	1,047	523	523
2	198	431618	7564300	431630	7564345	1,550	0	65	10	10	10	5	1,007	155	155	155	77
					Total Area	**12,016**	-	-	-	-	-	-	**8,334**	**1,202**	**1,202**	**678**	**601**
					Total %	-	-	-	-	-	-	-	**69**	**10**	**10**	**6**	**5**

Appendix 4.3-8(b). Detailed Habitat Data for Western Roberts Bay, Doris North Project, 2010

Habitat Number	Habitat Unit Length (m)	UTMs Start (from S)		UTMs End (from N)		Area (m^2)	Organics (%)	Fines (%)	Gravel (%)	Cobble (%)	Boulder (%)	Bedrock (%)	Fines (m^2)	Gravel (m^2)	Cobble (m^2)	Boulder (m^2)	Bedrock (m^2)
1	17	431652	7564332	431627	7564349	792	0	8	33	54	6	0	59	257	428	48	0
2	37	431627	7564349	431612	7564380	1,848	2	13	28	55	4	0	231	508	1,016	65	0
3	16	431612	7564380	431616	7564381	108	0	85	8	5	3	0	92	8	5	3	0
4	10	431616	7564381	431628	7564388	400	0	30	60	10	1	0	120	238	40	2	0
5	13	431628	7564388	431641	7564399	580	0	15	80	5	0	0	87	464	29	0	0
6	69	431641	7564399	431607	7564485	2,574	5	20	45	20	10	0	515	1,158	515	257	0
7	78	431607	7564485	431528	7564543	2,839	0	18	30	33	20	0	497	852	923	568	0
8	4	431528	7564543	431581	7564543	288	0	1	2	2	95	0	3	6	6	273	0
9	20	431581	7564543	431567	7564558	1,113	0	8	80	10	3	0	83	890	111	28	0
10	25	431567	7564558	431559	7564581	1,228	0	28	68	5	0	0	338	829	61	0	0
11	106	431559	7564581	431591	7564680	2,652	0	5	53	28	15	0	133	1,392	729	398	0
12	25	431591	7564680	431592	7564699	503	0	15	33	48	5	0	75	164	239	25	0
					Total Area	**14,925**	-	-	-	-	-	-	**2,233**	**6,767**	**4,102**	**1,666**	**0**
					Total %	-	-	-	-	-	-	-	**15**	**45**	**27**	**11**	**0**

Appendix 4.3-8(c). Detailed Habitat Data for Northwestern Roberts Bay, Doris North Project, 2010

Habitat Number	Habitat Unit Length (m)	UTMs Start (from S)		UTMs End (from N)		Area (m^2)	Organics (%)	Fines (%)	Gravel (%)	Cobble (%)	Boulder (%)	Bedrock (%)	Fines (m^2)	Gravel (m^2)	Cobble (m^2)	Boulder (m^2)	Bedrock (m^2)
1	25	431225	7565500	431195	7565507	189	0	20	10	20	50	0	38	19	38	95	0
2	14	431195	7565507	431175	7565516	90	0	60	5	30	5	0	54	4	27	4	0
3	11	431175	7565516	431163	7565519	31	0	40	10	50	0	0	12	3	16	0	0
4	37	431163	7565519	431158	7565520	214	0	70	10	15	5	0	150	21	32	11	0
5	30	431158	7565520	431136	7565515	104	0	0	10	20	70	0	0	10	21	73	0
6	55	431136	7565515	431130	7565506	545	0	20	5	70	5	0	109	27	382	27	0
7	24	431130	7565506	431092	7565452	348	0	10	5	80	5	0	35	17	278	17	0
8	31	431092	7565452	431076	7565421	604	0	5	20	70	5	0	30	121	423	30	0
9	37	431076	7565421	431060	7565366	506	0	10	10	60	20	0	51	51	304	101	0
10	24	431060	7565366	431068	7565316	217	10	25	5	50	10	0	54	11	109	22	0
11	14	431068	7565316	431067	7565302	102	15	70	5	5	5	0	72	5	5	5	0
12	21	431067	7565302	431068	7565292	264	0	0	5	80	15	0	0	13	211	40	0
13	13	431068	7565292	431076	7565260	217	0	70	20	5	5	0	152	43	11	11	0
14	8	431076	7565260	431093	7565242	176	80	10	0	10	0	0	18	0	18	0	0
15	25	431093	7565242	431097	7565225	264	5	70	10	10	5	0	184	26	26	13	0
16	9	431097	7565225	431112	7565212	551	70	15	5	5	5	0	83	28	28	28	0
17	69	431112	7565212	431126	7565193	532	0	90	5	0	5	0	479	27	0	27	0
18	33	431126	7565193	431168	7565196	1,200	60	15	5	20	0	0	180	60	240	0	0
19	93	431168	7565196	431228	7565234	2,180	0	0	10	20	70	0	0	218	436	1,526	0
20	-	431152	7565206	431154	7565514	22,729	0	100	0	0	0	0	22,729	0	0	0	0
					Total Area	**31,065**	-	-	-	-	-	-	**24,430**	**706**	**2,604**	**2,029**	**0**
					Total %	-	-	-	-	-	-	-	**79**	**2**	**8**	**7**	**0**

Note: Habitat Unit 20 is the offhshore habitat assessed at this location.

Appendix 4.3-8(d). Detailed Habitat Data for Northern Roberts Bay, Doris North Project, 2010

Habitat Number	Habitat Unit Length (m)	UTMs Start (from S)		UTMs End (from N)		Area (m^2)	Organics (%)	Fines (%)	Gravel (%)	Cobble (%)	Boulder (%)	Bedrock (%)	Fines (m^2)	Gravel (m^2)	Cobble (m^2)	Boulder (m^2)	Bedrock (m^2)
1	895	431290	7565475	431354	7565827	5,956	0	0	0	0	5	95	0	0	0	298	5,658
					Total Area	**5,956**	**-**	-	-	-	-	-	**0**	**0**	**0**	**298**	**5,658**
					Total %	-	-	-	-	-	-	-	**0**	**0**	**0**	**5**	**95**

Appendix 5.2-1

Roberts Bay Water Quality Modelling Results

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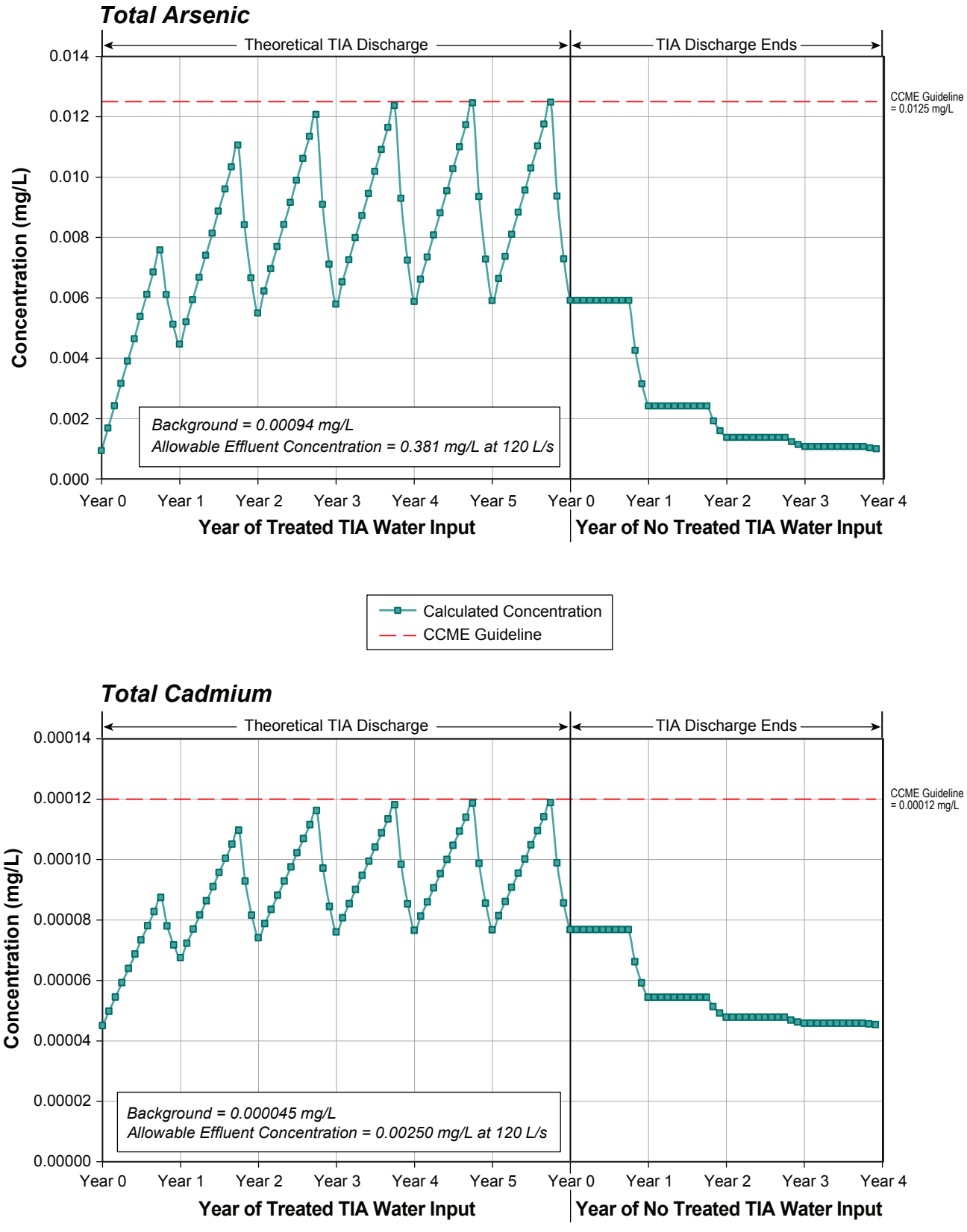

Note: Allowable Effluent Concentrations are based on continuous 120 L/s TIA discharge rate.

NEWMONT NORTH AMERICA

Time Evolution of Total Arsenic and Total Cadmium Concentrations in Roberts Bay

Figure 5.2-1a

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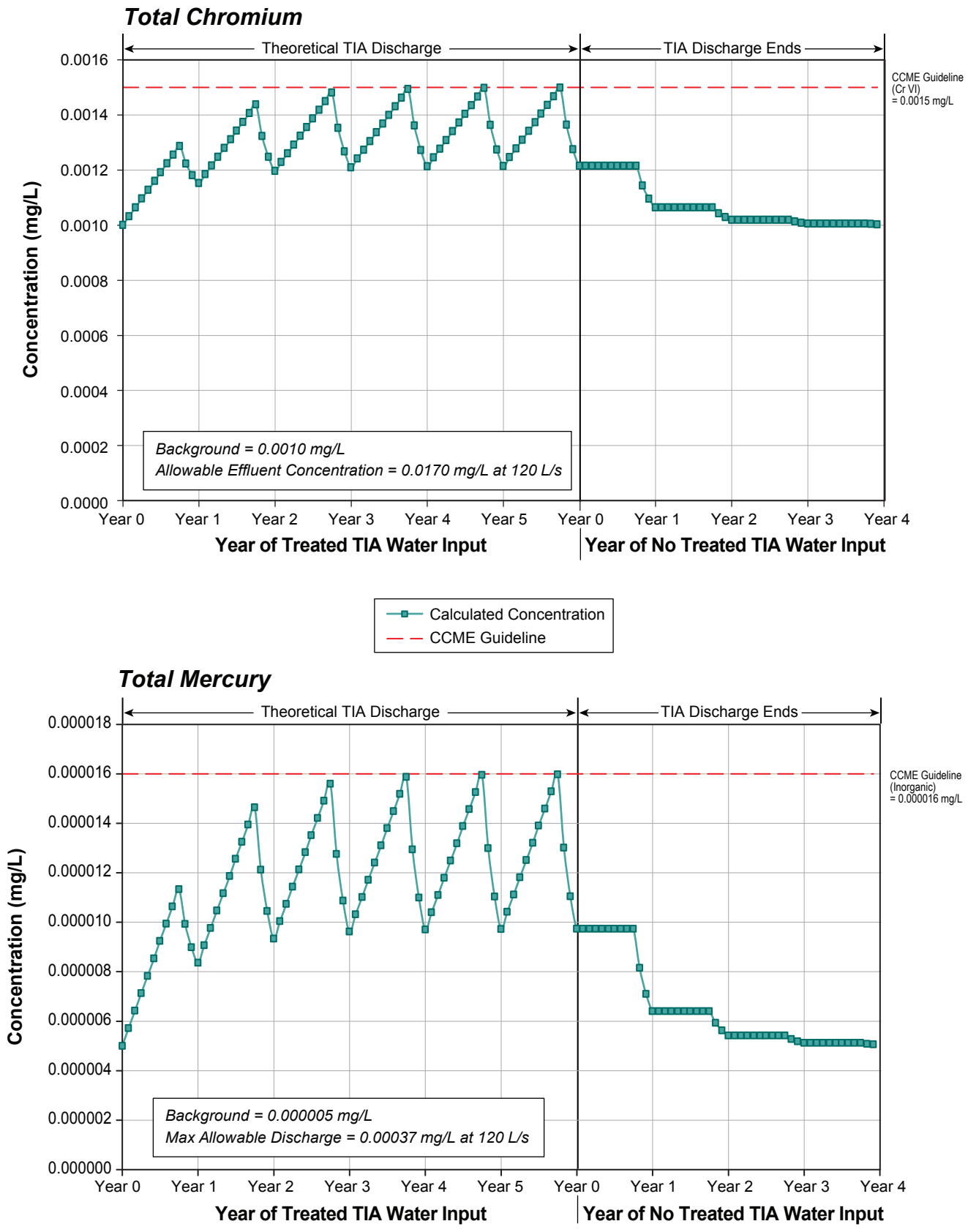

Note: Allowable Effluent Concentrations are based on continuous 120 L/s TIA discharge rate.

NEWMONT NORTH AMERICA

Time Evolution of Total Chromium and Total Mercury Concentrations in Roberts Bay

Figure 5.2-1b

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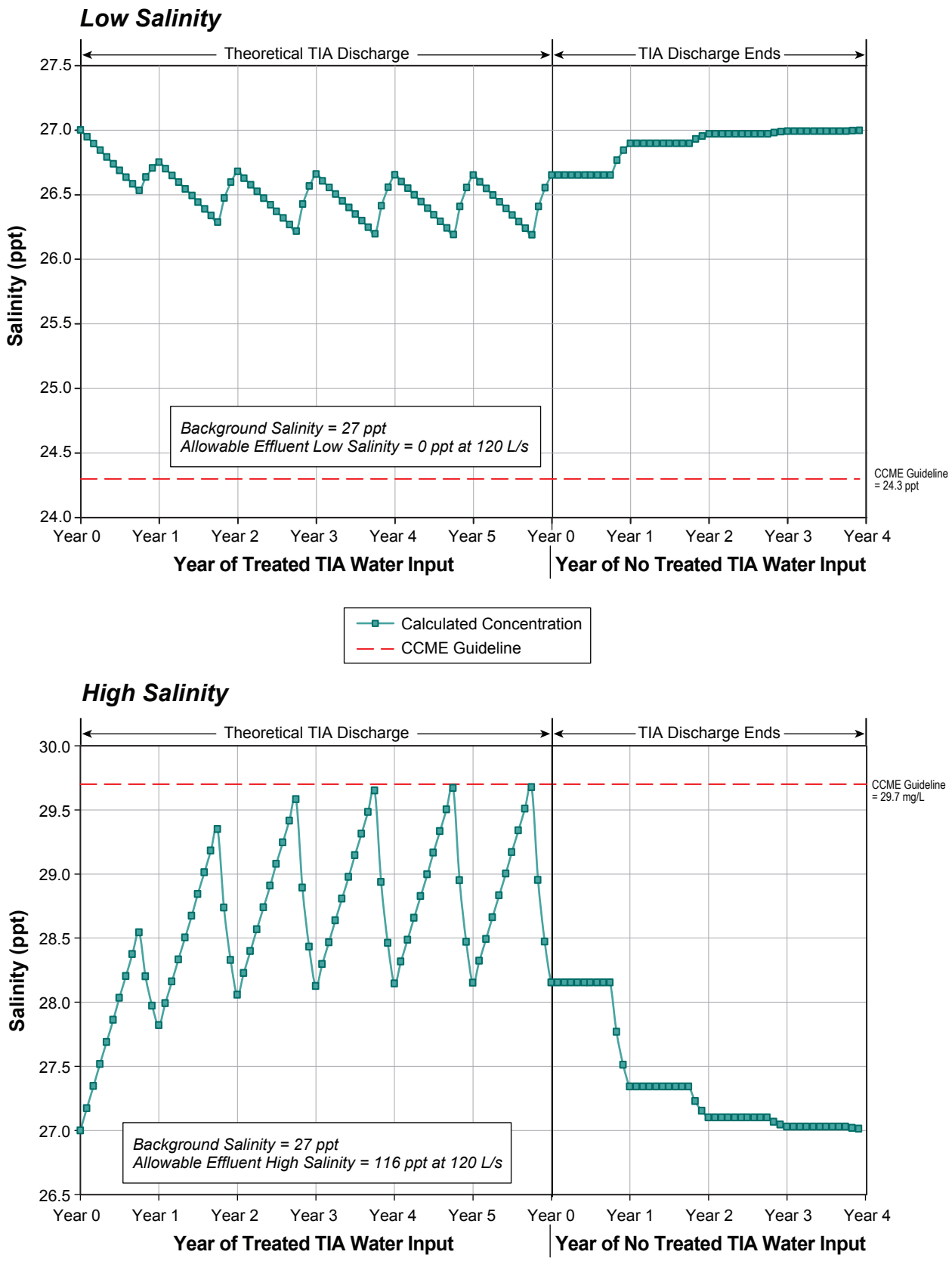

Notes: Allowable Effluent Concentrations are based on continuous 120 L/s TIA discharge rate. Low and high salinities correspond to 10% below (24.3 ppt) and above (29.7 ppt) the background deep water salinity in Roberts Bay (27 ppt).

NEWMONT NORTH AMERICA

Time Evolution of Low and High Salinity Concentrations in Roberts Bay

Figure 5.2-1c

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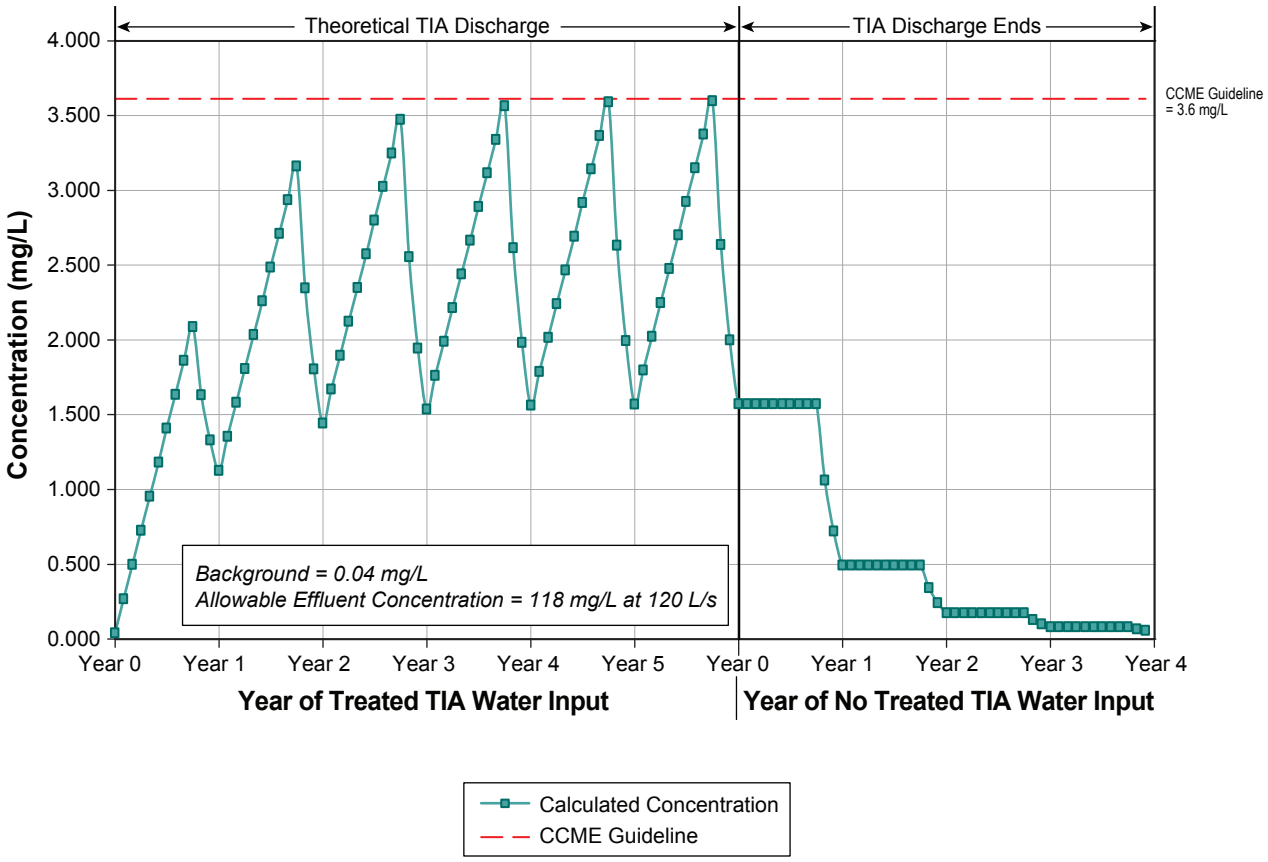

Note: Allowable Effluent Concentrations are based on continuous 120 L/s TIA discharge rate.

NEWMONT NORTH AMERICA

Time Evolution of Nitrate Concentrations in Roberts Bay

Figure 5.2-1d

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