Appendix 6 McLoughlin Point Outfall – Siting Study

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CAPITAL REGIONAL DISTRICT

McLoughlin Point Outfall

Siting Study

307071-00623 – 0001

30 January 2013

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SYNOPSIS

WorleyParsons was retained to develop a conceptual alignment for the marine outfall associated with the proposed wastewater treatment plant at McLoughlin Point as part of the Core Area Wastewater Treatment Project. This alignment study identified three suitable alignment options to accommodate a variety of outfall design and installation methods, namely both surface lay and sub-surface installation techniques.

A number of regulatory approvals will be required specifically relating to the siting and construction of the marine outfall. The marine outfall will be constructed through the Victoria Harbour Migratory Bird Sanctuary. The approvals likely required relate to the following legislation: *Canadian Environmental Assessment Act 2012; Fisheries Act; BC Lands Act; Navigable Waters Protection Act; and Canadian Environmental Protection Act*.

The marine outfall will be constructed in an area with valued marine resources, including some that are designated at risk or endangered. Key marine resources include: subtidal clam beds, killer whales (and associated critical habitat), northern abalone, and Olympia oysters. A variety of other marine species will also require consideration to minimize potential impacts, and construction activities may be restricted to times of year that pose lower risk to marine species.

Three proposed outfall alignments were considered to accommodate both surface and subsurface installation techniques. A modified version of alignment Option 3 is the recommended option with the design concept of a HDD or tunneled outfall (and associated emergency overflow) section from land to approximately 15 m depth transitioning to a surface lay to 60 m depth.

PROJECT 307071-00623 - MCLOUGHLIN POINT OUTFALL

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
A	Issued for review	J.Clarke	I.Van Bastelaere		30-Oct-12		
B	Issued for review	J. Clarke	I. Van Bastelaere		28-Jan-13		
0	Issued for final	J. Clarke	I. Van Bastelaere		30-Jan-13		

To advance the marine outfall design work to a suitable level for handover to a design/build contractor, the following tasks are recommended to be completed:

- The nearshore seabed sediments should be sampled and screened for potential contaminants. The target areas would be those likely to be trenched/dredged for burial and protection of the outfall. Dredged sediments may also require disposal which will need to be screened for contaminants prior to determining appropriate handling and disposal options.
- The design of the outfall (and possibly some options of material and installation method) should be advanced to a suitable level for generating a +/- 25% capital cost estimate
- Sub-surface geotechnical investigations should be conducted that are appropriate for the route alignment and construction methods that continue to be considered. For a surface laid outfall method (float and sink with trenching) the nearshore shallow sub-surface conditions will be important for determining feasibility of trench depths. If subsurface installation methods (HDD or tunnelling) continue to be pursued, then deeper geotechnical information will be required along the full length of the drilled or tunnelled alignment.

Disclaimer

The information presented in this document was compiled and interpreted exclusively for the purposes stated in Section1 of the document. WorleyParsons provided this report for Capital Regional District for the purpose noted above.

WorleyParsons has exercised reasonable skill, care, and diligence to assess the information acquired during the preparation of this report, but makes no guarantees or warranties as to the accuracy or completeness of this information. The information contained in this report is based upon, and limited by, the circumstances and conditions acknowledged herein, and upon information available at the time of its preparation. The information provided by others is believed to be accurate but cannot be guaranteed.

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Any questions concerning the information or its interpretation should be directed to J.Clarke or I.Van Bastelaere.

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1. INTRODUCTION

WorleyParsons was retained to develop a conceptual alignment for the marine outfall associated with the proposed wastewater treatment plant at McLoughlin Point (Figure 1) as part of the Core Area Wastewater Treatment Project (CAWTP).

The scope of work included the collection of water depth, seabed and marine resource information to develop conceptual alignment options. Capital cost estimates for the alignment options were not part of the scope of work, as the development of these costs would require the design of the outfall to be advanced beyond route selection.

2. MCLOUGHLIN POINT MARINE OUTFALL

2.1 Concept Description

Outfall alignment options were developed based on the following assumed design concepts.

The discharge of effluent through the outfall should be by gravity. The treatment plant elevation will be near sea level, which will provide limited elevation available to accommodate head losses associated with discharging effluent. Allowances should also accommodate the potential for sea level rise associated with climate change and storm surge. Previous work that developed a conceptual design for the outfall diffuser estimated the diameter requirement for the outfall to be a minimum of 1,800 mm diameter (Van Bastelaere 2010).

The marine outfall will originate along the south eastern shoreline of the proposed treatment plant site. The conceptual layout of the treatment plant is given in Figure 2, which shows the final stage of effluent treatment located at the south east corner of the facility. It is therefore logical that the landfall of the outfall and the connection to the treatment facility should be near the south east corner of the facility.

A terminus location near the existing Macaulay Point Outfall terminus was selected prior to this study based on an effluent plume modelling assessment (Hodgins & Tinis 2011). The benefit of a co-located diffuser is that historic seabed monitoring data at the Macaulay Point outfall can be utilized for future receiving environment monitoring that will be required for the McLoughlin Point outfall. Also, it is logical that the potentially compromised seabed area around the Macaulay Point outfall terminus be utilized again for the McLoughlin Point outfall.

Effluent will be discharged from the proposed outfall via a 33 port, 200 m long diffuser. The conceptual design for the diffuser included 33 ports with a diameter of 200 mm with an average spacing of 6.15 m (Van Bastelaere 2010). The diffuser configuration was developed to provide a combination of adequate dilution characteristics and the hydraulic requirement of full flow by gravity at higher high water large tide with an assumed allowance for 1 m for potential sea level rise and 1 m storm surge.

The proposed outfall design should avoid reverse grade high points with the potential to trap air in the outfall pipeline. Significant air entrapment could result in "air locks" within the pipeline that would reduce the hydraulic capacity of the outfall.

The outfall should be suitably weighted and protected from potential hazards such as storm waves, anchor strikes and commercial fishing gear. An emergency outfall will likely be required so the alignment should accommodate at least 2 pipelines.

2.2 Alignment Options

Three outfall alignment options were identified for the proposed McLoughlin Point outfall (Figure 2). All three potential routes have a similar offshore alignment, but differ in the nearshore alignment and approach to the shoreline. Options 1 and 2 assume the outfall will make landfall at either of two existing retaining walls at the south east corner of the proposed treatment site (Figure 3). These two options are suitable for an outfall that is constructed using surface installation techniques. Option 3 is a straight alignment with the shortest distance to the outfall terminus, and is suitable for sub-surface installation techniques (horizontal directional drill or tunnelling).

2.3 Option 1

The proposed alignment plan and profile for Option 1 is shown in Figure 4. The outfall would make landfall on the east side of an existing retaining wall (Photo A, Figure 3). This alignment is the least direct route to the proposed terminus however it would likely result in limited disruption in the intertidal zone due to a short distance to deeper water.

Photo A Option 1 – Proposed Shoreline Crossing

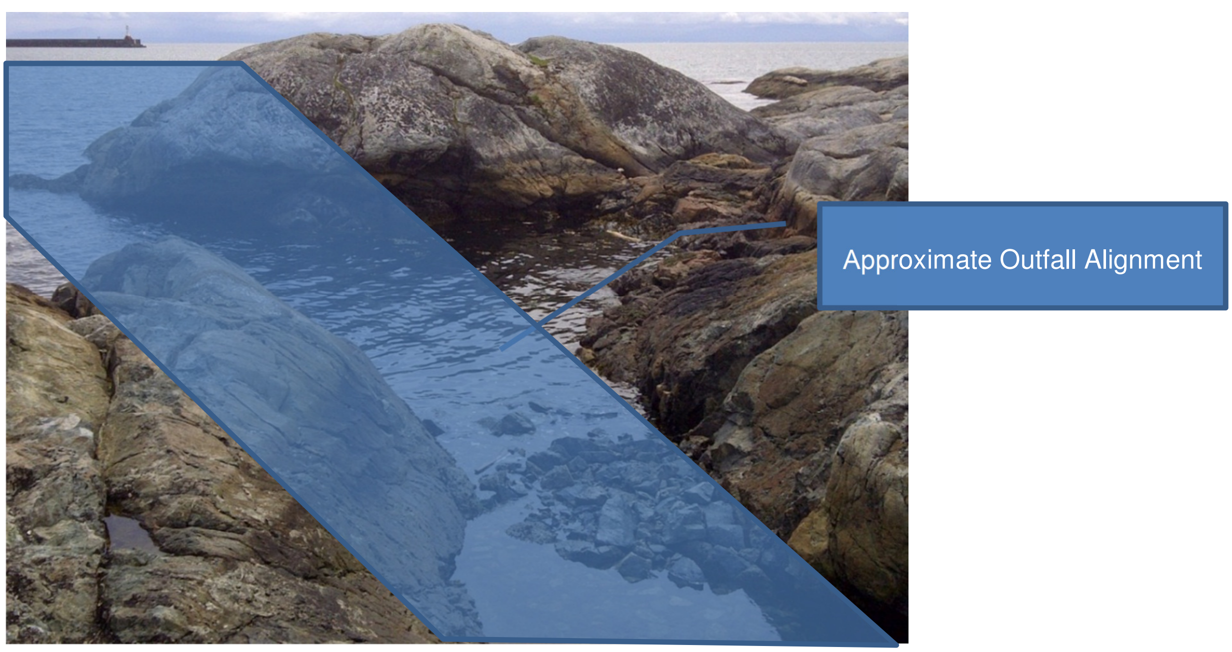
2.4 Option 2

The proposed alignment plan and profile for Option 2 is shown in Figure 5. The outfall would make landfall on the south side of the existing retaining wall (Photo B, Figure 3). This alignment provides a slightly more direct route to the proposed terminus than Option 1, while taking advantage of exiting shoreline features to minimize rock excavation.

Photo B Option 2 – Upper Intertidal Zone

The intertidal zone and shallow subtidal zone along this alignment consists of bedrock outcrops and would require some trenching through rock as shown in Photo C.

Photo C Option 2 – Intertidal Zone Looking Offshore



2.5 Option 3

Option 3 would be suitable for sub-surface drilling or tunnelling the outfall below the intertidal zone and shallow subtidal zone out to deeper water. The proposed alignment plan and profile for this option is shown on Figure 6. The construction feasibility of such an option would need to be investigated and would involve the collection and assessment of geotechnical conditions along the alignment.

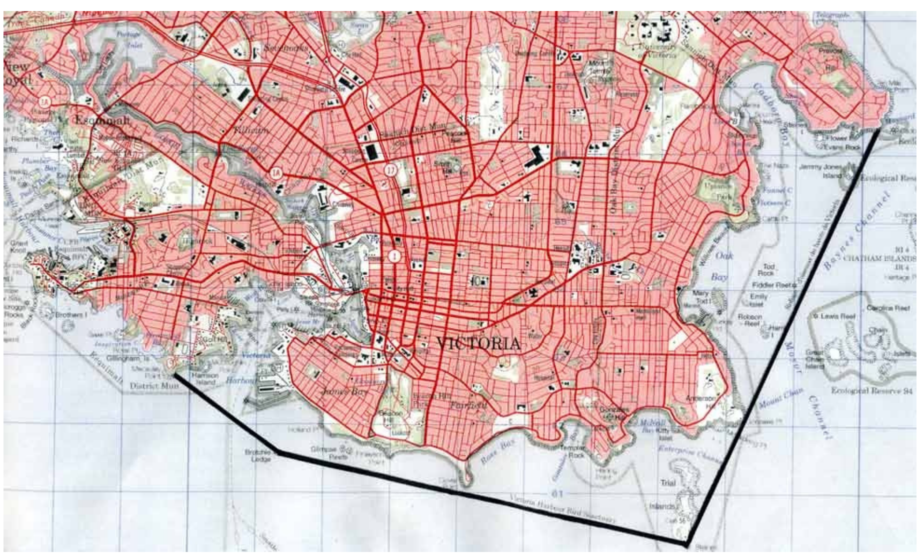
3. REGULATORY CONSIDERATIONS

A number of regulatory approvals will be required for the construction of the marine outfall (Appendix 1). The approvals summarized here are not intended to be comprehensive for the entire CAWTP and also do not cover the approvals for operating the discharge. Likely construction related approvals fall under the following legislation:

- *Canadian Environmental Assessment Act 2012*
- *Fisheries Act*
- *BC Lands Act*
- *Navigable Waters Protection Act*
- *Canadian Environmental Protection Act*

The outfall will pass through the Victoria Harbour Migratory Bird Sanctuary (Figure A). For mitigating potential regulatory risks, CRD indicated a preference to avoid construction in the intertidal zone.

Figure A Migratory Bird Sanctuary



Source: Ringuette, 2009

4. SITE CHARACTERISTICS

Victoria Harbour is located on the southern tip of Vancouver Island and opens onto Juan de Fuca Strait. The proposed outfall site extends from McLoughlin Point, located at the western edge of Victoria Harbour entrance, for approximately 2 km south into Juan de Fuca Strait to a water depth of approximately 63 m (relative to chart datum).

Victoria Harbour is composed of the outer harbour, inner harbour and upper harbour and is connected to the Selkirk Waterway, Gorge Waterway and Portage Inlet (City of Victoria 2001; TC 2008; Figure 1). Victoria Harbour is heavily used by marine vessel and aircraft traffic.

The maximum water depth in the outer harbour from Ogden Point breakwater to Shoal Point is approximately 18 m. The depth at the Coast Guard Base and Fisherman's Wharf ranges from 9 to 18 m (City of Victoria 2001).

4.1 Area Uses

4.1.1 Former Facility Infrastructure

The proposed site of the Treatment Plant is located on a decommissioned Imperial Oil Resources tank farm. The marine berth facility (Photo D) and upland infrastructure have been removed.

Photo D Imperial Oil facility (2003)

Source: Google Earth 2003

4.1.2 DND

The Department of National Defence (DND) operates from nearby Esquimalt Harbour and has a long history of using the seabed areas between Race Rocks and Victoria Harbour. They were contacted to determine if any military infrastructure or impediments to construction exist along the proposed route, such as cables or unexploded ordinances. The Department of National Defence was also questioned regarding their interest in the seabed area along the proposed alignment. As of December 31, 2012 no official response was provided.

4.1.3 Harbour Authority

The Greater Victoria Harbour Authority operates four port facilities (Figure B). The facilities do not directly conflict with the proposed outfall alignment. The remainder of Victoria Harbour is under the jurisdiction of Transport Canada (Greater Victoria Harbour Authority 2009).

Figure B Harbour Authority

Source: Greater Vicotria Harbour Authority, 2009

4.1.4 Land Tenures

The BC Land Title & Survey Authority of British Columbia (2012), online cadastre was accessed to confirm the location of exiting land tenures in the vicinity of the proposed outfall. There are no surveyed land parcels or land tenures that would conflict with the proposed outfall.

4.1.5 Marine Traffic

Victoria Harbour is used by numerous commercial, public and recreational users. Commercial vessel traffic includes ferry service (Coho Ferry, and Victoria Clipper), cruise ships, commercial whale watch and eco-tour vessels, commercial fishing vessels, and tug and barge traffic. The Canadian Coast Guard has a facility at Shoal Point for large vessels. The harbour has a number of paddling clubs, marinas, commercial terminals, residential docks and public boat launches.

In addition to marine vessel traffic, both seaplanes and helicopters regularly fly to/from the harbour. There are seaplane takeoff and landing zones approximately 100 m east of McLoughlin Point as shown in Figure 3 (CHS, 2005).

The alignment of the outfall and marine construction activities will need to be planned and coordinated in respect of marine and air traffic safety and navigation.

4.1.6 Recreational Use

The Victoria Harbour area and Juan de Fuca Strait are high use areas for recreational activities such as boating, fishing, whale watching, kayaking, paddling, diving and wind/kite surfing (Golder 2002).

4.2 Fisheries Resources

The presence of fisheries and biological resources is an important consideration for outfall construction. The proposed outfall is located in a marine area identified as being ecologically and biologically significant (EBSA) (DFO 2012a). These areas warrant enhanced management and were created to complement those for the Pacific North Coast Integrated Management Area (PNCIMA) (DFO 2012). Some resources of importance that occur in the vicinity of the proposed outfall include:

- Herring
- Salmon
- Crab
- Shellfish (eg. Subtidal clams, Northern abalone, Olympia oysters)
- Marine mammals (eg. Killer whales and associated critical habitat, Appendix 2)

Within this listing are species that are designated threatened or endangered (Appendix 2) and would require consideration during outfall design and construction.

4.3 Bathymetry

High resolution bathymetry (seabed depths) was obtained for the project location from the Canadian Hydrographic Service (2012). Seabed depths were provided at 5 m resolution; 1 m depth contours were plotted and are shown on Figure 2.

Significant features of the bathymetry along the proposed outfall alignment include:

- exposed rock extends up to 75 m from the high water line, and to depths up to 10 m along the shoreline of McLoughlin Point;

- below a depth of 10 m the average slope of the seabed is 2.5% with a maximum slope along the proposed alignment of 10%, between a depth of 52 m and 58 m.
- at a depth of 60 m the seabed flattens out.
- south (offshore) beyond the proposed outfall terminus, along the same alignment, depths begin to shallow;
- depths deepen east of the proposed terminus.

4.4 Seabed Surface Conditions

A visual survey of the outfall corridor was conducted using a remotely operated vehicle (ROV) on July 10, 2012. Appendix 4 provides a description of the ROV survey methods and observations.

During the survey, sector scanning sonar was also used to detect potential structural features within 10 m to 20 m to either side of the ROV. The seabed generally consisted of fine (sand/mud) substrates and shell for the majority of the route between 10 m and 60 m depth. Occasional boulders were seen across about a 1 km section from 57 m to 22 m depth. Most boulders were 0.5 m or less in diameter with the largest observed to be approximately 1.5 m in diameter, within a size that could be moved if needed.

From a water depth of about 10 m to the shoreline there is cobble, pebble and exposed irregular bedrock.

4.5 Seabed Sub-Surface Conditions

An underwater geophysical survey at the entrance to Victoria Harbour was conducted by Frontier Geosciences (2010). The survey was conducted to determine "ocean bottom contours, thickness of overturned materials and the depth of and configuration of the bedrock surface" for the planning of proposed pipeline crossings.

The sub-bottom survey included the area fronting McLoughlin Point where the proposed outfall would be trenched or drilled through the shallow subtidal zone. The measured bathymetry, bedrock depth and sediment thickness in the survey area are included in Appendix 3. The interpreted sediment thickness (distance between the seabed and bedrock) is a minimum along the shoreline with a thickness less than 5 m extending out 100 m from the shoreline. If trenching is required through the intertidal or shallow subtidal zones, bedrock is likely to be encountered.

5. PIPE MATERIAL

The most common and likely pipeline materials for consideration are high density polyethylene (HDPE) and steel, although other pipe materials can also be used for outfalls. HDPE pipe ballasted with concrete will likely be the preferred pipeline materials. HDPE is robust, flexible for conforming to seabed contours, easily handled and well suited to marine outfall construction. HDPE pipe produced by North American manufactures is limited to 1,600 mm diameter. HDPE pipe up to 2,000 mm diameter can be produced outside North America (eg. Norway) which could require longer order lead times and higher delivery costs. If hydraulic criteria dictate the need for an outfall larger than 1,600 mm, then design consideration could be given to twin pipelines, or the use of steel.

Steel pipe up to, and larger than 2,000 mm diameter is available in North America. Protective coatings and cathodic protection systems are important elements of steel outfall systems.

6. LESSONS FROM MACAULAY POINT OUTFALL

It is useful to briefly review the design and construction of the Macaulay Point outfall as it has successfully been in operation for over four decades. Commentary of the design and construction of the Macaulay Point outfall is provided in Appendix 5.

Design features of the Macaulay Point outfall included:

- pigging chamber at shoreline terminus;
- emergency overflow;
- inspection man way (man hole);
- pig removal hatch;
- protection in the intertidal / shallow subtidal zone;

Similar design features should be considered for the McLoughlin Point outfall.

7. EVALUATION OF OUTFALL ALIGNMENT OPTIONS

Appendix 6 provides a comparison of the three proposed outfall alignment options. Different construction methodologies are suited to the different alignments.

Generally, there is more capital cost and schedule risk associated with subsurface construction methods. If regulatory risks were not an issue, then Option 1 or Option 2 would be suitable for a surface based design for the full outfall length. However, potential regulatory risks exist that could have negative impacts on the project cost and schedule. The CRD has indicated a preference to avoid construction through the more ecologically sensitive shallow nearshore zone. For this reason, Option 3 is recommended with the implementation of sub-surface construction techniques. Sub-surface techniques, such as HDD or tunneling could be limited to a short section beneath the intertidal zone and shallow subtidal zone to approximately 15 m depth, rather than continuing subsurface for the full outfall length. The offshore portion of the outfall beyond approximately 15 m depth could be installed with surface lay methods which should be more cost effective than subsurface installation. Since a small portion of the alignment shown in Figure 6 potentially trespasses DND property at the shoreline, the alignment for Option 3 was modified. Figure 7 presents the recommended modified Option 3 outfall alignment plan and profile with the combination of both sub-surface and surface lay construction methods. This modified alignment also provides a more accessible work area behind, and in-line with the drill entry point.

8. CONCLUSIONS

This alignment study identified suitable alignment options to accommodate a variety of outfall design and installation methods.

A number of regulatory approvals will be required for the construction of the marine outfall that relate to legislation such as:

- Canadian Environmental Assessment Act 2012
- Fisheries Act
- BC Lands Act
- Navigable Waters Protection Act
- Canadian Environmental Protection Act

The marine outfall will be constructed in an area with valued marine resources, including some that are designated at risk or endangered. Key marine resources within the area of the marine outfall that will likely require prescriptive mitigation measures incorporated into regulatory approvals are:

- Shellfish (Subtidal clams, Northern abalone, Olympia oysters)
- Killer whales (and associated critical habitat)
- Salmon and herring

A variety of other marine species will also require consideration to minimize potential impacts. Construction activities may need to be restricted to times of year that pose lower risk to marine species.

No conflicting seabed tenures were found to exist within the outfall corridor. The marine waters at the outfall location are utilized by a variety of users such as commercial fishing, recreational activities, marine vessel traffic and aviation traffic. Construction activities will likely have to be planned to accommodate these activities and may result in schedule restrictions.

Alignment Option 3 (modified) is the recommended option with the design concept of a HDD or tunneled outfall (and associated emergency overflow) section from land to approximately 15 m depth transitioning to a surface lay to 60 m depth. This option will mitigate regulatory approval risks associated with environmental sensitivities in the shallow nearshore zone.

9. RECOMMENDATIONS

To advance the marine outfall design work to a suitable level for handover to a design/build contractor, the following tasks are recommended to be completed:

- The nearshore seabed sediments should be sampled and screened for potential contaminants. The target areas would be those likely to be trenched/dredged for burial and protection of the outfall.

Dredged sediments may also require disposal which will need to be screened for contaminants prior to determining appropriate handling and disposal options.

- The design option(s) for the outfall should be advanced to a suitable level for generating a +/- 25% capital cost estimate
- Sub-surface geotechnical investigations should be conducted along the outfall alignment where trenching, drilling or tunneling will be carried out. Deeper geotechnical information will be required along proposed drilled or tunnelled outfall sections.

10. CLOSURE

We trust that this report satisfies your current requirements and provides suitable documentation for your records. If you have any questions or require further details, please contact the undersigned at any time.

Report Prepared by:

Original signed and sealed on file February 4, 2013.

Jason Clarke E.I.T.
Manager Aquatic and Marine Science

Senior Review by:

Original signed and sealed on file February 4, 2013.

Ivo Van Bastelaere P.Eng.
Senior Outfall Specialist

Water Business Unit
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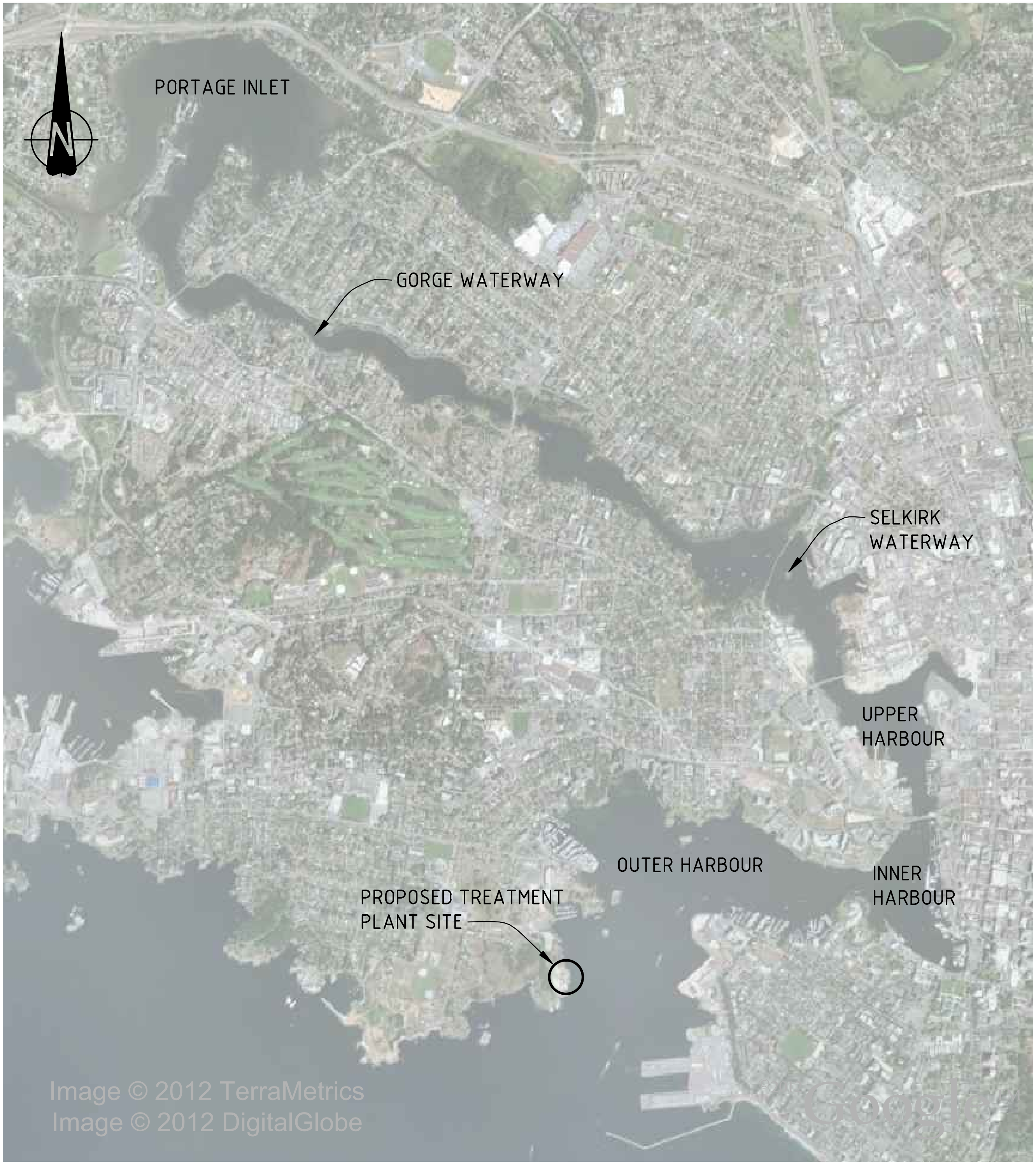

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PRELIMINARY

DO NOT USE FOR CONSTRUCTION

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CAPITAL REGIONAL DISTRICT
MCLOUGHLIN POINT OUTFALL
SITING STUDY

PROPOSED TREATMENT PLANT LOCATION MAP

Date: 31-OCT-12	Drawn by: KL	Edited by:	App'd by: PH
OneWay to zero harm	WorleyParsons resources & energy	WorleyParsons Project No. 307071-00623	
		FIG No FIGURE 1	REV A

USER NAME: kirsten.lindquist
ISSUING OFFICE: VICTORIA
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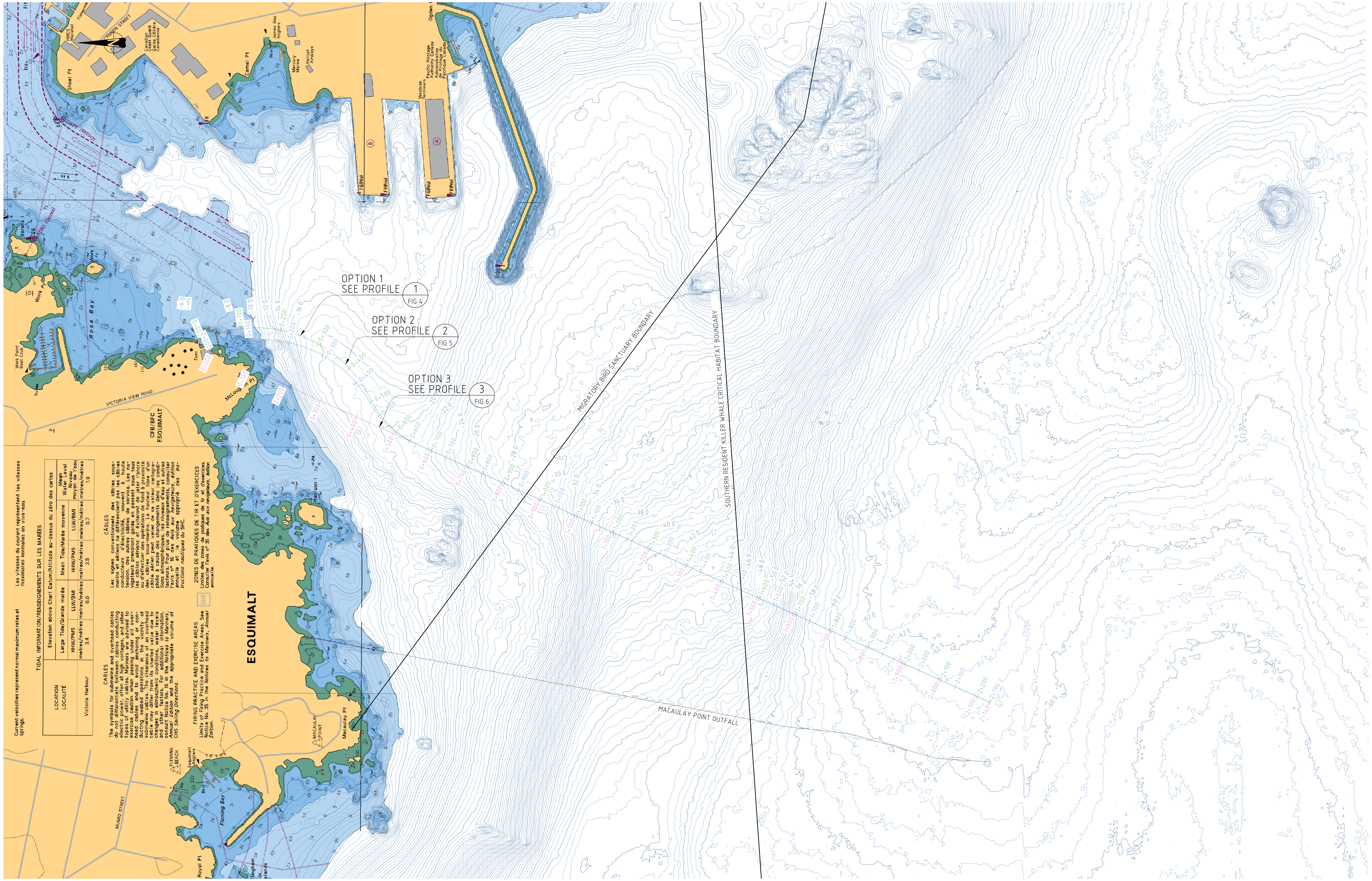

LEGEND:

PROPOSED OUTFALL ALIGNMENT OPTION 1

PROPOSED OUTFALL ALIGNMENT OPTION 2

PROPOSED OUTFALL ALIGNMENT OPTION 3

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SOURCE: CANADIAN HYDROGRAPH SERVICE 2005 – VICTORIA HARBOUR CHART #3412

SOURCE: CANADIAN HYDROGRAPH SERVICE 2012 – UNPUBLISHED/MULTIBEAM DATA, 5m RESOLUTION

DEPTH DATUM: METERS RELATIVE TO HYDROGRAPHIC CHART DATUM

CAPITAL REGIONAL DISTRICT
MCLOUGHLIN POINT OUTFALL
SITING STUDY

PROPOSED OUTFALL ALIGNMENTS

Date: 29-JAN-13	Drawn by: KL	Edited by:	App'd by: JC
		WorleyParsons Project No. 307071-00623	
		FIG No FIGURE 2	REV A

OneWay to zero harm

WorleyParsons resources & energy

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ISSUING OFFICE: VICTORIA

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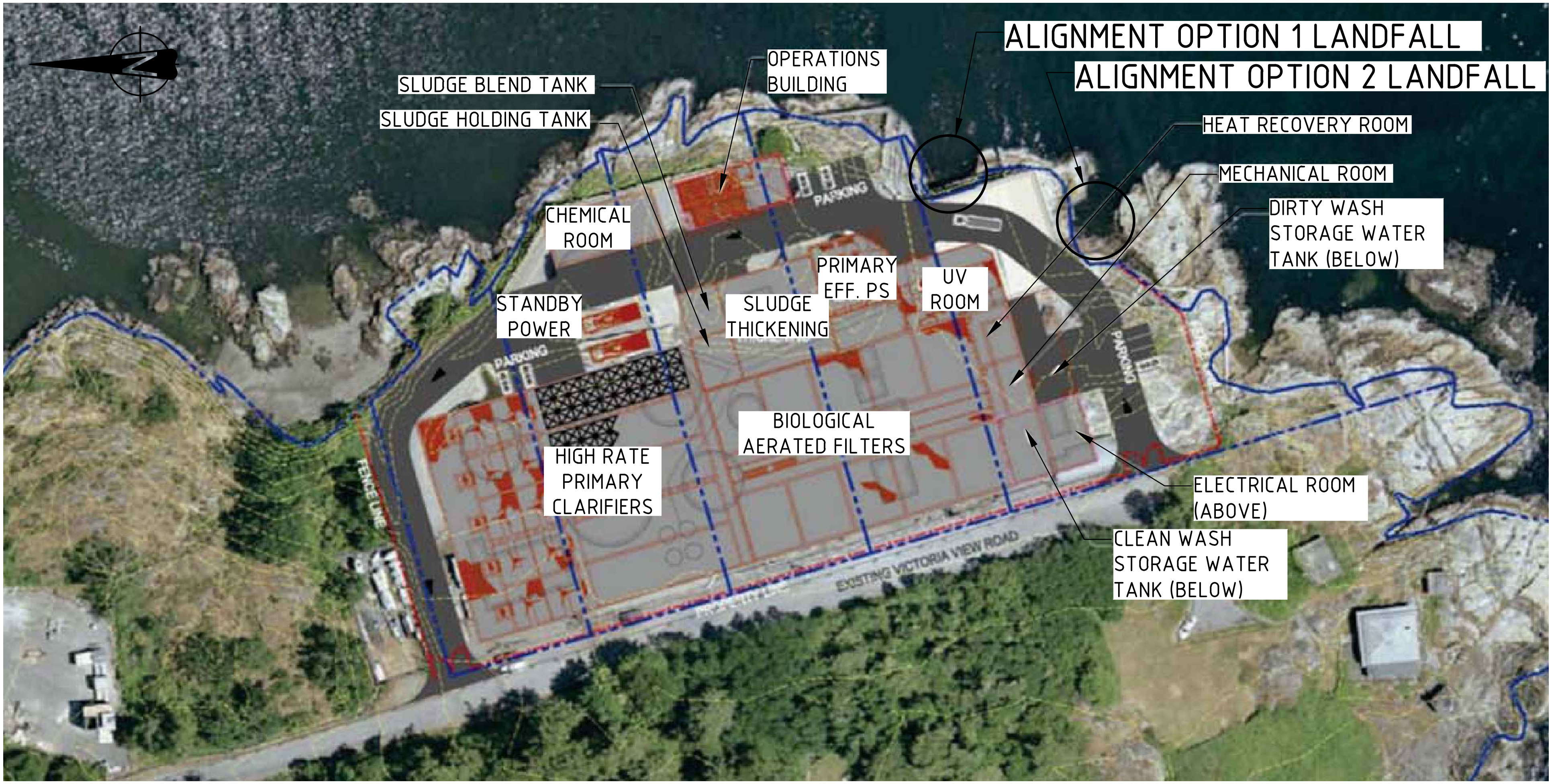

N.T.S.

SOURCE: STANTEC - CORE AREA WASTEWATER PROGRAM DRAWING # ML-A5-C-010

CAPITAL REGIONAL DISTRICT
MCLOUGHLIN POINT OUTFALL
SITING STUDY

PROPOSED TREATMENT PLANT
SITE LAYOUT

Date: 29-JAN-13	Drawn by: KL	Edited by: CM	App'd by: JC
OneWay to zero harm	WorleyParsons resources & energy	WorleyParsons Project No. 307071-00623	
		FIG No FIGURE 3	REV A

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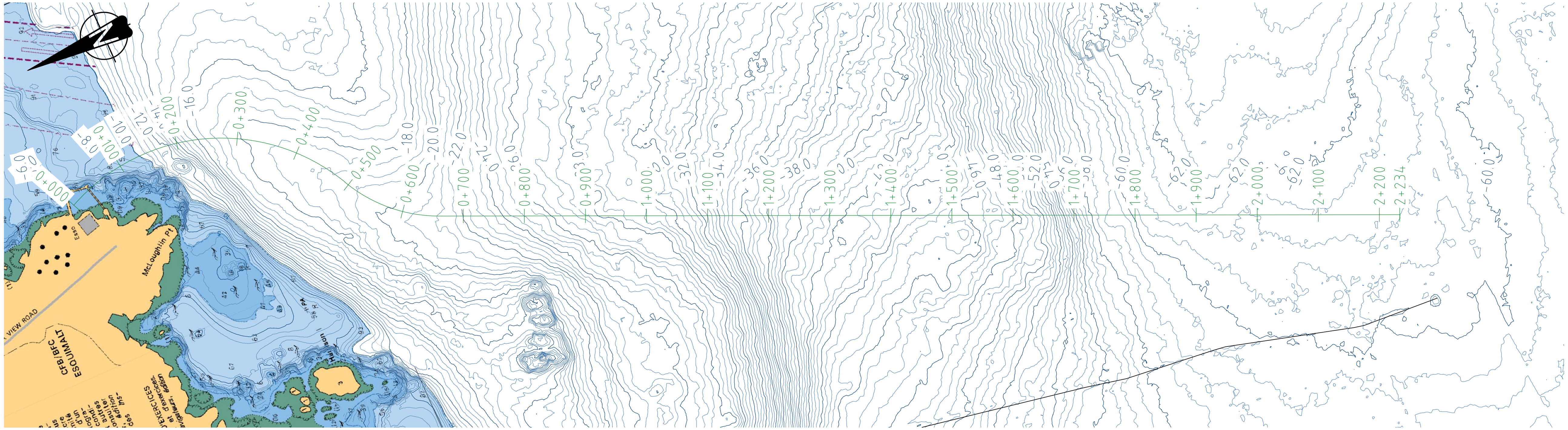

SOURCE: CANADIAN HYDROGRAPH SERVICES 2005 - VICTORIA HARBOUR CHART #3412
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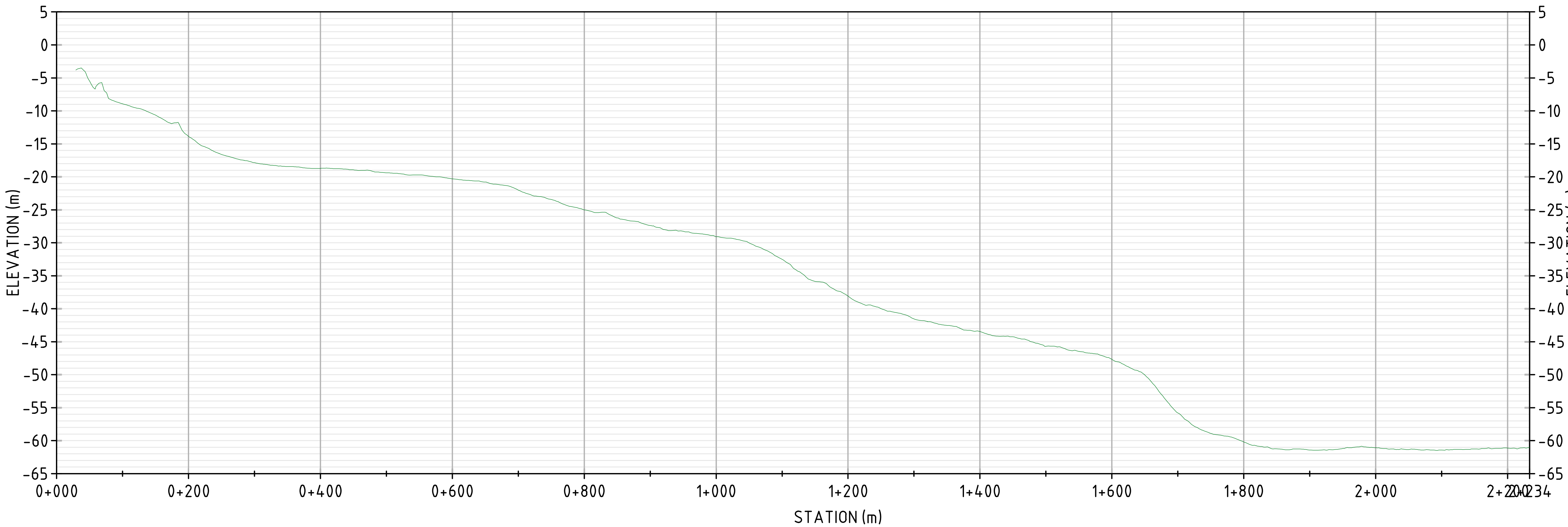
DEPTH DATUM: METERS RELATIVE TO HYDROGRAPHIC CHART DATUM



PROFILE 1 FIG 2
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(VERTICAL EXAGGERATION 10x)

CAPITAL REGIONAL DISTRICT
MCLOUGHLIN POINT OUTFALL
SITING STUDY

PROPOSED OUTFALL ALIGNMENTS
SHORELINE APPROACH OPTION 1

OneWay to zero harm

WorleyParsons resources & energy

Date: 29-JAN-13	Drawn by: KL	Edited by: CM	App'd by: JC
WorleyParsons Project No. 307071-00623			
FIG No FIGURE 4		REV A	

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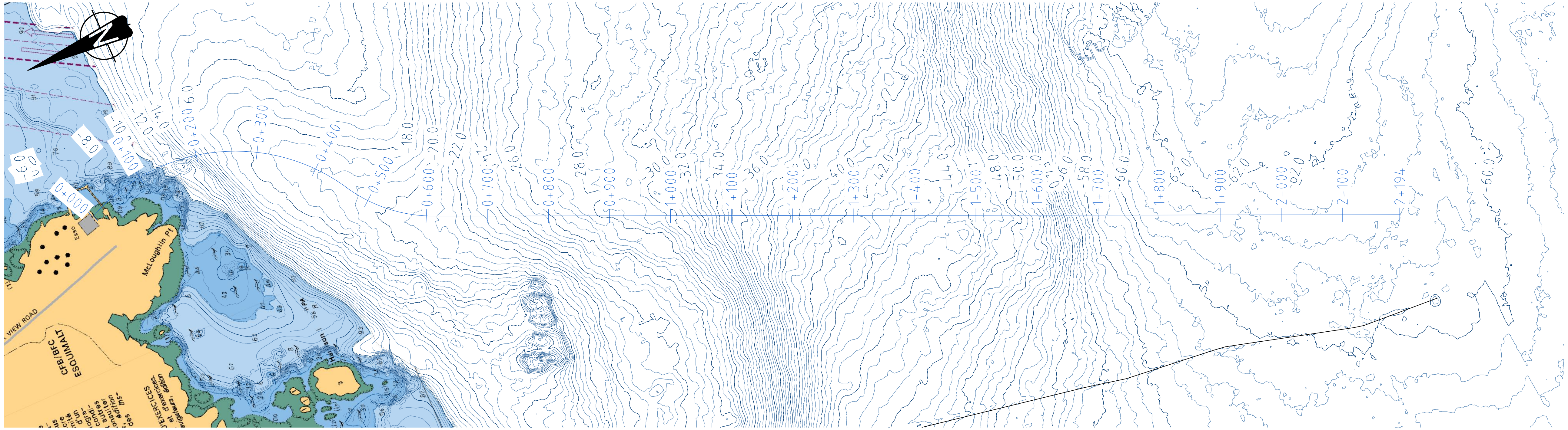

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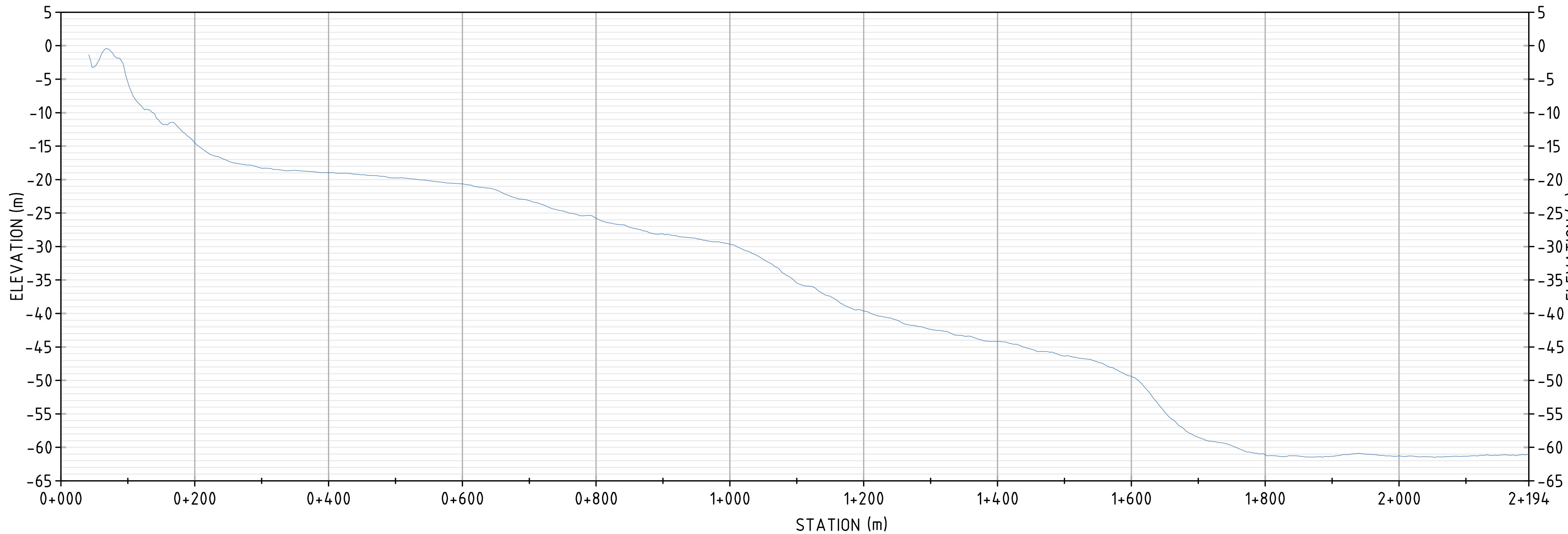

PROFILE 2 FIG 2
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1:7500 HORIZONTAL
(VERTICAL EXAGGERATION 10x)

CAPITAL REGIONAL DISTRICT
MCLOUGHLIN POINT OUTFALL
SITING STUDY

PROPOSED OUTFALL ALIGNMENTS
SHORELINE APPROACH OPTION 2

Date: 29-JAN-13	Drawn by: KL	Edited by: CM	App'd by: JC

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FIG No **FIGURE 5** REV **A**

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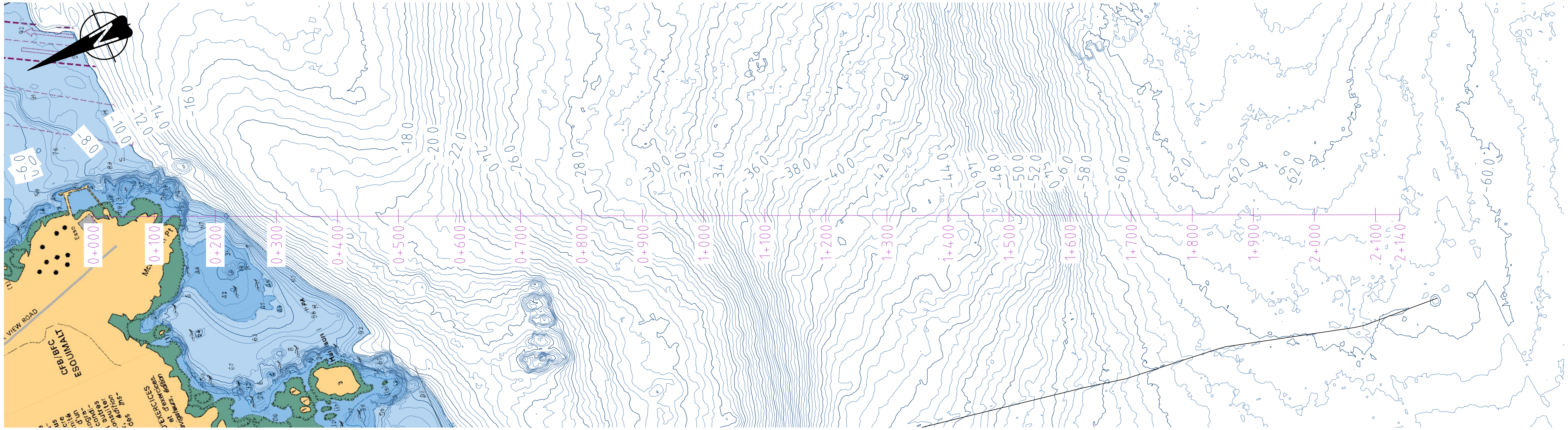

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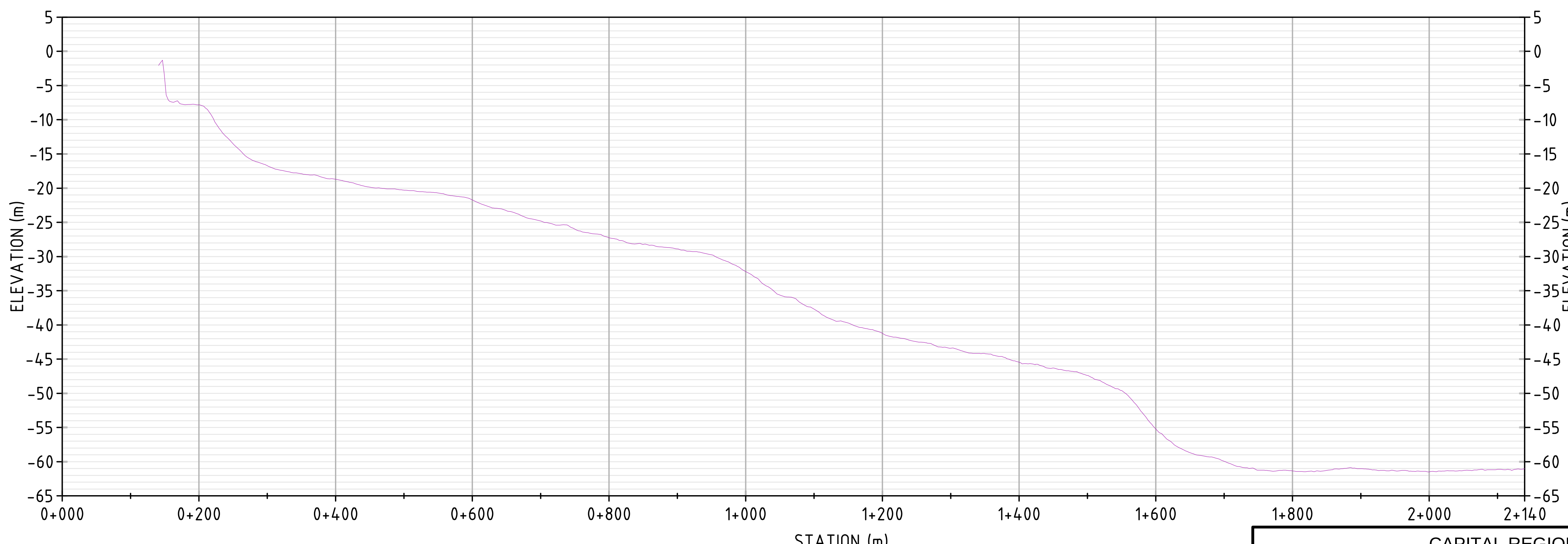

PROFILE 3 FIG 2
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(VERTICAL EXAGGERATION 10x)

CAPITAL REGIONAL DISTRICT
MCLOUGHLIN POINT OUTFALL
SITING STUDY

PROPOSED OUTFALL ALIGNMENTS
SHORELINE APPROACH OPTION 3

Date: 29-JAN-13	Drawn by: KL	Edited by: CM	App'd by: JC

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WorleyParsons Project No. 307071-00623
FIG No **FIGURE 6** REV **A**

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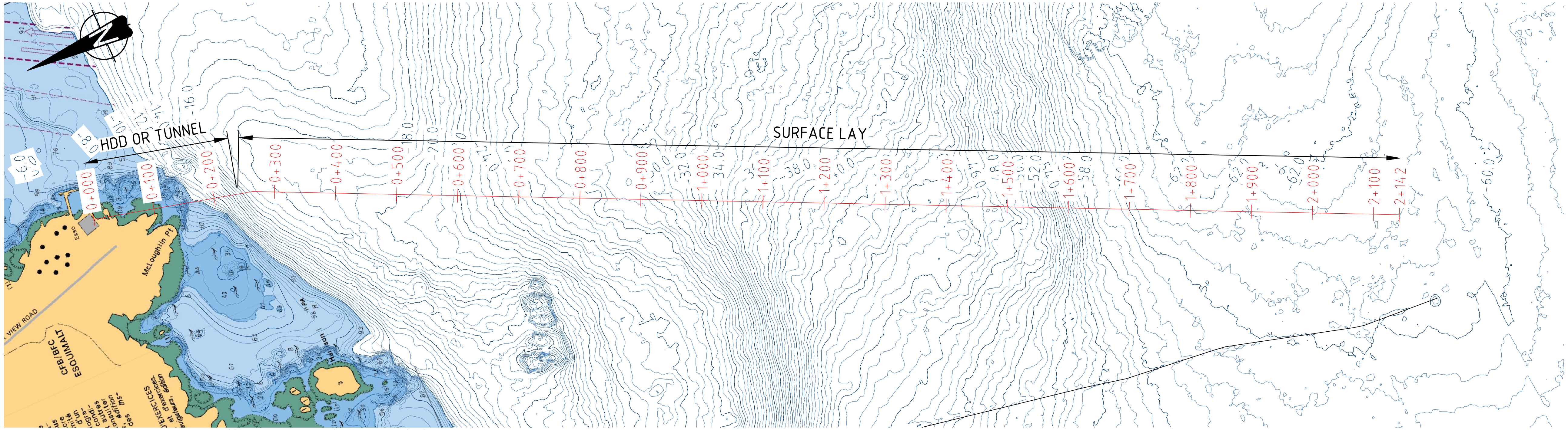

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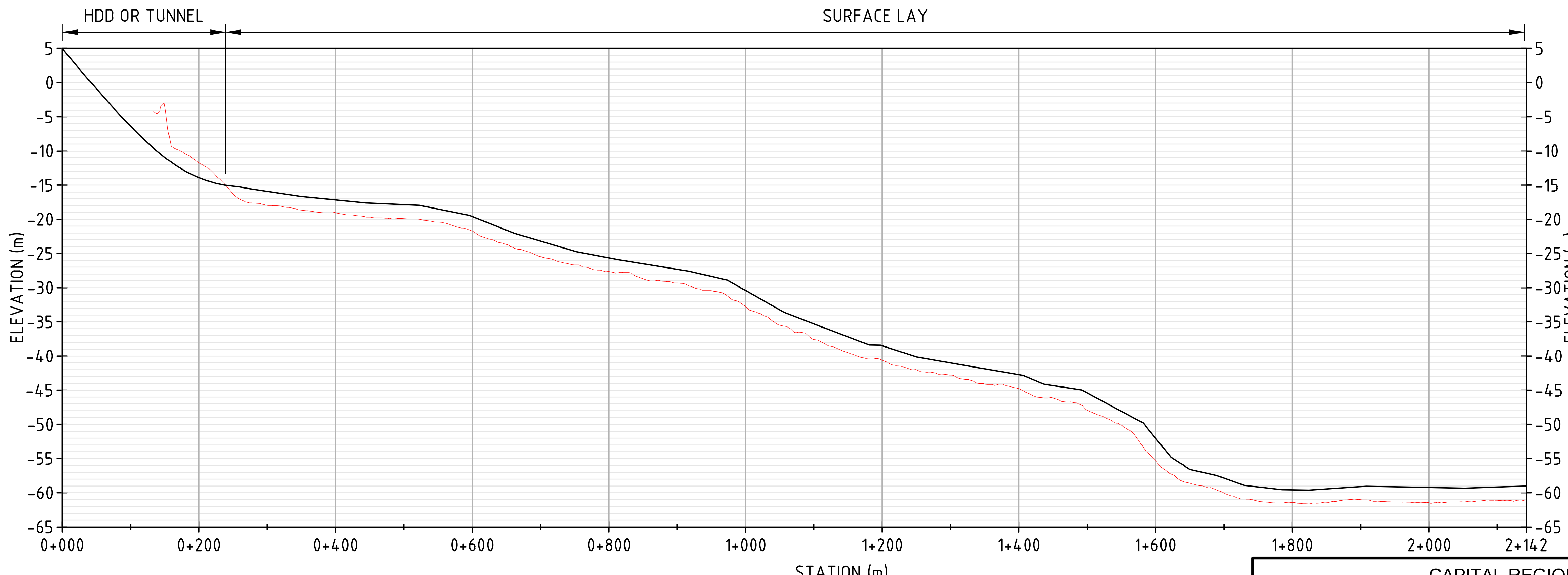

PROFILE
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m 0 10 20 30 40 m
1:7500 HORIZONTAL
(VERTICAL EXAGGERATION 10x)

CAPITAL REGIONAL DISTRICT
MCLOUGHLIN POINT OUTFALL
SITING STUDY

PROPOSED OUTFALL ALIGNMENTS
SHORELINE APPROACH OPTION 3 - HDD/TUNNEL & SURFACE LAY

Date: 04-FEB-13	Drawn by: KL	Edited by: CM	App'd by: JC

WorleyParsons Project No. 307071-00623

FIG No **FIGURE 7** REV **A**

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USER NAME: chris.dumann
ISSUING OFFICE: VICTORIA
PLOT DATE & TIME: 4/2/2013 9:39:29 AM
SAVE DATE & TIME: 29/1/2013 1:59:56 PM

FILE LOCATION: J:\307071\00623_CRD_OUTFALL\11_DRAWINGS\15_I_AND_E\02_MARINE\307071-00623-00-MA-DAL-1000.DWG

Appendix 1 Regulatory Considerations

1. REGULATORY CONSIDERATIONS

A number of regulatory approvals will be required for the construction of the marine outfall. The approvals summarized here are not intended to be comprehensive for the entire CAWTP and also do not cover the approvals for operating the discharge. Likely construction related approvals fall under the following legislation:

- *Canadian Environmental Assessment Act 2012*
- *Fisheries Act*
- *BC Lands Act*
- *Navigable Waters Protection Act*
- *Canadian Environmental Protection Act*

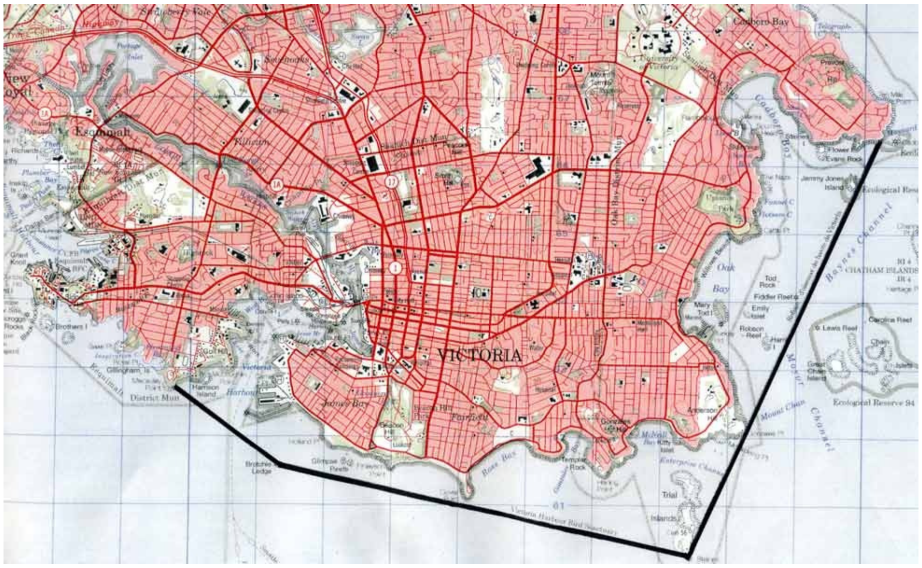
Summaries of the various authorizations are described in the following sections.

1.1 Canadian Environmental Assessment Agency

The CRD submitted a project description to the Canadian Environmental Assessment Agency (Westland 2012). The project description is intended to assist federal staff determine how the *Canadian Environmental Assessment Act (CEAA)* will apply to the proposed project. Several possible Environmental Assessment (EA) triggers were identified including; disposal at sea, *Navigable Waters Protection Act*, *Fisheries Act,* and federal funding (Westland 2012). The project description was submitted under the old *Canadian Environmental Assessment Act* which is now repealed.

The new act, *Canadian Environmental Assessment Act 2012 – Regulations Designating Physical Activities* specifies a new regime of triggers for the determination if a project is a “Designated Project” and would have to undergo a comprehensive environmental assessment and consultation process. The main potential trigger identified was in relation to the construction and operation of a “waste management facility” in a migratory bird sanctuary. The wastewater treatment plant will be near the Victoria Harbour Migratory Bird Sanctuary (Figure A), and the associated outfall will be through the Victoria Harbour Migratory Bird Sanctuary. WorleyParsons’ direct communication with the Canadian Environmental Assessment Agency suggested the project is unlikely to be a “Designated Project” because the wastewater management facility itself was going to be outside the boundaries of the migratory bird sanctuary.

Figure A Migratory Bird Sanctuary



Source: Ringuette, 2009

1.2 Fisheries and Oceans Canada – Fisheries Act

Construction near or within the marine environment is subject to Section 35 of the Fisheries Act (Canada 2012a), that states *"no person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat.*" Depending on the severity of potential impacts, Fisheries and Oceans Canada (DFO) provides approvals in the form of an Authorization for Works or Undertakings Affecting Fish Habitat. Approval documents will typically outline specific conditions under which construction can take place. These conditions include construction practices which must be avoided along with the time of year for which the construction can take place.

Subsection 35(1) of the Act has recently been replaced by the following: "*No person shall carry on any work, undertaking or activity that results in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery".* Where serious harm to fish is "*the death of fish or any permanent alteration to, or destruction of, fish habitat*" and fish habitat is defined as "*spawning grounds and any other areas, including nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly in order to carry out their life processes."*

The changes to the *Fisheries Act* are currently not in force; however, an approval under the Fisheries Act will likely require compensation for damaged or lost habitat.

1.3 Ministry of Forest, Lands and Natural Resource Operations – Crown Land Tenure

The outfall will be constructed over crown seabed through the intertidal and subtidal zones. A crown land tenure will need to be secured from the Ministry of Forest Land and Natural Resources Operations

(MFLNRO) for the outfall. The application will require the preparation of the application form, site plans, and a management plan.

Once the application has been received and accepted by MFLNRO, the application will be referred to First Nations and local, provincial and federal agencies for consultation. The MFLNRO will also advise on the nature of public advertising requirements.

1.4 Transport Canada – Navigable Waters Protection Act

Structures placed in the marine environment trigger the following section in the Navigable Waters Protection Act (Canada 1985) which is administered by Transport Canada. It states: "*No work shall be built or placed in, on, over, under, through or across any navigable water unless*

(a) the work and the site and plans thereof have been approved by the Minister, on such terms and conditions as the Minister deems fit, prior to commencement of construction;

Outfalls do not typically cause navigational concerns due to their low profile on the seabed; however, this project will involve a large diameter outfall as well as heavy duty construction equipment that will have to work within a harbour entrance with active vessel and sea plane traffic. On site signage indicating the presence of the outfall to mariners will be a requirement by Transport Canada.

Currently, Transport Canada is replacing the Navigable Waters Protection Act with the Navigation Protection Act. This new Act limits application of the legislation to a list of named waterways, specifically 97 lakes, 62 rivers and three Oceans. Based on inclusion of the Pacific Ocean, it is likely that the Transport Canada information requirements and review process will not change substantively from reviews under the Navigable Waters Protection Act.

1.5 Environment Canada – Disposal at Sea

The excavation of a trench or tunnel for installation of the outfall will result in the need for disposal or re-use of waste material. If the material is to be disposed of at sea then a Disposal at Sea Permit will be required under the *Canadian Environmental Protection Act* (1999) and the *Disposal at Sea Regulation* (Canada, 2009).

The disposal of waste dredged material and inert inorganic geological matter is permitted; provided that the material is screened for pollutants specified in the *Disposal at Sea Regulation* and/or meets the criteria for biological testing specified in the regulation.

The waste material may be disposed at the nearest designated disposal site (Environment Canada, 2010). The nearest disposal site to Victoria Harbour is located approximately 3 km south of Albert Head, near Parry Bay (Canadian Hydrographic Service 2005). The Parry Bay site is found within critical habitat for SARA-listed southern resident Killer Whales and is currently closed to ocean disposal. The designated disposal site at Porlier Pass, near Nanaimo, BC is the closest disposal site currently available to receive dredge material generated by this project.

The placement of backfill and protection works along the alignment of the outfall and associated works is not considered disposal and will not require a Disposal at Sea permit (Environment Canada, 2010).

1. REFERENCES

Canada. 1985. Navigable Waters Protection Act R.S.C., 1985, c. N-22

Canada. 2009. Disposal at Sea Regulation SOR/2001-275.

Canada. 2012a. Fisheries Act. Fisheries Act R.S.C., 1985, c. F-14

Canadian Hydrographic Service. 2005. Race Rocks to/a D'Arcy Island. Marine Chart # 3440. Ottawa.

Environment Canada. 2010. Activities That Do Not Require Disposal at Sea Permits. Available online at http://www.ec.gc.ca/iem-das/default.asp?lang=En&n=D21EAD32-1 Accessed October 2012

Westland Resource Group. 2012. Project Description: Core Area Wastewater Treatment Program. Report Prepared for Capital Regional District for Submission to Canadian Environmental Assessment Agency.

Appendix 2 Fisheries Resources

1. FISHERIES RESOURCES

The presence of fisheries and biological resources is an important consideration for construction in marine waters. The proposed project area is located in an area identified as being marine ecologically and biologically significant (EBSA) (DFO 2012a). These areas warrant enhanced management and were created to complement those for the Pacific North Coast Integrated Management Area (PNCIMA) (DFO 2012a).

1.1 Salmon

Salmonids are of significant ecological, economic and social/cultural importance. They are fished commercially, recreationally and by First Nations. Salmon are keystone species that act as predators, prey and suppliers of critical nutrients in aquatic and terrestrial environments (Hyatt and Godbout 2000). Keystone species are species that exert a great influence on an ecosystem relative to its abundance. Salmon are commonly used as indicators of change in marine and aquatic environments because they are relatively widespread in freshwater and marine environments, highly important economically and culturally, and highly sensitive to environmental changes at several life history changes.

Commercial salmon seine, gill net and trolling activities are known to occur in the project area (DFO 2012a). Recreational salmon fishing also occurs within the project area.

Juan de Fuca Strait in the Victoria Harbour area provides habitat and migration corridors for numerous salmonid species due to the proximity of salmon bearing drainages, such as those flowing into the head of Victoria Harbour (Colquitz Creek, Craigflower Creek), Esquimalt Harbour (Millstream River) and Esquimalt Lagoon (Colwood Creek, Bee Creek).

Fisheries information data inquiry reports and escapement reports are available for Colquitz Creek and include coho salmon (*Oncorhynchus kisutch)*, chum salmon (*O. keta*), sockeye salmon (*O. nerka*), pink salmon (*O. gorbuscha)* and cutthroat trout (*O. clarki*). The presence of rainbow trout (*O. mykiss*) has been documented in Colquitz Creek (FISS 2012). Escapement data for Craigflower Creek was obtained and included data for coho salmon, chum salmon, sockeye salmon and cutthroat trout. The presence of rainbow trout and steelhead (*O. mykiss*) were also documented in Craigflower Creek (FISS 2012).

Escapement data for Millstream River was obtained and included data for coho salmon. The presence of rainbow trout, steelhead and cutthroat trout has also been documented within this creek (FISS 2012). The presence of cutthroat trout, rainbow trout, and coho salmon has been documented in Colwood Creek (FISS 2012), and coho salmon and cutthroat trout were documented in Bee Creek (CRD 2012).

Many urban watersheds in the CRD support salmonid populations (FISS 2012), therefore the nearshore zone near McLoughlin Point likely provides important habitat for out migrating anadromous juvenile salmonids and returning adult spawners.

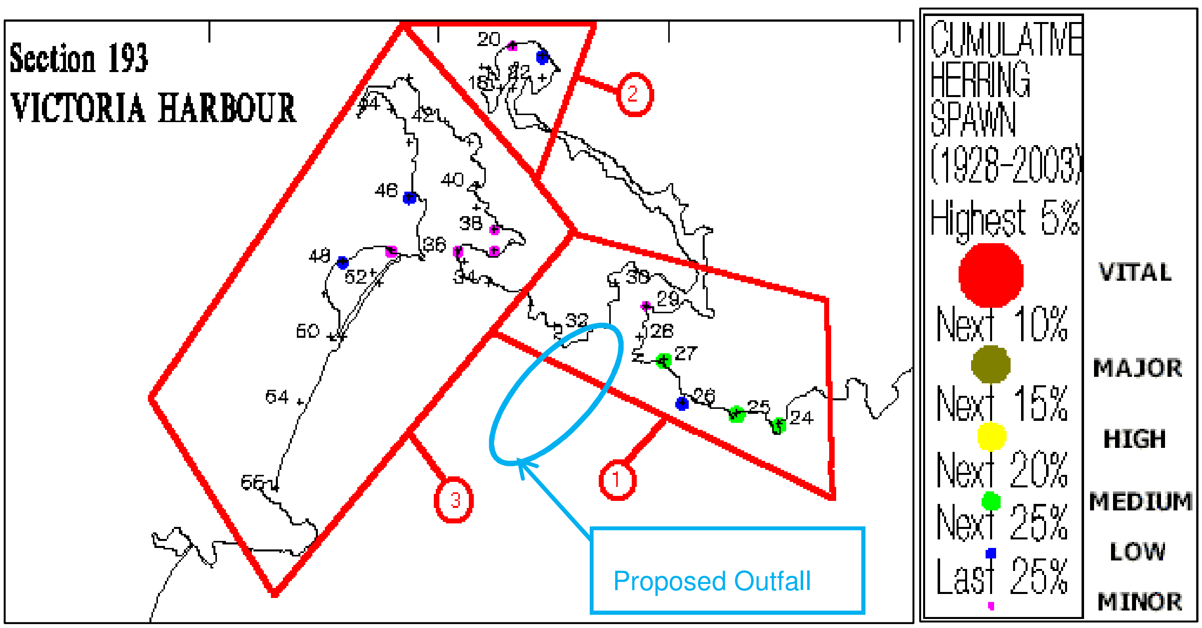
1.2 Herring

Pacific herring (*Clupea harengus pallasi*) are ecologically important as they are forage fish for salmon and other fish, marine mammals, and marine birds. They are also economically and culturally important as they are fished commercially for their roe as well as being fished by First Nations peoples.

Herring tend to spawn in shallow vegetated areas such as on kelp or in eelgrass beds. Herring spawning typically occurs between late January and mid-April. Eggs may be sensitive to underwater noise, sedimentation, chemical toxicity and depressed oxygen levels, all of which are potential impacts from the installation and operation of wastewater discharges.

Spawning records for Pacific herring suggests that the Victoria Harbour area is not typically used by herring for spawning (Figure A) (Hay et al. 1989, revised 2009). Limited herring spawning occurs in the Victoria Harbour area, but not in the immediate vicinity of the project site. Minor to low spawning event records are found for Esquimalt Harbour and Esquimalt Lagoon, the eastern shoreline of Victoria Harbour and Portage Inlet. Along the shoreline between Ogden Point and Ross Bay, low to medium spawning events are documented (Figure A; Hay et al. 1989, revised 2009). The proposed project area is located in an area identified as being ecologically and biologically significant to herring (DFO 2012a).

Figure A Herring Spawn Records in the Victoria Harbour, Juan de Fuca Strait Area



Source: Hay et al. 1989, revised 2009

1.3 Bivalve Shellfish

Shellfish are sensitive to changes in water quality as they feed by filtering organisms and organic material from the water column. Bioaccumulation is the storage of a chemical in the tissues of organisms. Bioaccumulation in shellfish can occur through a variety of routes of exposure, such as ingestion, respiration or direct contact with water and sediment (WSDE 1991).

Government mapping applications (Mapster, Coastal Resource Information System (CRIS)) have not documented clam beds along the proposed outfall alignment area (DFO 2012a; GEOBC 2012); however clam beds have been documented to be present in Esquimalt Lagoon and along the shoreline south of Fisgard Lighthouse (DFO 2012; GEOBC 2012).

During the ROV survey (July 10, 2012), geoduck and piddock clam siphons were observed in the soft substrate between 22 and 44 m depth (relative to chart datum) (Photos A and B).

No commercial or recreational bivalve fishing records were available for the area. The waters and intertidal foreshore in the Victoria Harbour area are closed to shellfish harvesting due to a sanitary shellfish closure (Figure B) DFO 2012b)

Photo A Geoduck siphon at T5, 22.2 m depth

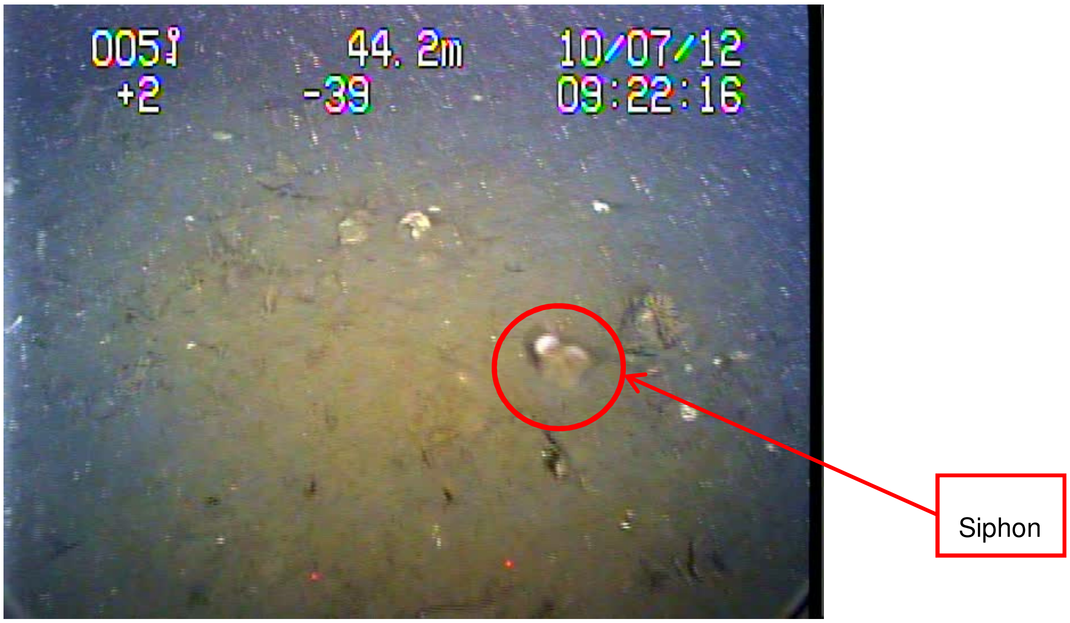
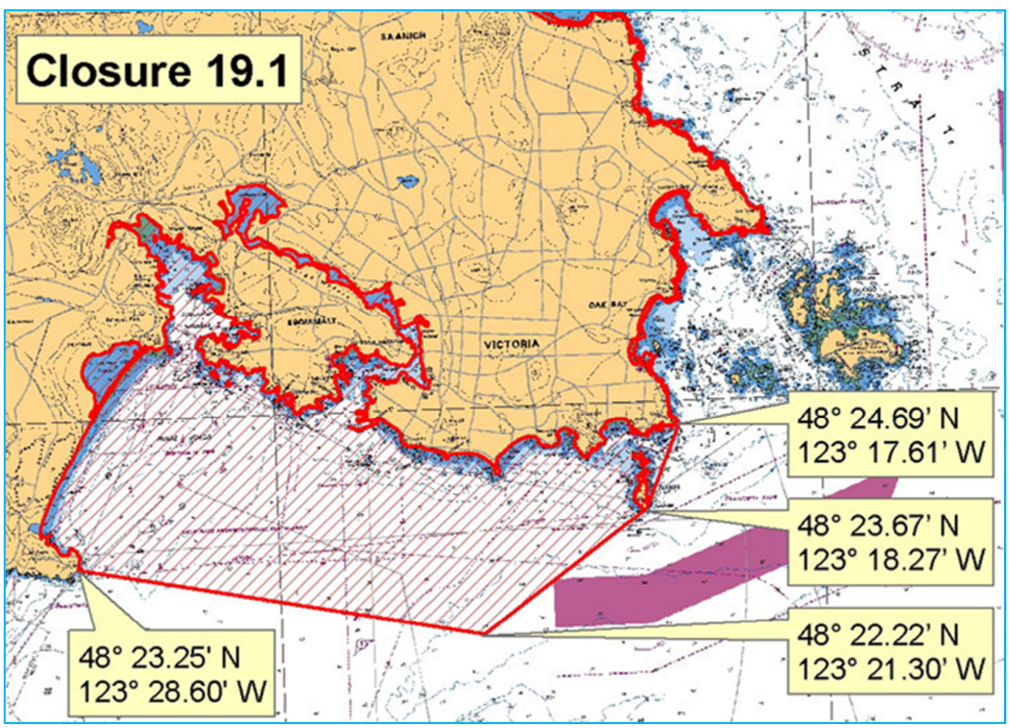


Photo B Rough piddock siphon at T3, 36.0 m depth

Figure B Sanitary Shellfish Closure in the Victoria Harbour Area



Source: DFO 2012b

1.4 Prawn, Shrimp and Crab

Commercial prawn fishing is reported to occur in the subtidal waters near the project site in Juan de Fuca Strait. Between 2001 and 2009, over 6,100 kg of prawn were captured at the mouth of Victoria Harbour, and over 1,400 kg were harvested in the area directly west of Macaulay Point (DFO 2012a).

No commercial shrimp harvesting records were available for the waters in the vicinity of the project area (GEOBC 2012; DFO 2012a).

The proposed project area is located in an area identified as being ecologically and biologically significant to dungeness crab (DFO 2012a).Commercial crab harvesting is reported to occur in the subtidal areas near the project site in Juan de Fuca Strait. Between 2001 and 2009, over 12,000 kg and 189,000 kg of dungeness crab were harvested at the mouth of Victoria Harbour and west of Macaulay Point respectively. Between 2001 and 2005 and 2007, over 2,900 kg of red rock crab were harvested in the subtidal waters of Juan de Fuca Strait, west of the entrance to Victoria Harbour. No recreational crab fishing records were available for the waters in the vicinity of the project area (GEOBC 2012; DFO 2012a).

2. PROVINCIAL AND FEDERAL SPECIES/ECOSYSTEMS RANKING

The province of BC and the federal government use separate systems to classify rare or endangered species. The federal and provincial databases were searched to compile a list of ranked species and/or ecosystems. Numerous species have been listed by the Federal and Provincial governments as being of special conservation status. Species and ecological communities are red or blue-listed on the basis of the provincial conservation Status Rank (SRANK).

Red List: Includes any ecological community, and indigenous species and subspecies that is extirpated, endangered, or threatened in British Columbia. Extirpated elements no longer exist in the wild in British Columbia, but do occur elsewhere. Endangered elements are facing imminent extirpation or extinction. Threatened elements are likely to become endangered if limiting factors are not reversed.

Blue List: Includes any ecological community, and indigenous species and subspecies considered to be of special concern (formerly vulnerable) in British Columbia. Elements are of special concern because of characteristics that make them particularly sensitive to human activities or natural events. Blue-listed elements are at risk, but are not Extirpated, Endangered or Threatened. Blue listed species are species with SRANK classifications of 2-3, 3, or 3-4 (animals only).

Yellow List: Includes uncommon, common, declining and increasing species – all species not included on the Red or Blue lists. Yellow listed species are species with SRANK classifications of 4, 5, 4-5, or 3-4 (plants only). Those species ranked S4, however, are considered to be of conservation concern because they have a small range or low abundance in the province, because they have shown provincial declines, or there are perceived long-term threats.

Federally, species ranking is conducted by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). COSEWIC is a committee of experts that assesses and designates which wild species of animal, plant or other organism are in danger of disappearing from Canada (Canada 2008).

Federally, species rankings are conducted by COSEWIC, with the following categories (COSEWIC 2005):

Extinct (X): a species that no longer exists;

Extirpated (XT): a species that no longer exists in the wild in Canada, but occurs elsewhere;

Endangered (E): a species facing imminent extinction;

Threatened (T): a species that is likely to become endangered if practices are not reversed;

Special Concern (SC): a species which is particularly sensitive to human activities or natural events, but is not endangered or threatened;

Data Deficient (DD): a species for which there is inadequate information to make a direct or indirect, assessment of its risk or extinction;

Not at Risk (NAR): a species that has been evaluated and found to be not at risk.

Prior to a category designation by COSEWIC, a species is ranked in a candidate list. The candidate list has been ranked into three priority groups to reflect the relative urgency with which each species should receive a COSEWIC assessment.

Group 1: contains species of highest priority for assessment by COSEWIC, and includes species that are suspected to be extirpated from Canada.

Group 2: contains species of intermediate priority for assessment by COSEWIC

Group 3: contain species that are lower priority for assessment by COSEWIC

COSEWIC rankings are regarded as recommendations to the federal government; the government then makes the final decision on whether species will be listed under SARA. Schedule 1 of SARA is the official list of wildlife species at risk in Canada. It includes species that are extirpated (extinct in Canada), endangered, threatened, and of special concern. Species listed on Schedule 2 and 3 are not yet officially protected under SARA.

The BC Species and Ecosystem Explorer and government mapping applications (Mapster, CRIS) were reviewed and found blue and red-listed wildlife species with potential to occur in marine environments within the Capital Regional District of Vancouver Island. These animals include seven mammals, two birds and two invertebrates (MOE 2012). Table A below lists the identified red and blue-listed species with the potential to occur in the proposed work area. Additional information on red-listed and indicator species is described in more detail below.

Table A Rare and Endangered Species potentially occurring within marine habitats of the Capital Regional District of Vancouver Island

Common Name	Scientific Name	BC/COSEWIC
Marbled Murrelet	*Brachyramphus marmoratus*	Blue/T (2012)
Grey Whale	*Eschrichtius robustus*	Blue/SC (2004)

Common Name	Scientific Name	BC/COSEWIC
Steller Sea Lion	*Eumetopias jubatus*	Blue/SC (2003)
Peregrine Falcon, *pealei* subspecies	*Falco peregrinus pealei*	Blue/SC (2007)
Northern Abalone	*Haliotis kamtschatkana*	Red/T (2000)
Killer Whale - Southern	*Orcinus orca*	Red/E (2008)
Killer Whale – Northern	*Orcinus orca*	Red/T (2008)
Killer Whale - Offshore	*Orcinus orca*	Red/T (2008)
Killer Whale – West Coast	*Orcinus orca*	Red/T (2008)
Olympia Oyster	*Ostrea conchaphila*	Blue/SC (2011)
Harbour Porpoise	*Phocoena phocoena*	Blue/SC (2003)

2.1 Marine Mammals

Marine mammals are known to occur in Juan de Fuca Strait. Marine mammals that may occur in the area include, but are not limited to, killer whales (GEOBC 2012), grey whales, harbour porpoises, harbour seals and steller sea lions (MOE 2012).

The proposed project area is located in an area identified as being ecologically important and biologically significant to harbour seals, harbour porpoises, southern resident killer whales and steller sea lions (DFO 2012a).

2.1.1 Killer Whales

Multiple populations of killer whales have been identified to use this area. Four designated populations occur in the coastal and offshore waters of British Columbia (northern resident population, southern resident population, west coast transient population, and offshore population). All four populations migrate and feed along the coast of Vancouver Island (COSEWIC 2008). The southern resident population is designated as endangered by COSEWIC, with the remaining Pacific populations designated as threatened. All populations are red-listed by the BC *Wildlife Act.*

Critical habitats is defined under the *Species at Risk Act* (SARA) as "*the habitat that is necessary for the survival or recovery of a listed wildlife species that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species"* (SARA s.2(1)).

Juan de Fuca Strait has been identified as critical habitat for southern resident killer whales (Table B). This is adjacent to an area that Washington State has designated as critical habitat under the *Endangered Species Act* (COSEWIC 2008). The proposed outfall alignment falls within the southern resident killer whale critical habitat, as defined by the Government of Canada (Canada 2009).

Table B Southern Resident Killer Whale Critical Habitat Boundaries

Described clockwise from the western boundary — all Latitudes are Decimal Degrees North; all Longitudes are Decimal Degrees West

	Point Description	Latitude Deg	Latitude Min	Longitude Deg	Longitude Min
1	Western boundary	48	29.68	124	44.31
2		48	40.02	124	50.68
3	Excluding waters north of the line joining (Sooke	48	21.30	123	44.32
4	Inlet)	48	20.33	123	42.90
5	Excluding waters north of the line joining (Royal	48	24.25	123	28.97
6	Roads, Esquimalt Hbr, Victoria Hbr)	48	24.57	123	22.61
7	Excluding waters west of the line joining	48	29.69	123	18.61
8	(Cordova Channel and Sidney Channel)	48	36.12	123	18.51
9	Excluding waters west of the line joining	48	37.04	123	18.49
10	(western half of Miners Channel and the waters west of Gooch Island)	48	39.70	123	17.72
11	Excluding waters west of the line joining	48	39.88	123	17.68
12	(western half of Prevost Channel and Moresby Passage)	48	42.96	123	19.63
13	Excluding waters west of the line joining	48	43.34	123	19.88
14	(western portion of Swanson Channel between Moresby Island and Prevost Island)	48	48.86	123	22.70
15	Excluding waters west of the line joining	48	50.66	123	23.33
16	(western portion of Trincomali Channel between Prevost Island and Parker Island)	48	52.61	123	23.92
17	Excluding waters west of the line joining	48	52.85	123	23.92
18	(western portion of Trincomali Channel between	48	53.08	123	23.76
19	Parker Island and Galiano Island)	48	54.28	123	20.67
20		48	55.39	123	21.98
21	Excluding waters west of the line joining	49	0.00	123	18.88
22	(western portion of southern Strait of Georgia)	49	10.39	123	22.82
23		49	13.58	123	21.97
24		49	13.58	123	21.97
25	Excluding waters north of the line joining (portion	49	14.00	123	21.09
26	of southern Strait of Georgia)	49	14.18	123	19.22
27		49	13.79	123	17.21
28		49	13.79	123	17.21
29		49	12.87	123	15.75
30	Excluding waters north and east of the line joining (portion of southern Strait of Georgia)	49	9.01	123	16.48
31		49	3.39	123	9.24
32		49	3.47	123	8.48
	And bounded on the east and south by Point Roberts and the United States Border				

2.1.2 Grey Whales

Grey whales are currently designated by COSEWIC as a species of special concern, and are blue-listed under the BC *Wildlife Act.* Grey whales are usually found in shallow (< 60 m) water close to shore (COSEWIC 2004). Grey whales feed predominantly on amphipod crustaceans by scooping up sediment and straining it through their baleen (DFO 2008). Grey whales off British Columbia similarly prefer shallow nearshore habitats with mud or sand bottom (COSEWIC 2004; DFO 2008).

2.1.3 Steller Seal Lions

Stellar sea lions are a species of special concern as designated by COSEWIC, and a provincially blue listed species under the BC *Wildlife Act.*

Preferred prey in BC include, but are not limited to, Pacific Herring, Pacific Hake (*Merluccius productus*), sandlance (*Ammodytes hexapterus*), salmon (*Oncorhynchus spp.*), spiny dogfish (*Squalus acanthias*), eulachon (*Thaleichthys pacificus*), sardines (*Sardinops spp.)*, and rockfish (*Sebastes spp.*) (COSEWIC 2003). Besides humans, the main predators of steller sea lions (*E. jubatus*) are killer whales. It is assumed that steller sea lions forage in the area. The prey species of stellar sea lions are most vulnerable during spawning and juvenile stages. Impacts to spawning and rearing sites, such as kelp and eelgrass beds could have an adverse impact on their prey.

2.2 Shellfish

Two at risk shellfish species were identified to potentially occur in marine waters of the CRD, northern abalone and Olympia oysters.

2.2.1 Northern Abalone

Northern abalone (*Haliotis kamtschatkana*) is a threatened species as designated by COSEWIC, and a provincially red-listed species under the BC *Wildlife Act.* Fisheries and Oceans Canada (DFO) closed all abalone fisheries in 1990 for conservation purposes (COSEWIC 2009; DFO 2012b).

Abalone occur in a wide range of habitats, from sheltered bays to exposed coastlines. They are often found on hard substrates, such as boulders and bedrock, in the intertidal and shallow subtidal waters (COSEWIC 2009). They are often found in areas where kelp (*Nereocystis, Macrocystis, Pteryogophora*) is prevalent, as it is a major food source (COSEWIC 2009).

The impacts of work and development in water on abalone populations are relatively unknown (COSEWIC 2009).

2.2.2 Olympia Oysters

Olympia oysters are designated by COSEWIC as a species of special concern, and are provincially blue-listed under the BC *Wildlife Act.* This species is the only native oyster in British Columbia (COSEWIC 2011) and occurs in the waters of Victoria Harbour. Fisheries and Oceans Canada recreational daily fishing limit for Olympia Oysters is zero (COSEWIC 2011; DFO 2012a).

Olympia oysters have a specific habitat requirement which limits its distribution to limited areas. Olympia oysters are usually found in the lower intertidal and shallow subtidal zone of estuaries and lagoons, however they have been known to occur in tidal flats and channels, bays, near freshwater inputs and attached to marine structures (pilings and floats) (Canada 2012b). Olympia oysters require a hard surface to attach to.

Olympia oysters are vulnerable to environmental extremes (cold winter water temperature), pollution, disease, introduced species and overfishing (Canada 2012b). Overfishing is the primary cause of historic population declines; however the population appears to have stabilized in recent decades (COSEWIC 2011). Olympia oysters are also vulnerable to sedimentation (COSEWIC 2011). There is evidence that habitat alteration, such as sedimentation, dredging, filling, industrial pollution and urbanization have had a cumulative impact on population numbers (COSEWIC 2011).

3. REFERENCES

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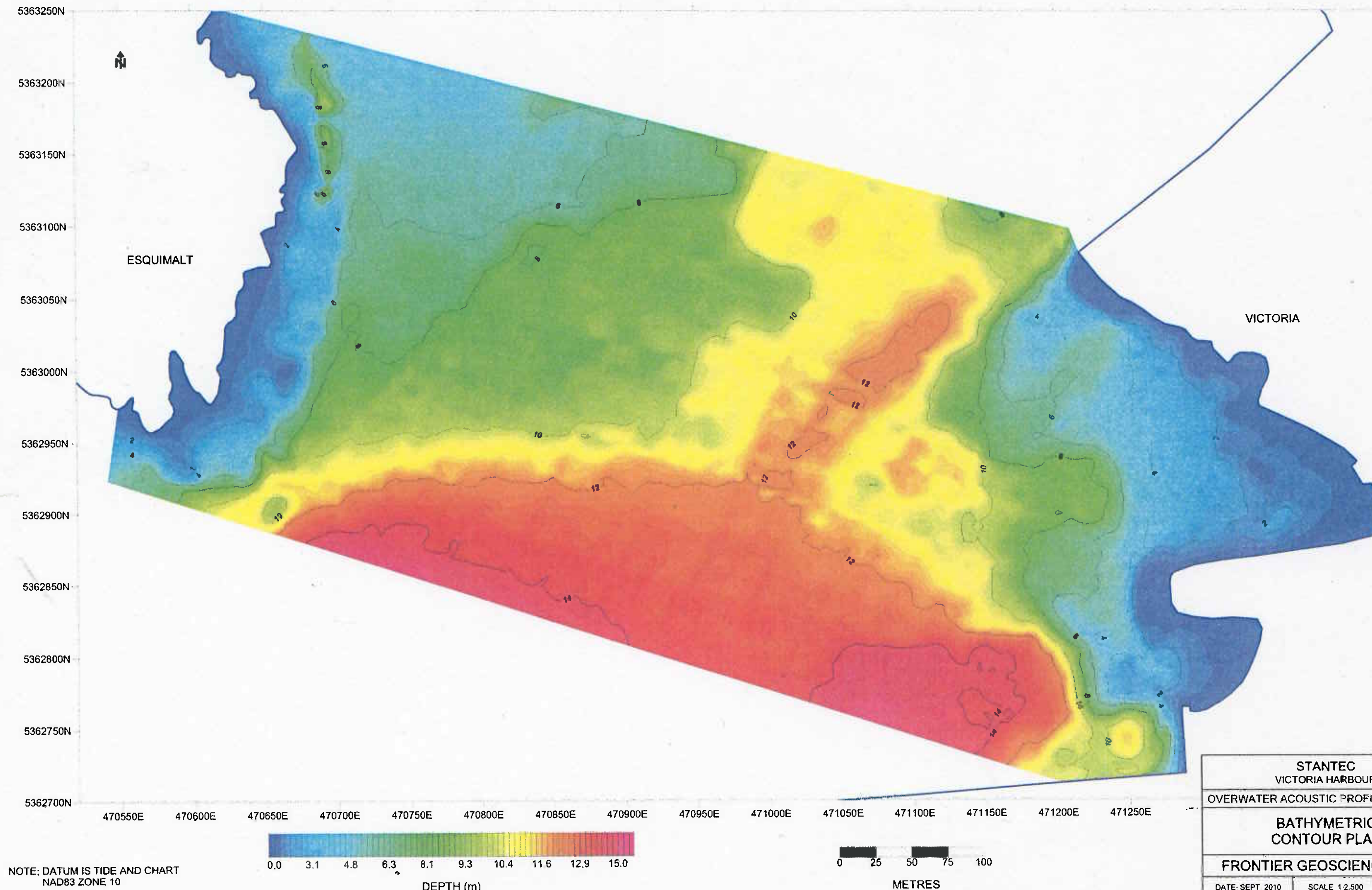
Appendix 3 Geophysical Survey Results



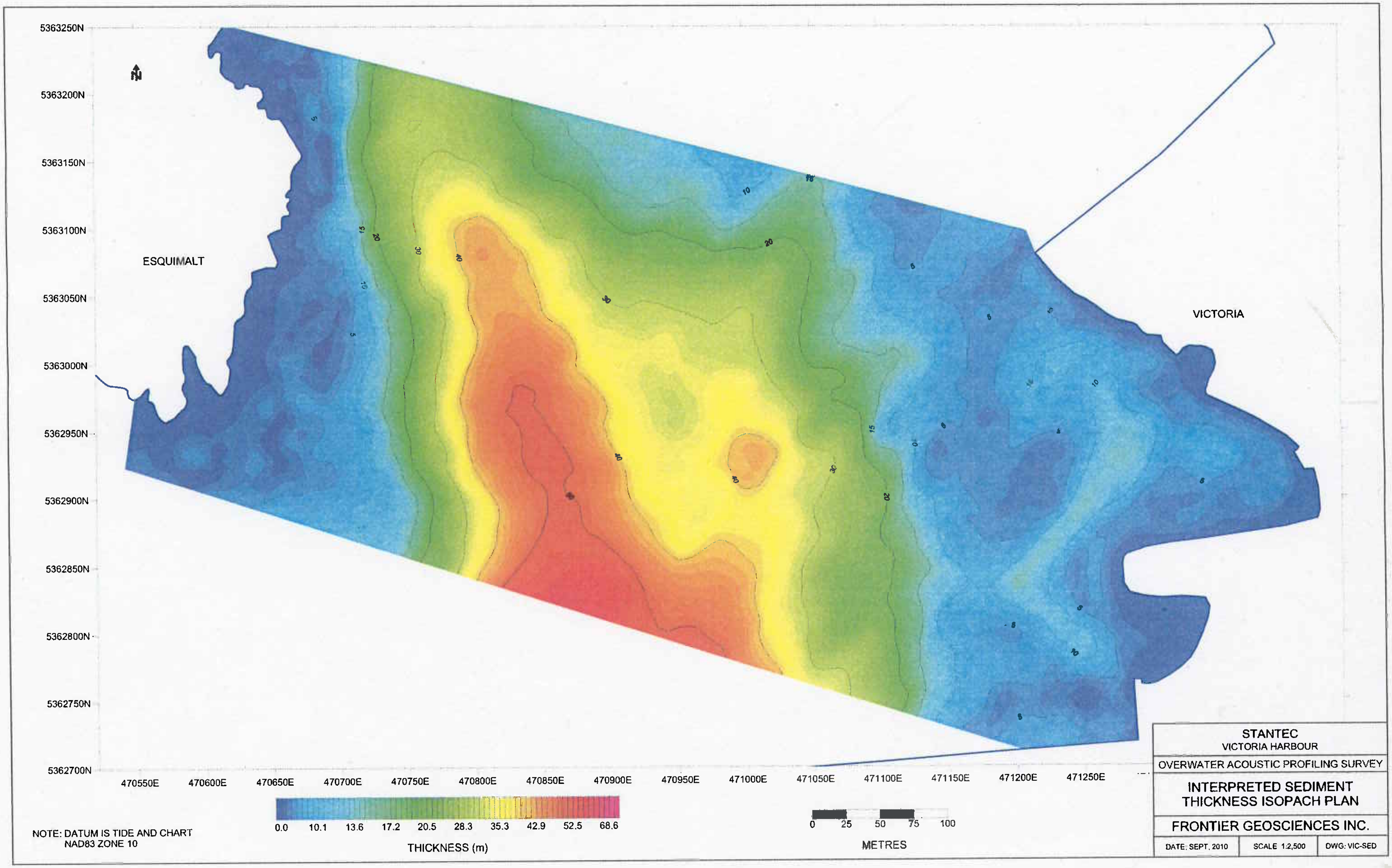
STANTEC
VICTORIA HARBOUR

OVERWATER ACOUSTIC PROFILING SURVEY

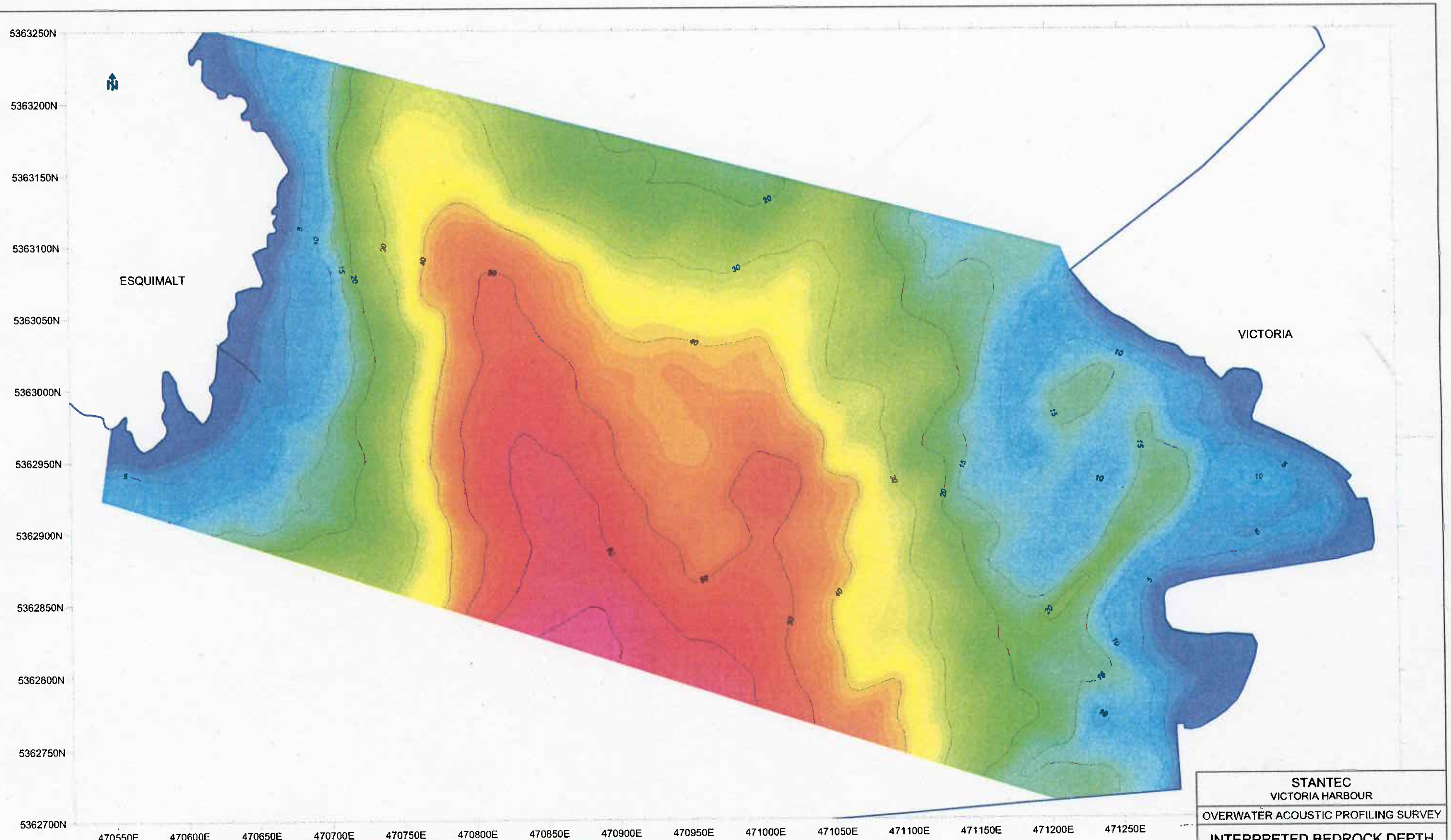
BATHYMETRIC
CONTOUR PLAN

FRONTIER GEOSCIENCES INC.

DATE: SEPT 2010	SCALE 1:2,500	DWG: VIC-BAT



5363250N
5363200N
5363150N
5363100N
5363050N
5363000N
5362950N
5362900N
5362850N
5362800N
5362750N
5362700N
470550E
470600E
470650E
470700E
470750E
470800E
470850E
470900E
470950E
471000E
471050E
471100E
471150E
471200E
471250E
ESQUIMALT
VICTORIA
0.0 10.1 13.6 17.2 20.5 28.3 35.3 42.9 52.5 68.6
THICKNESS (m)
0 25 50 75 100
METRES
NOTE: DATUM IS TIDE AND CHART
NAD83 ZONE 10
STANTEC
VICTORIA HARBOUR
OVERWATER ACOUSTIC PROFILING SURVEY
INTERPRETED SEDIMENT THICKNESS ISOPACH PLAN
FRONTIER GEOSCIENCES INC.
DATE: SEPT. 2010
SCALE 1:2,500
DWG: VIC-SED



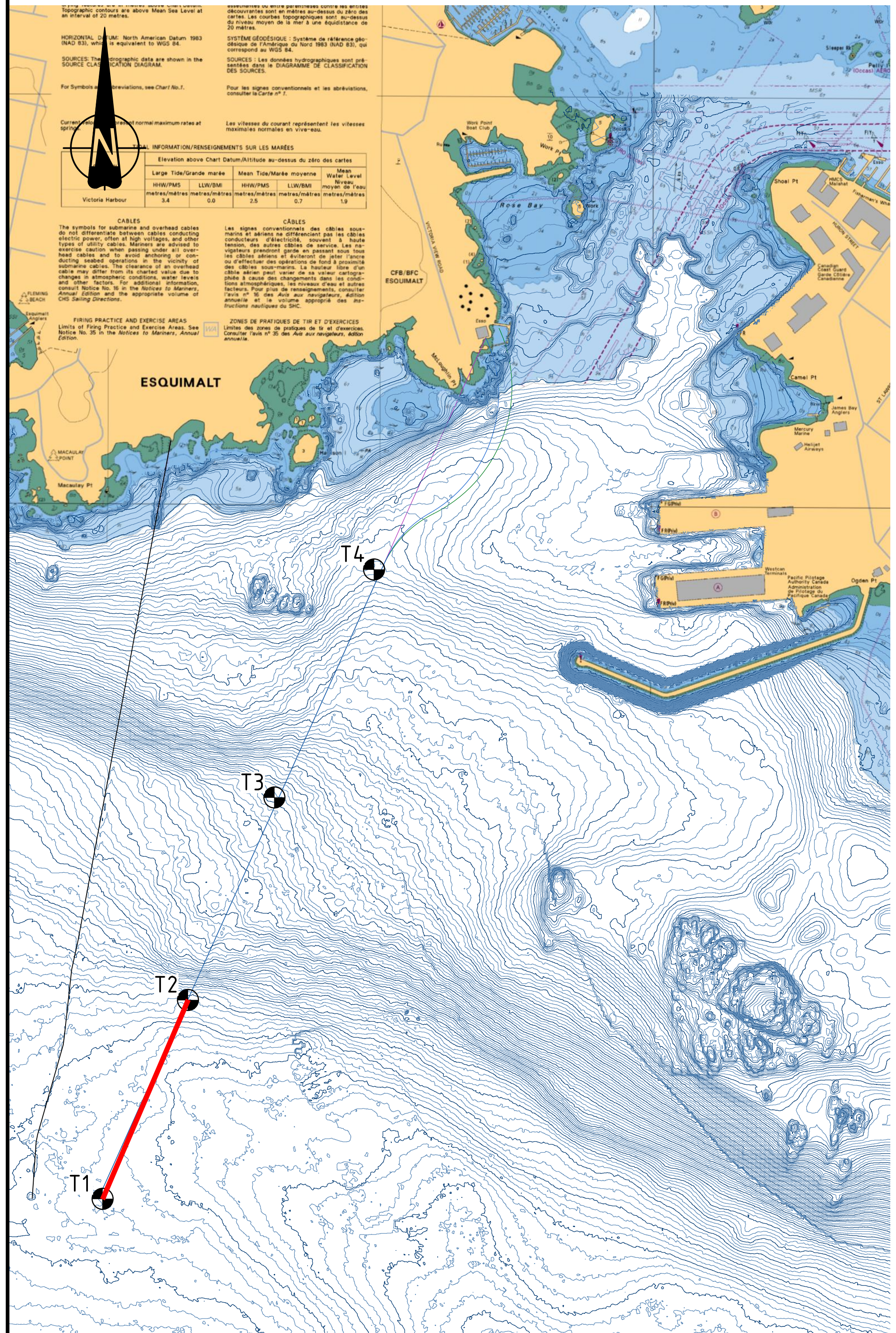
NOTE: DATUM IS TIDE AND CHART
NAD83 ZONE 10

DEPTH (m): 0.0, 10.1, 13.6, 17.2, 20.5, 28.3, 35.3, 42.9, 52.5, 68.6

METRES: 0, 25, 50, 75, 100

STANTEC VICTORIA HARBOUR		
OVERWATER ACOUSTIC PROFILING SURVEY		
INTERPRETED BEDROCK DEPTH CONTOUR PLAN		
FRONTIER GEOSCIENCES INC.		
DATE: SEPT. 2010	SCALE 1:2,500	DWG. VIC-BED

Appendix 4 ROV Seabed Survey



SITE PLAN

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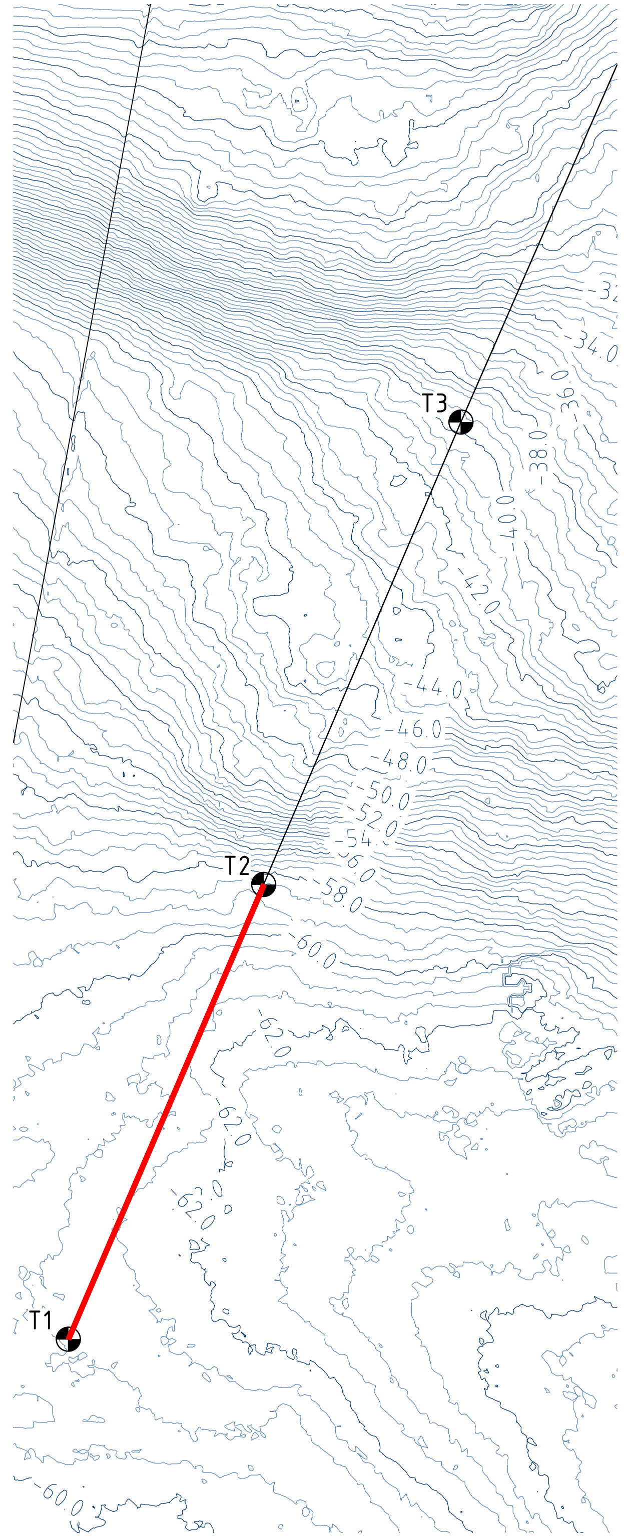
1:15000



KEY PLAN

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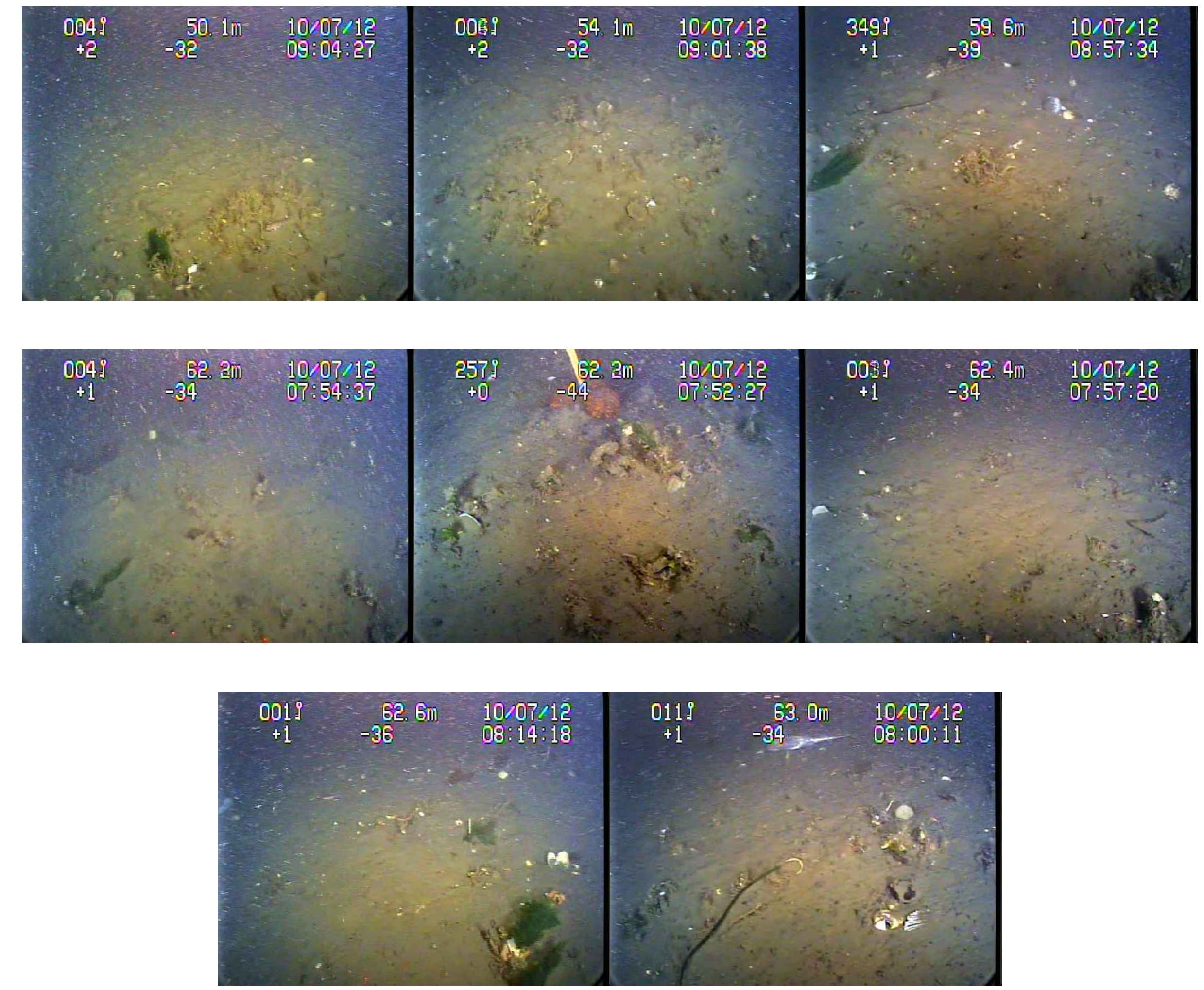
1:7500

T1 TO T2



SOURCE: CANADIAN HYDROGRAPH SERVICES 2005 – VICTORIA HARBOUR CHART #3412
SOURCE: CANADIAN HYDROGRAPH SERVICES 2012 – UNPUBLISHED/MULTIBEAM DATA, 5m RESOLUTION
DEPTH DATUM: METERS RELATIVE TO HYDROGRAPHIC CHART DATUM

CAPITAL REGIONAL DISTRICT
MCLOUGHLIN POINT OUTFALL
SITING STUDY

ROV SEABED SURVEY
T1 TO T2

Date: 29-JAN-13	Drawn by: KL	Edited by: CM	App'd by: JC

OneWay to zero harm

WorleyParsons resources & energy

WorleyParsons Project No. 307071-00623

FIG No **App. 4-1** REV **A**

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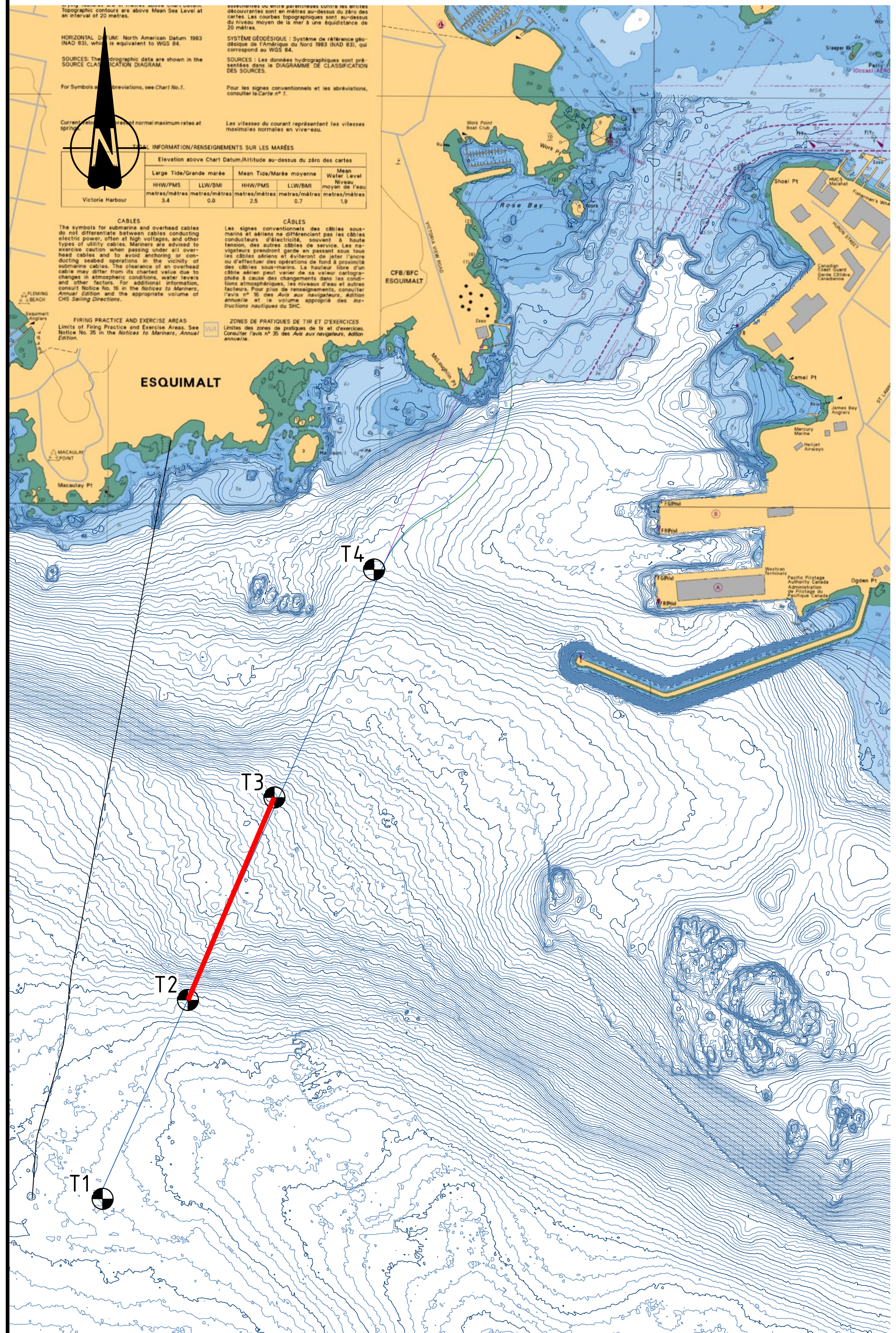

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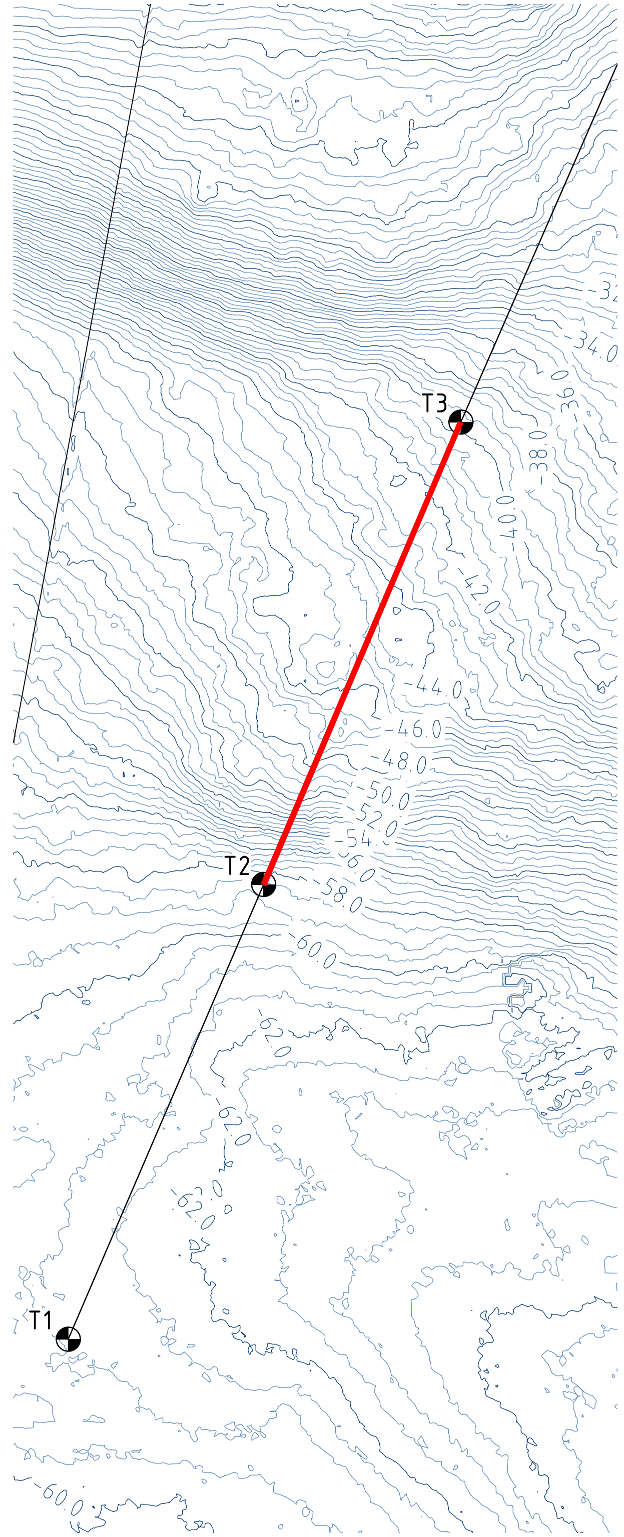

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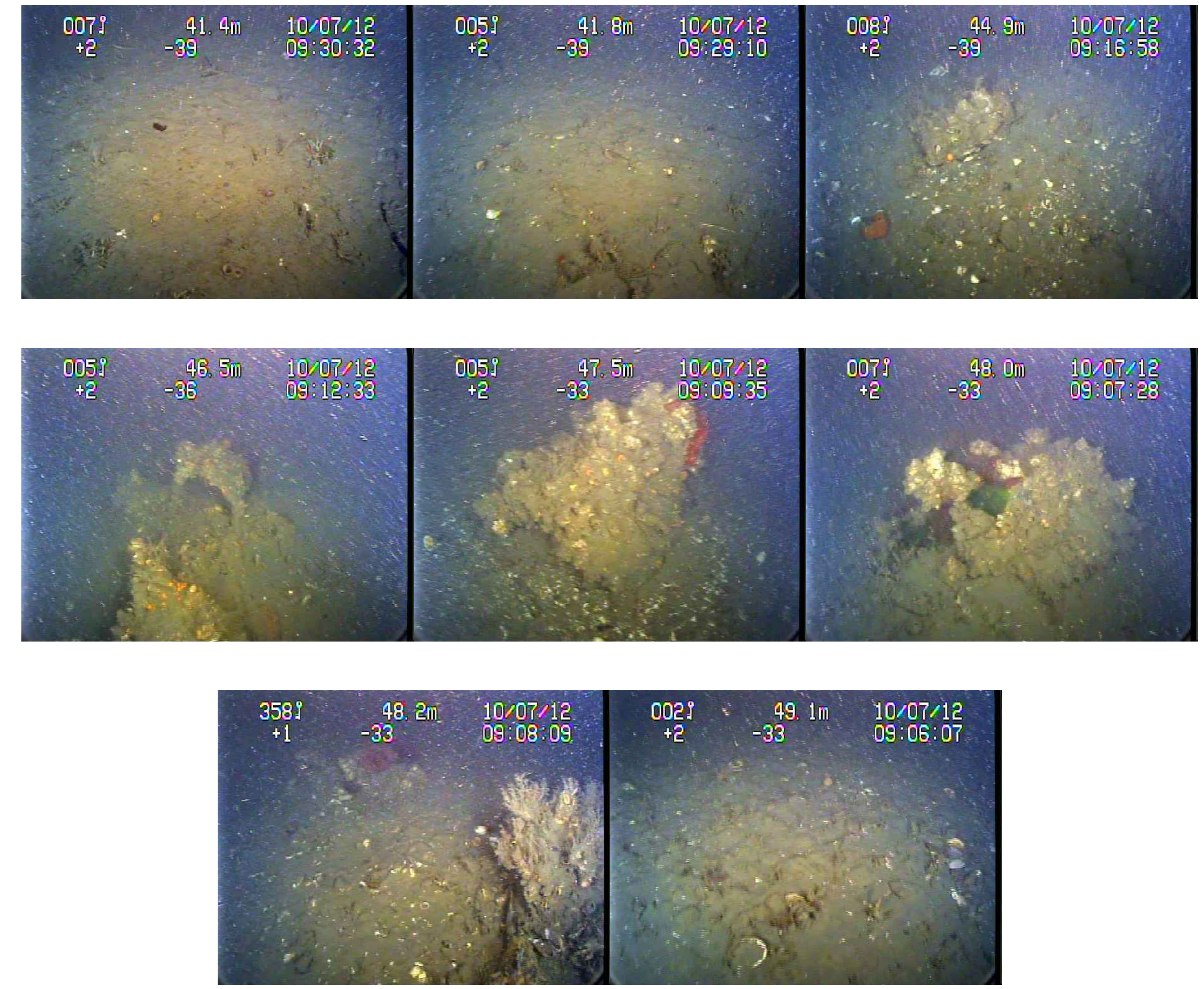
1:7500

T2 TO T3



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SOURCE: CANADIAN HYDROGRAPH SERVICES 2012 - UNPUBLISHED/MULTIBEAM DATA, 5m RESOLUTION
DEPTH DATUM: METERS RELATIVE TO HYDROGRAPHIC CHART DATUM

CAPITAL REGIONAL DISTRICT
MCLOUGHLIN POINT OUTFALL
SITING STUDY

ROV SEABED SURVEY
T2 TO T3

Date:	29-JAN-13	Drawn by:	KL	Edited by:	CM	App'd by:	JC

OneWay to zero harm

WorleyParsons resources & energy

WorleyParsons Project No. 307071-00623

FIG No App. 4-2

REV A

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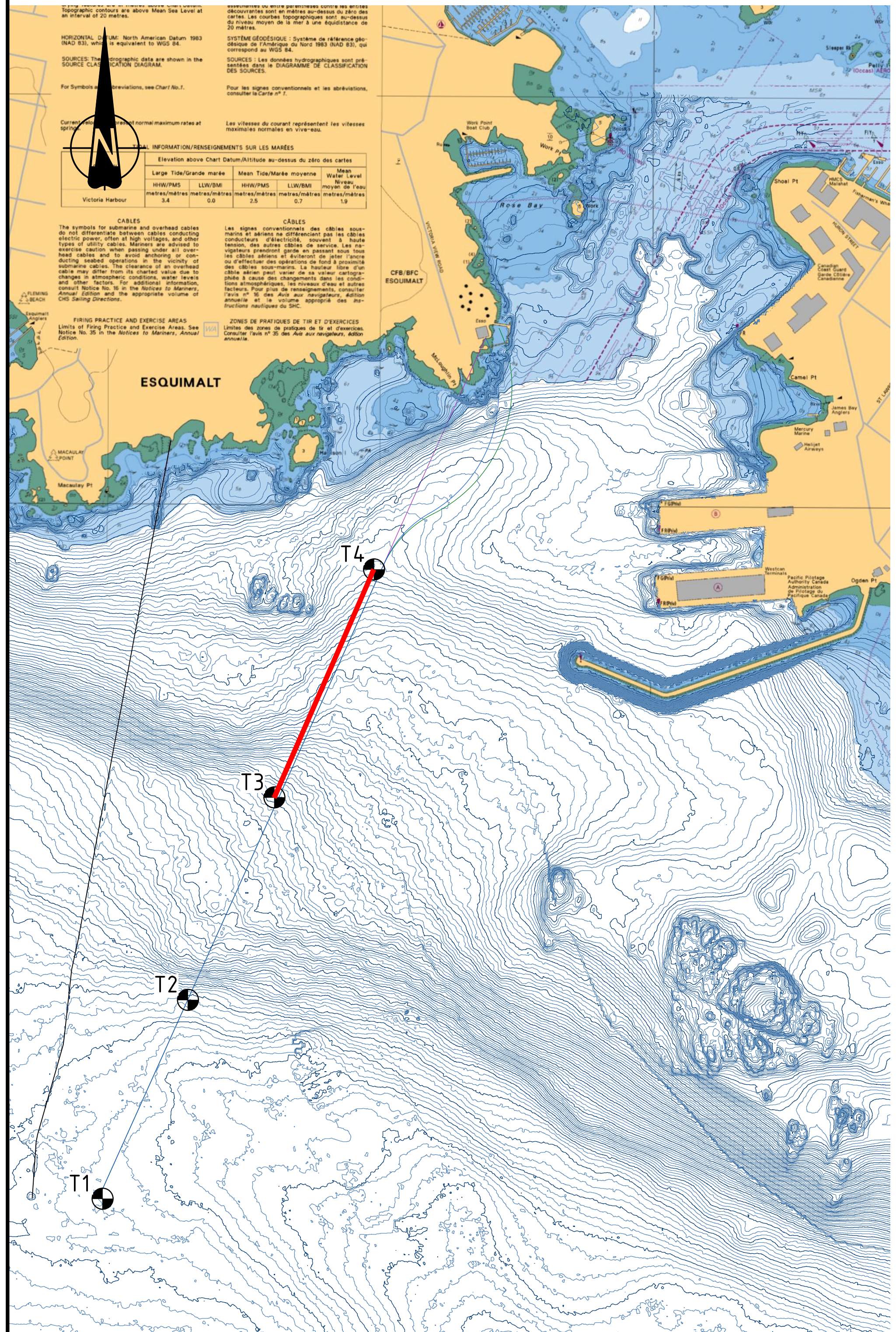

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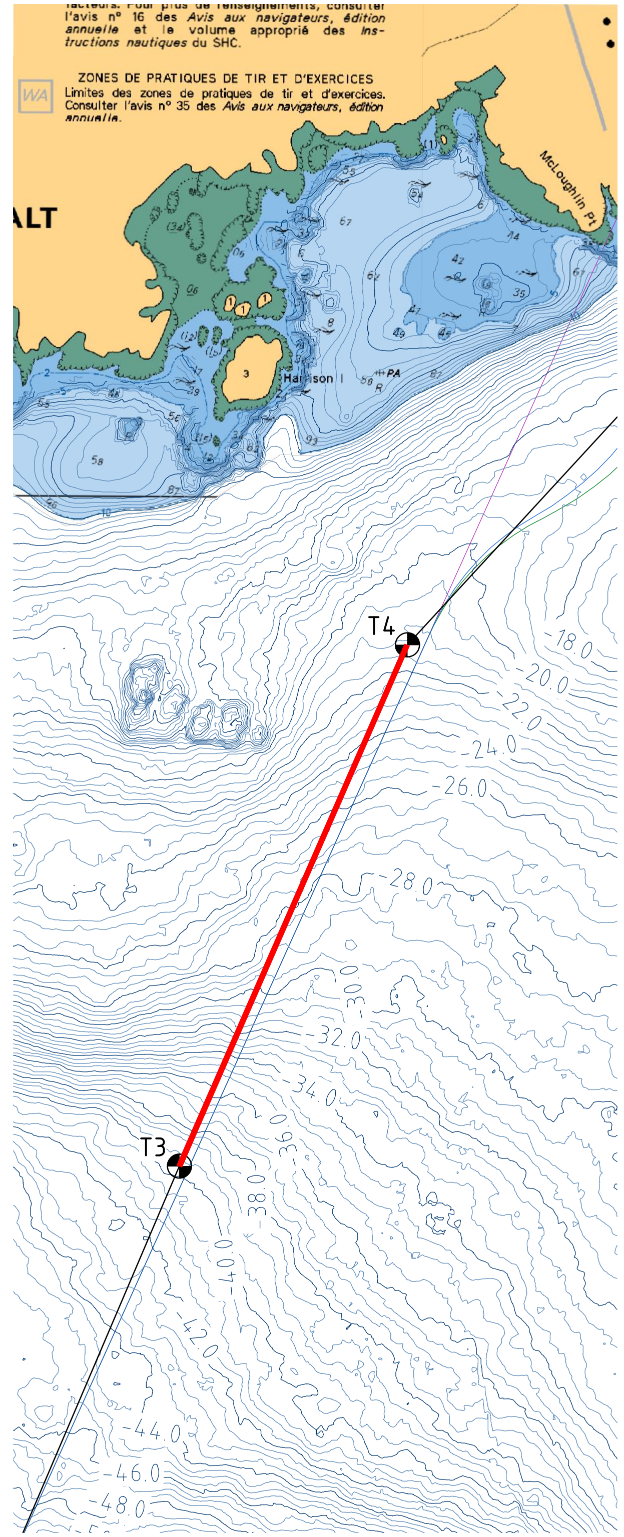
1:15000



KEY PLAN

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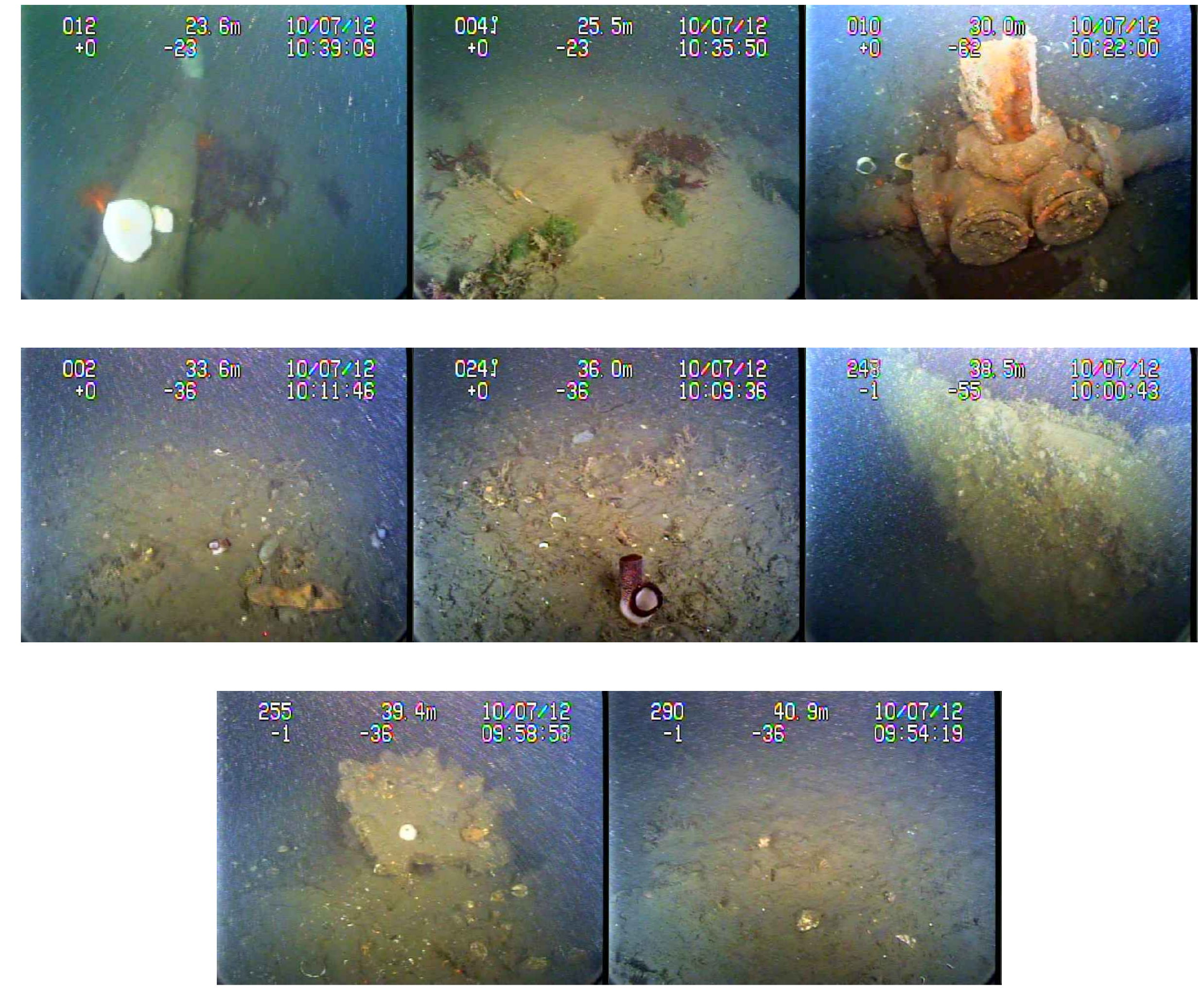
m 0 100 200 300 400 m

1:7500

T3 TO T4



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SOURCE: CANADIAN HYDROGRAPH SERVICES 2012 - UNPUBLISHED/MULTIBEAM DATA, 5m RESOLUTION
DEPTH DATUM: METERS RELATIVE TO HYDROGRAPHIC CHART DATUM

CAPITAL REGIONAL DISTRICT MCLOUGHLIN POINT OUTFALL SITING STUDY			
ROV SEABED SURVEY T3 TO T4			
Date: 29-JAN-13	Drawn by: KL	Edited by: CM	App'd by: JC
OneWay to zero harm	WorleyParsons resources & energy	WorleyParsons Project No. 307071-00623	
		FIG No **App. 4-3**	REV **A**

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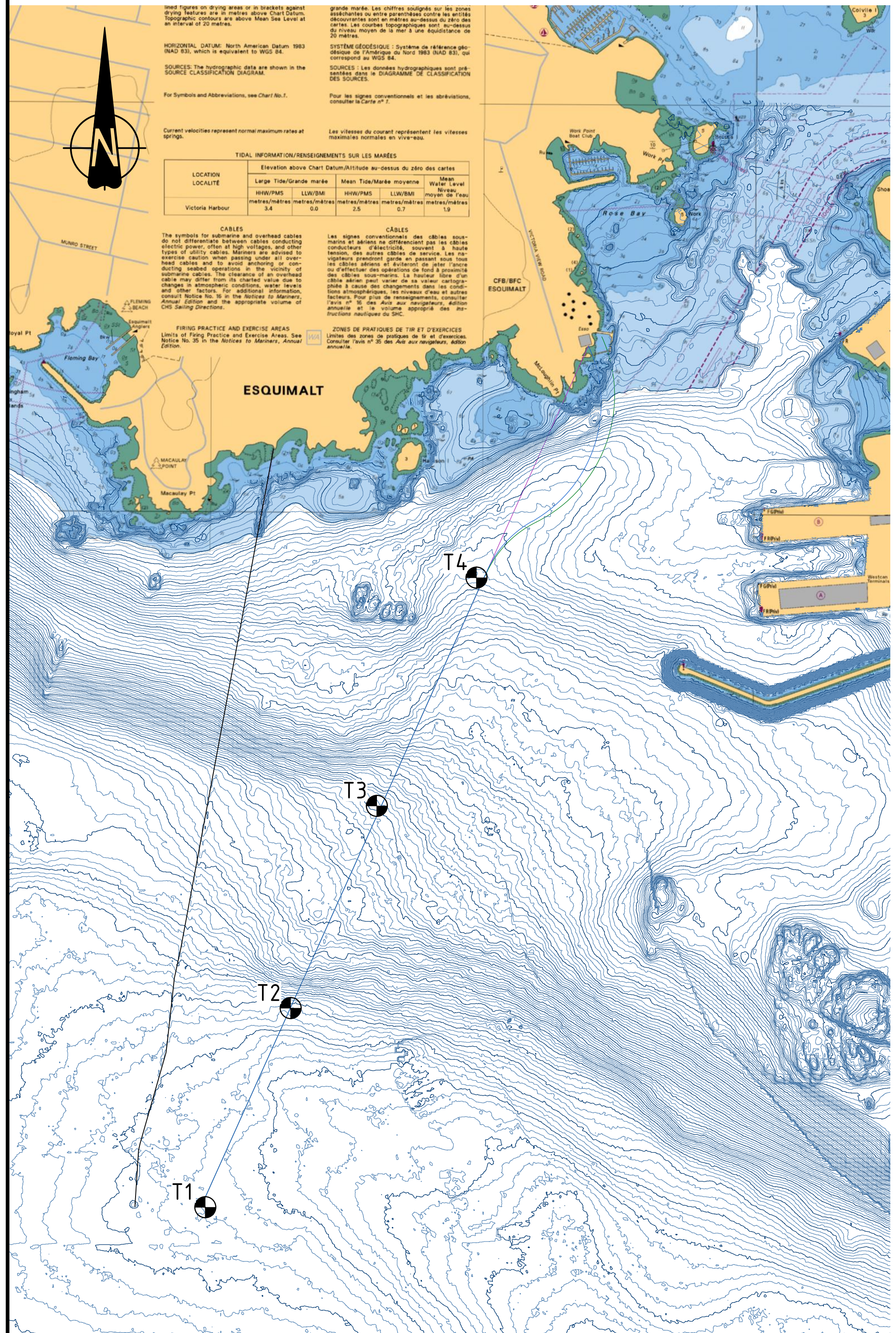

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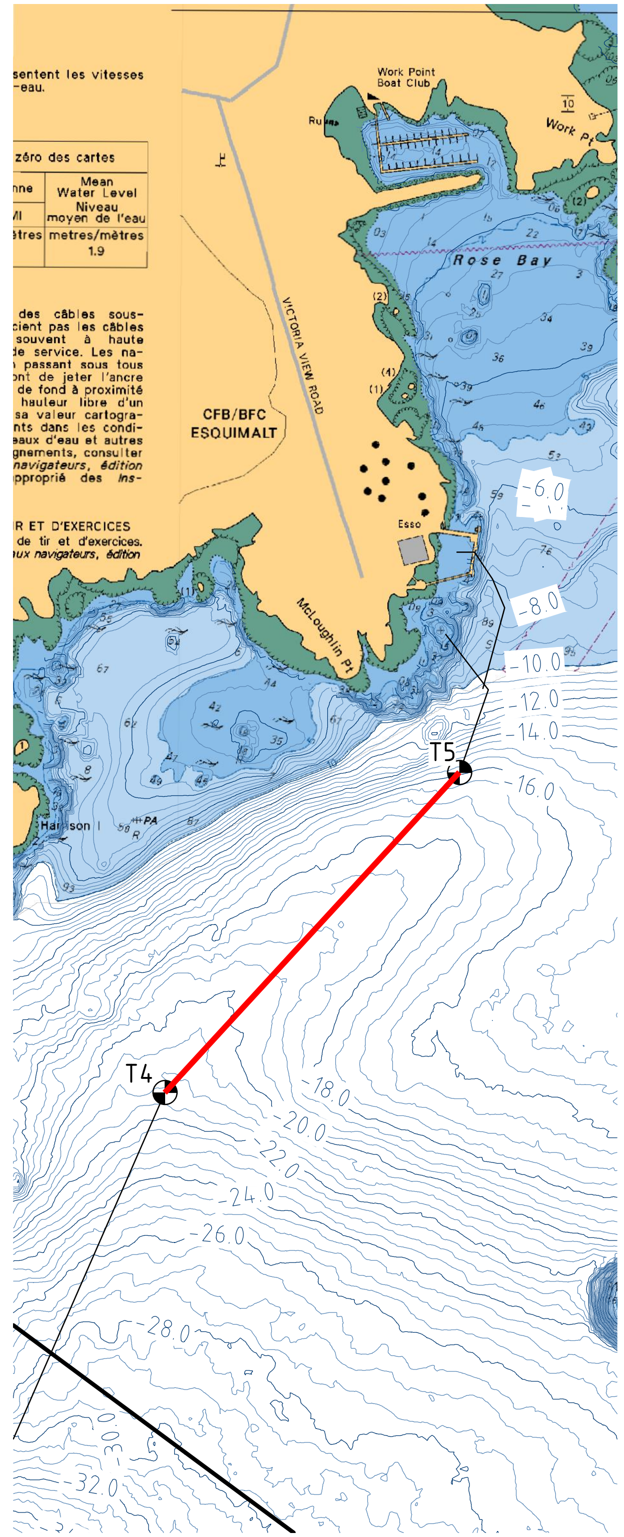
1:15000



KEY PLAN

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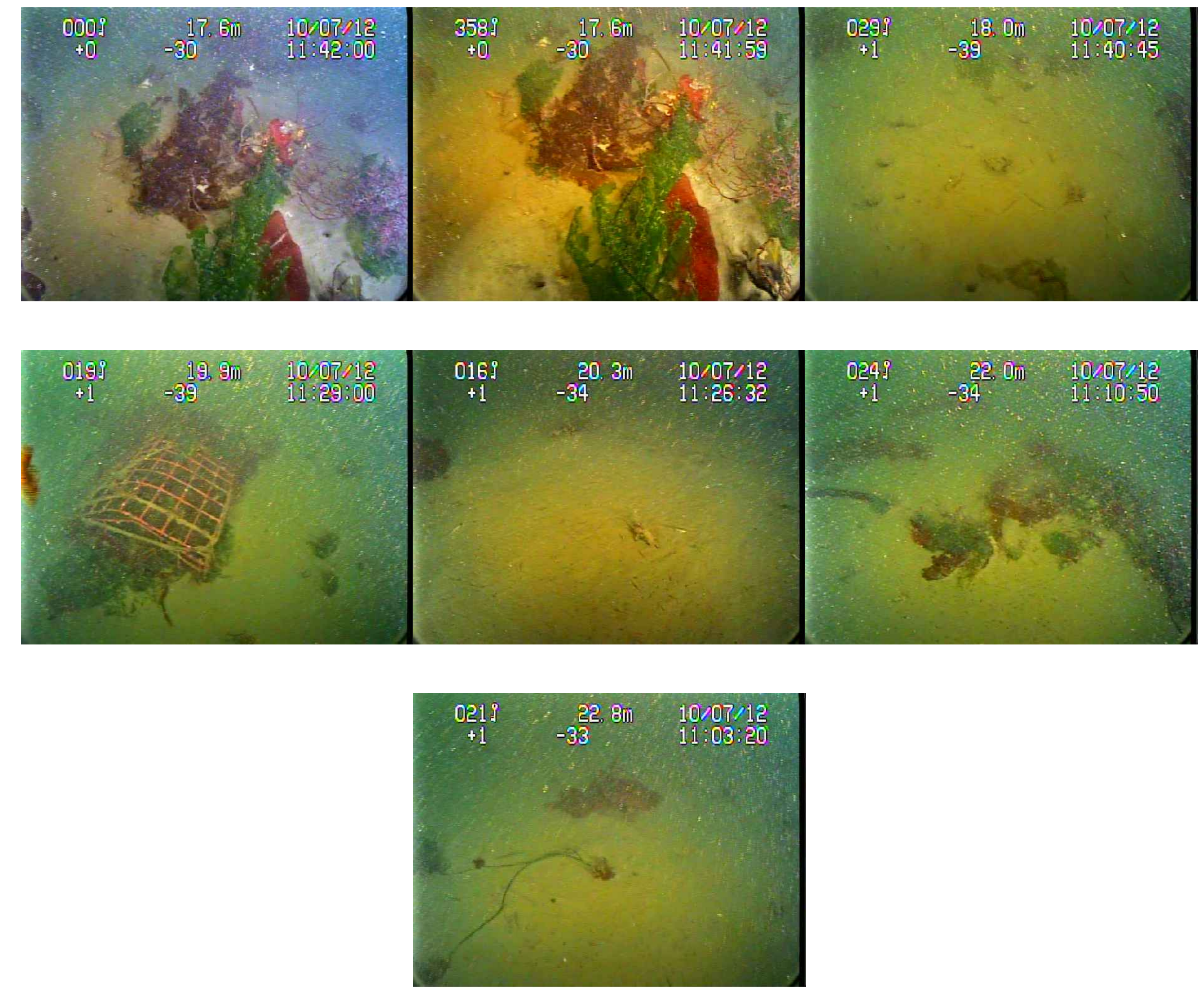
m 0 50 100 m

1:2000

T4 TO T5



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SOURCE: CANADIAN HYDROGRAPH SERVICES 2012 – UNPUBLISHED/MULTIBEAM DATA, 5m RESOLUTION
DEPTH DATUM: METERS RELATIVE TO HYDROGRAPHIC CHART DATUM

CAPITAL REGIONAL DISTRICT
MCLOUGHLIN POINT OUTFALL
SITING STUDY

ROV SEABED SURVEY
T4 TO T5

Date: 29-JAN-13	Drawn by: KL	Edited by: CM	App'd by: JC

OneWay to zero harm

WorleyParsons resources & energy

WorleyParsons Project No. 307071-00623

FIG No **App. 4-4** REV **A**

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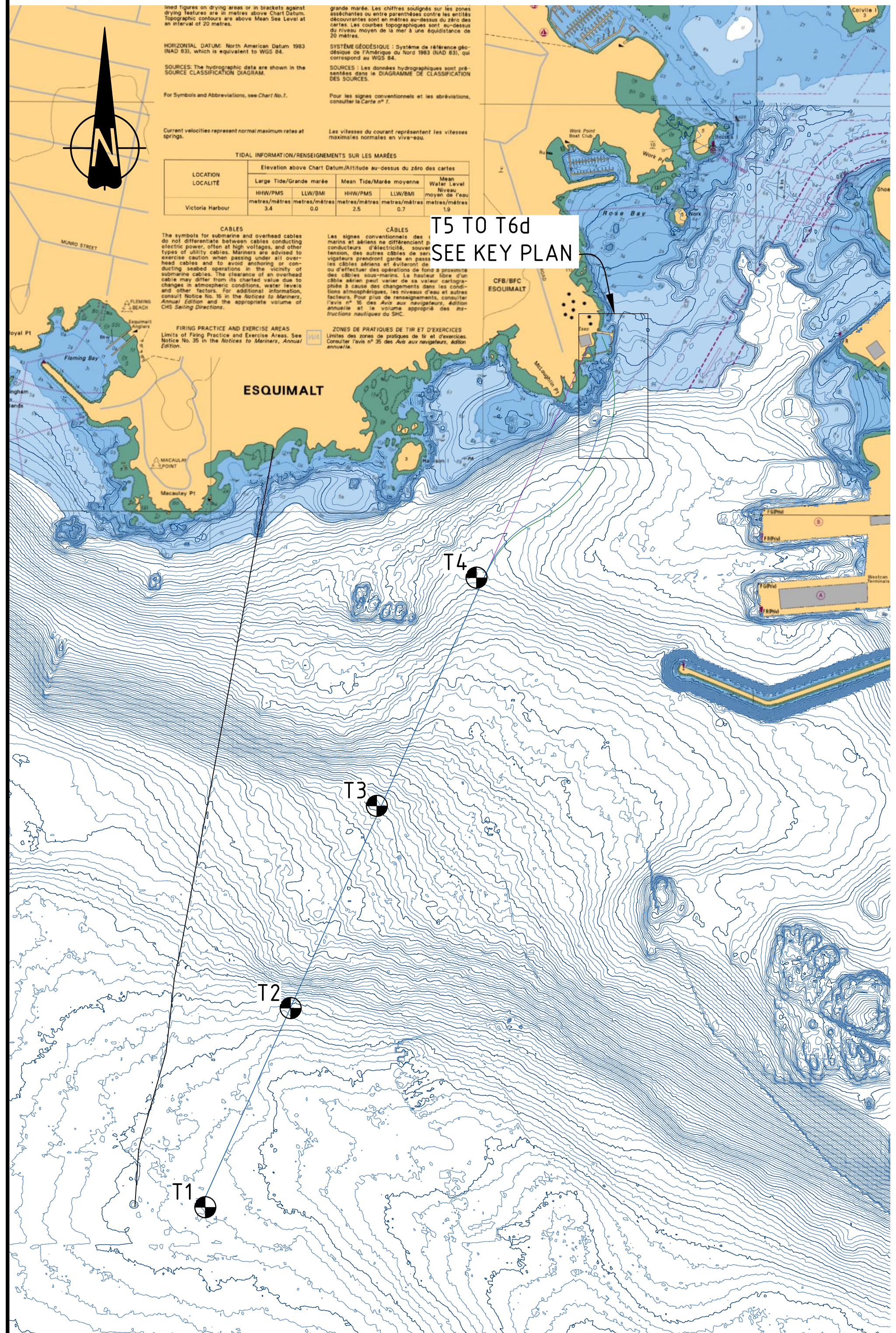

SITE PLAN

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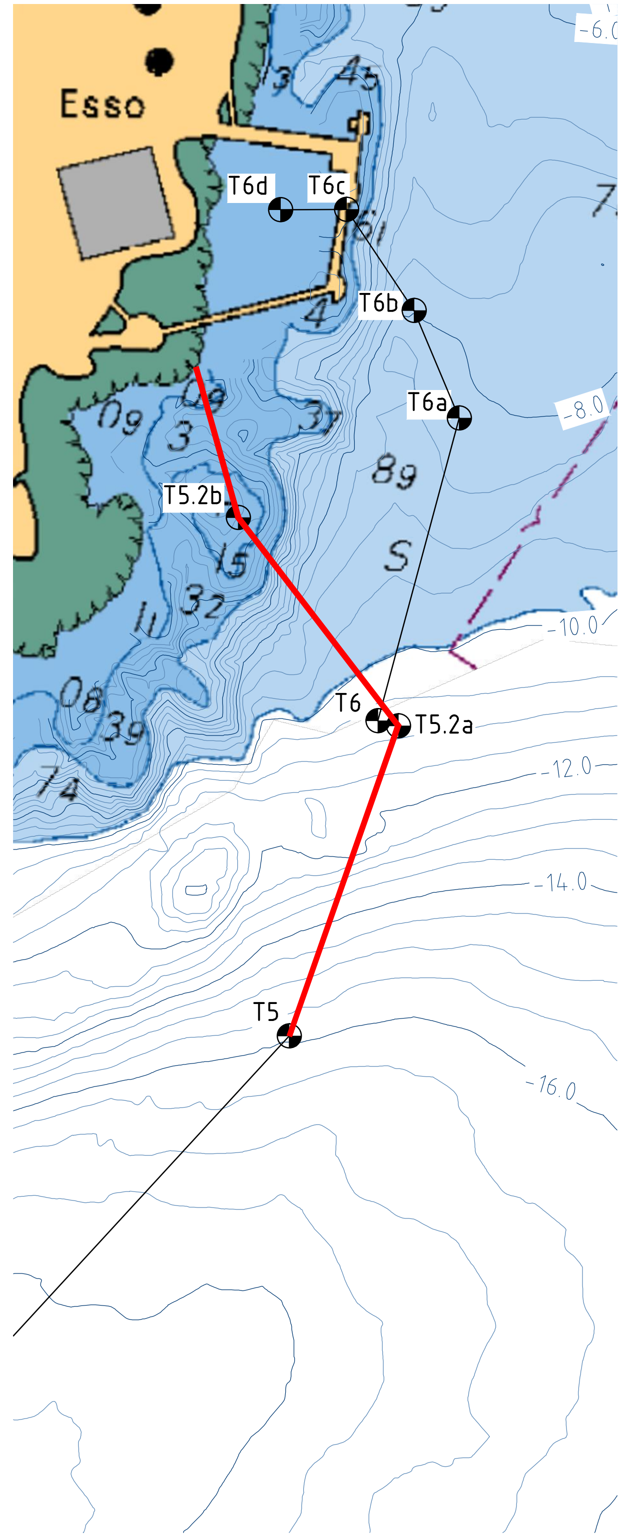

KEY PLAN

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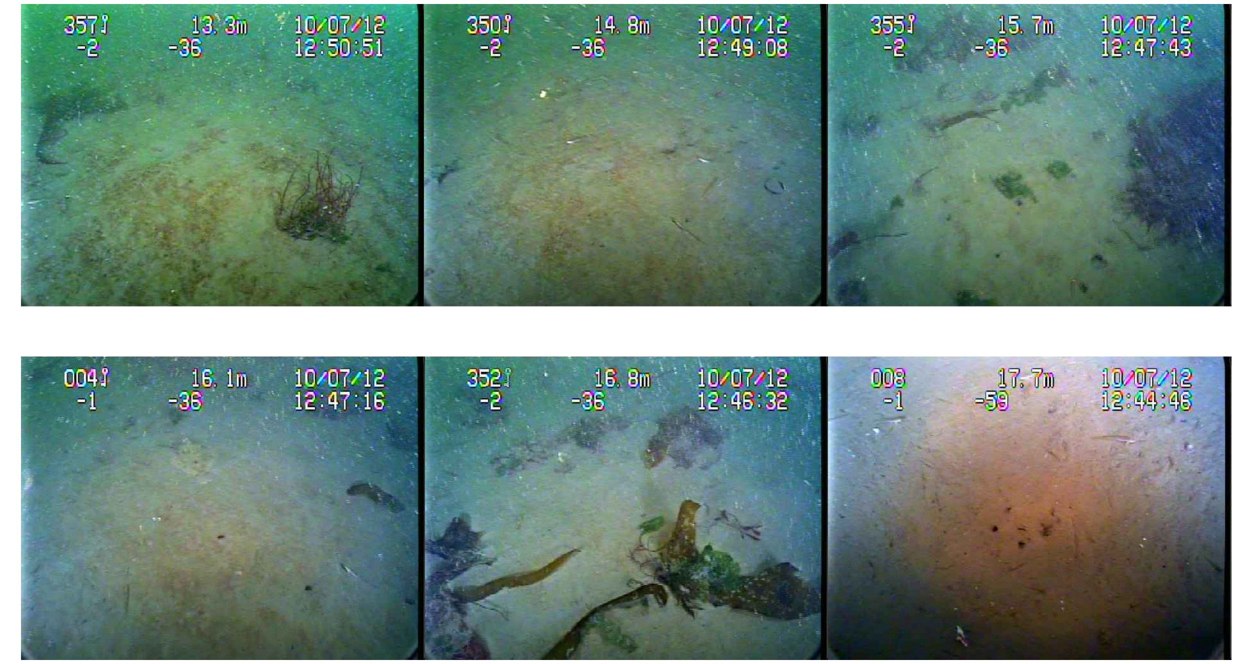
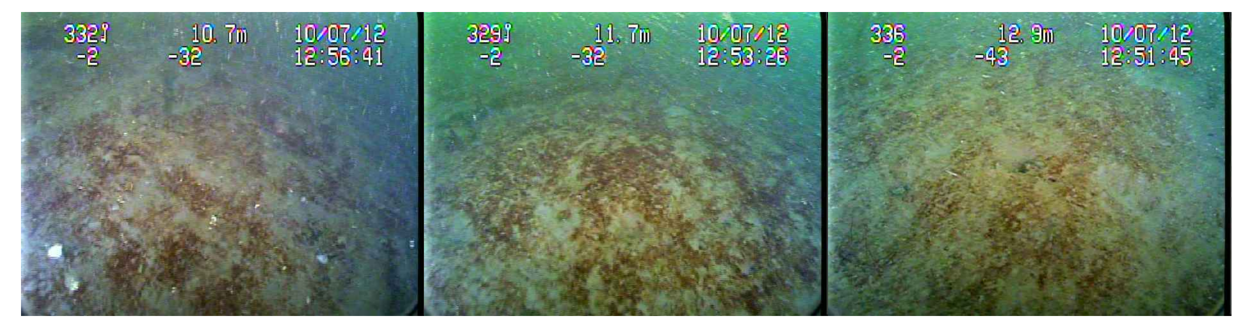
m 0 50 100 m

1:2000

T5 TO T5.2a



T5.2a TO T5.2b



T5.2b TO SHORELINE

SOURCE: CANADIAN HYDROGRAPH SERVICES 2005 - VICTORIA HARBOUR CHART #3412
SOURCE: CANADIAN HYDROGRAPH SERVICES 2012 - UNPUBLISHED/MULTIBEAM DATA, 5m RESOLUTION
DEPTH DATUM: METERS RELATIVE TO HYDROGRAPHIC CHART DATUM

FILE LOCATION: J:\307071\00623_CRD_OUTFALL\11_DRAWINGS\15_I_AND_E\02_MARINE\307071-00623-00-MA-DAL-1000.DWG

CAPITAL REGIONAL DISTRICT
MCLOUGHLIN POINT OUTFALL
SITING STUDY

ROV SEABED SURVEY
T5 TO 5.2a, T5.2a TO 5.2b & T.52b TO SHORELINE

OneWay to zero harm

WorleyParsons resources & energy

Date: 29-JAN-13	Drawn by: KL	Edited by: CM	App'd by: JC

WorleyParsons Project No. 307071-00623

FIG No **App. 4-5** REV **A**

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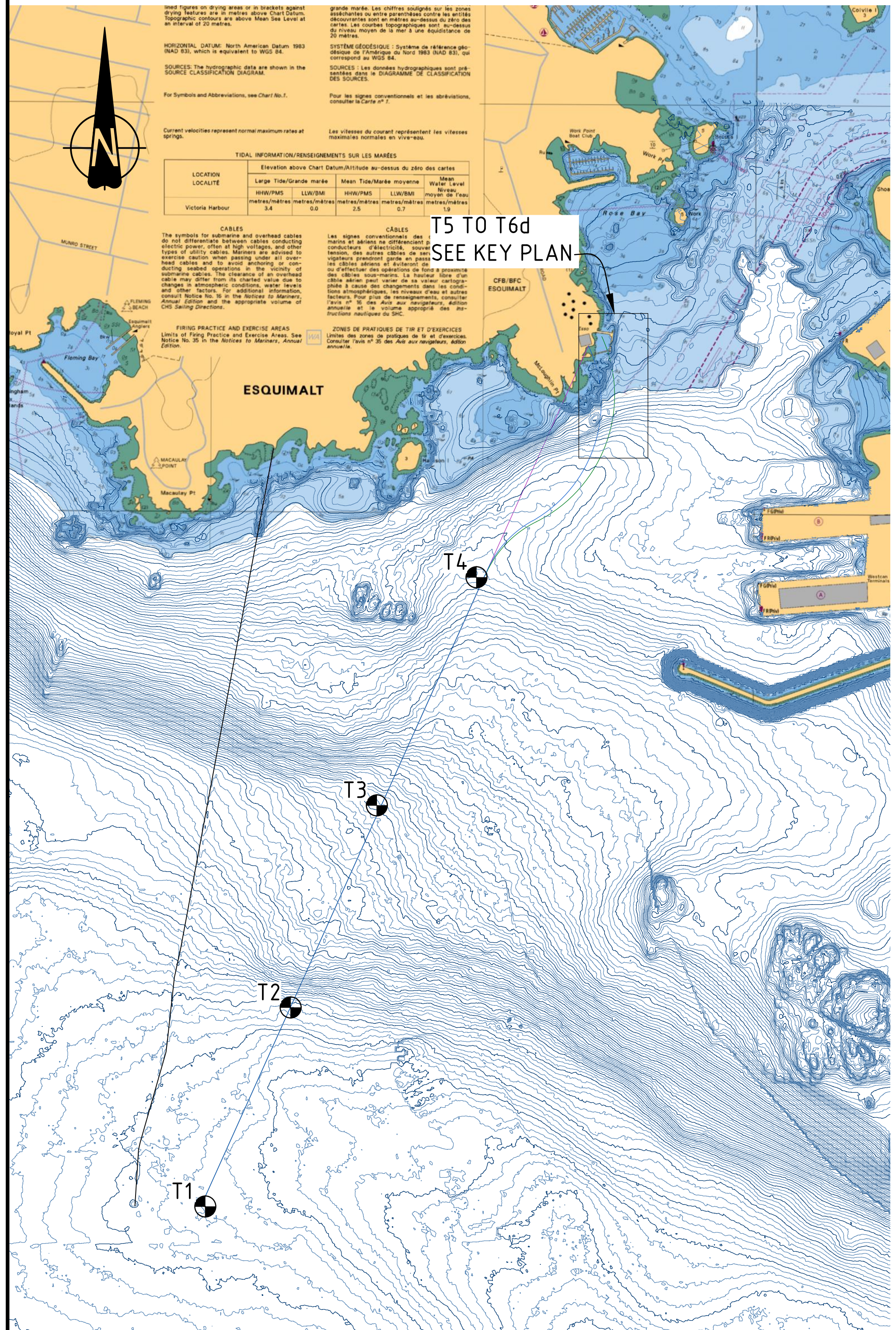
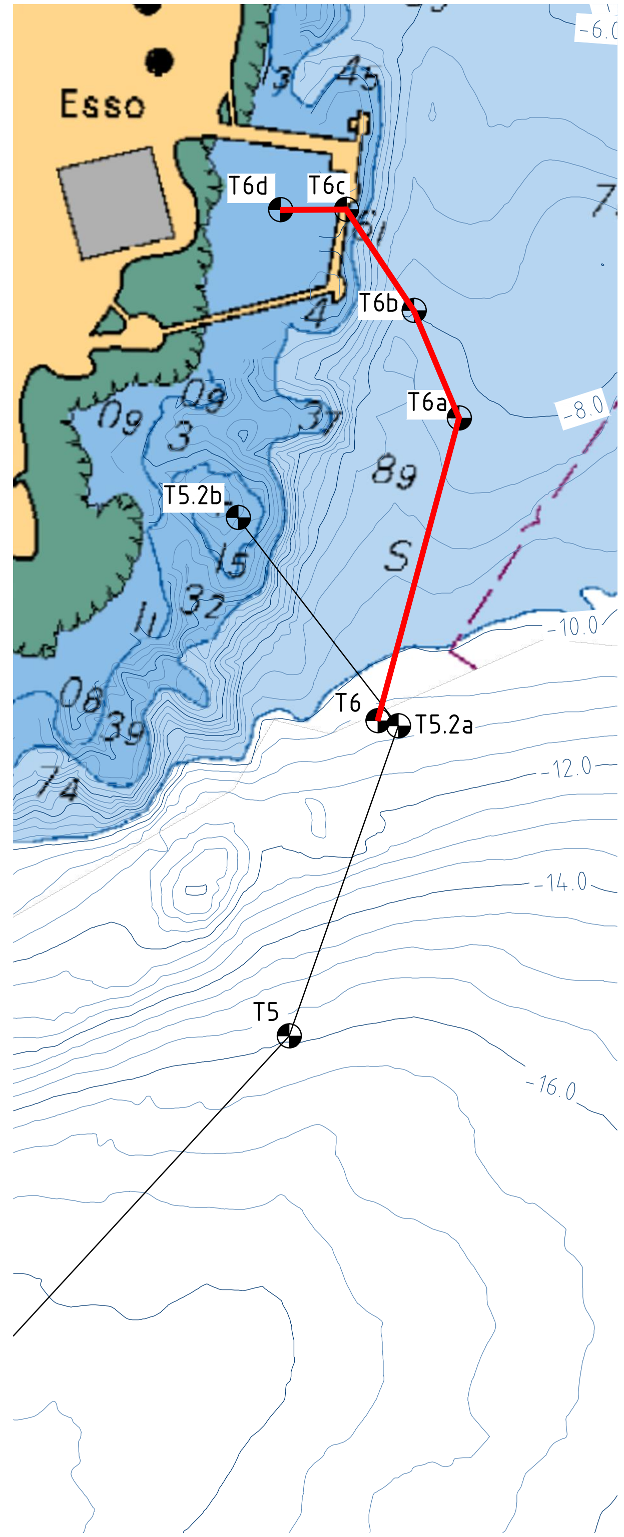


SITE PLAN

1:15000

m 0 100 300 500 1000 m

1:15000



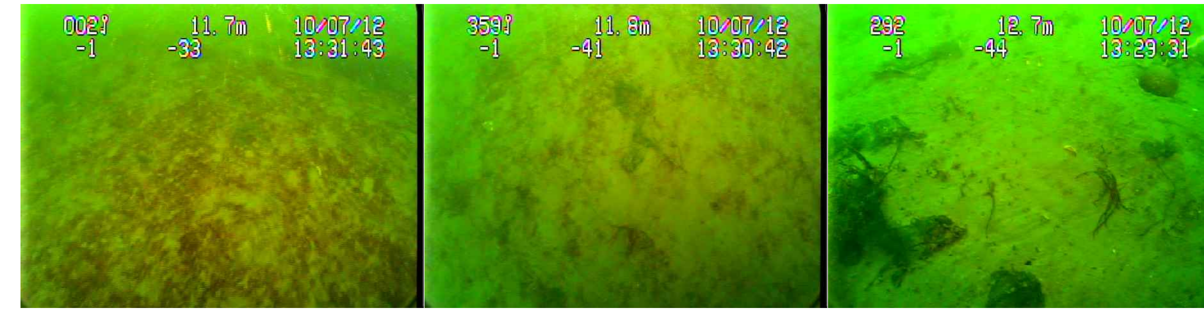
KEY PLAN

1:2000

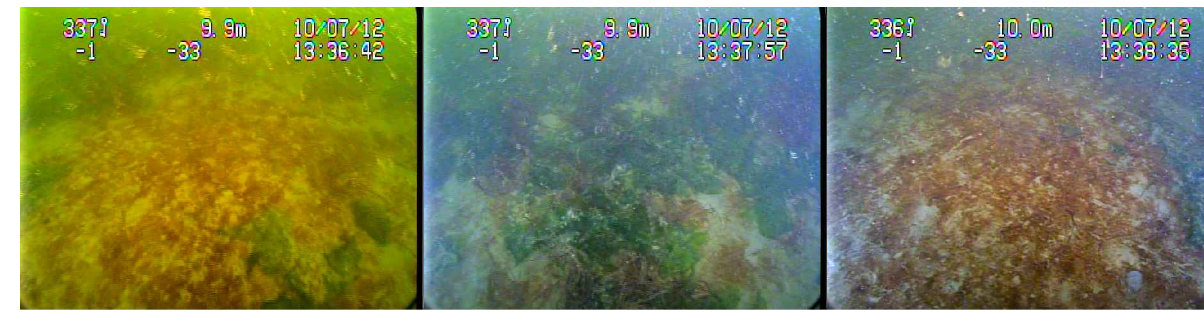
m 0 50 100 m

1:2000

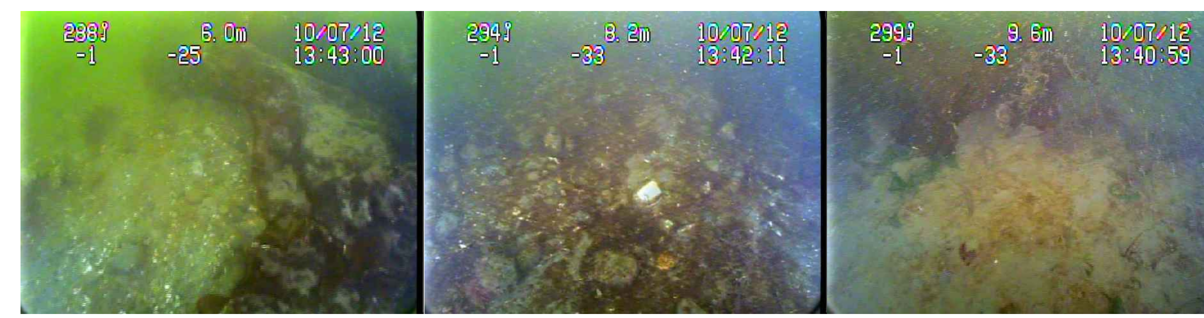
T6 TO T6a



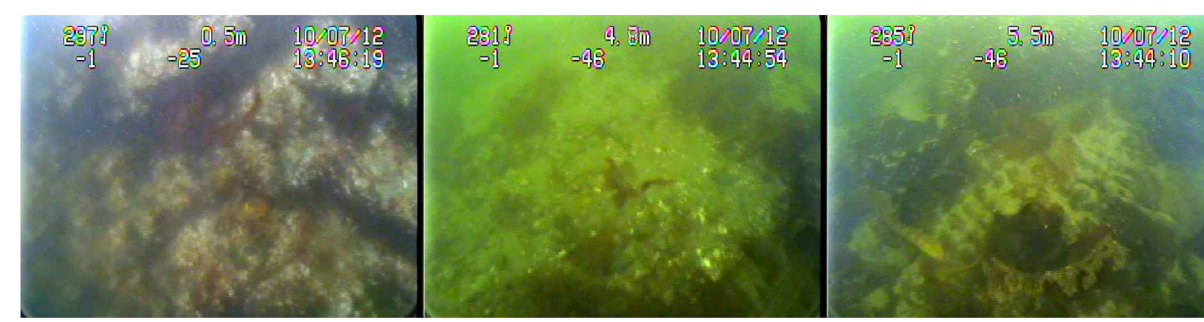
T6a TO T6b



T6b TO T6c



T6c TO T6d



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SOURCE: CANADIAN HYDROGRAPH SERVICES 2012 - UNPUBLISHED/MULTIBEAM DATA, 5m RESOLUTION
DEPTH DATUM: METERS RELATIVE TO HYDROGRAPHIC CHART DATUM

CAPITAL REGIONAL DISTRICT
MCLOUGHLIN POINT OUTFALL
SITING STUDY

ROV SEABED SURVEY
T6 TO T6a, T6a TO T6b, T6B TO T6c & T6c TO T6d

Date: 29-JAN-13	Drawn by: KL	Edited by: CM	App'd by: JC
WorleyParsons Project No. 307071-00623		FIG No App. 4-6	REV A

OneWay to zero harm — WorleyParsons resources & energy

FILE LOCATION: J:\307071\00623_CRD_OUTFALL\11_DRAWINGS\15_I_AND_E\02_MARINE\307071-00623-00-MA-DAL-1000.DWG

Appendix 5 Macaulay Point Outfall Construction

1. REVIEW OF MACAULAY POINT OUTFALL CONSTRUCTION

1.1 PURPOSE

The purpose of this review is to summarise the construction efforts expended on the original Macaulay Point Outfall construction and subsequent upgrading / remedial work. The intent is to provide a degree of familiarity with this facility and its design features for application (as relevant) to the proposed McLoughlin Point Outfall.

1.2 BACKGROUND

The Macaulay point outfall was constructed in the fall of 1971 with an anticipated design horizon of 50 years. The outfall was designed by Associated Engineering Services Ltd. The outfall is constructed of 36 inch (910 mm) diameter, 3/8 inch thick, welded seam steel pipe, coated and lined with coal tar enamel. The pipe is protected from corrosion with a cathodic protection system.

The outfall extends 1.8 km on an alignment of N10˚ 17' 20" E from the Macaulay Point Pump Station to a final terminus in 60 m water depth. The terminus of the pipe was originally a 150 m long staged diffuser, reducing from full pipe diameter to a 200 mm diameter end section.

During the initial outfall construction the final 66 m of the outfall was accidentally broken off. This section was subsequently replaced in November of 1971 with an HDPE diffuser varying in diameter from 610 mm to 450 mm

During an inspection in the late 1970's, it was discovered that the final portion of the HDPE diffuser replacement had also broken off and the majority of the effluent was coming out of the open ended pipe. In 1987 a repair program was developed and implemented to restore the outfall to its original design functionality.

1.3 Summary of Design

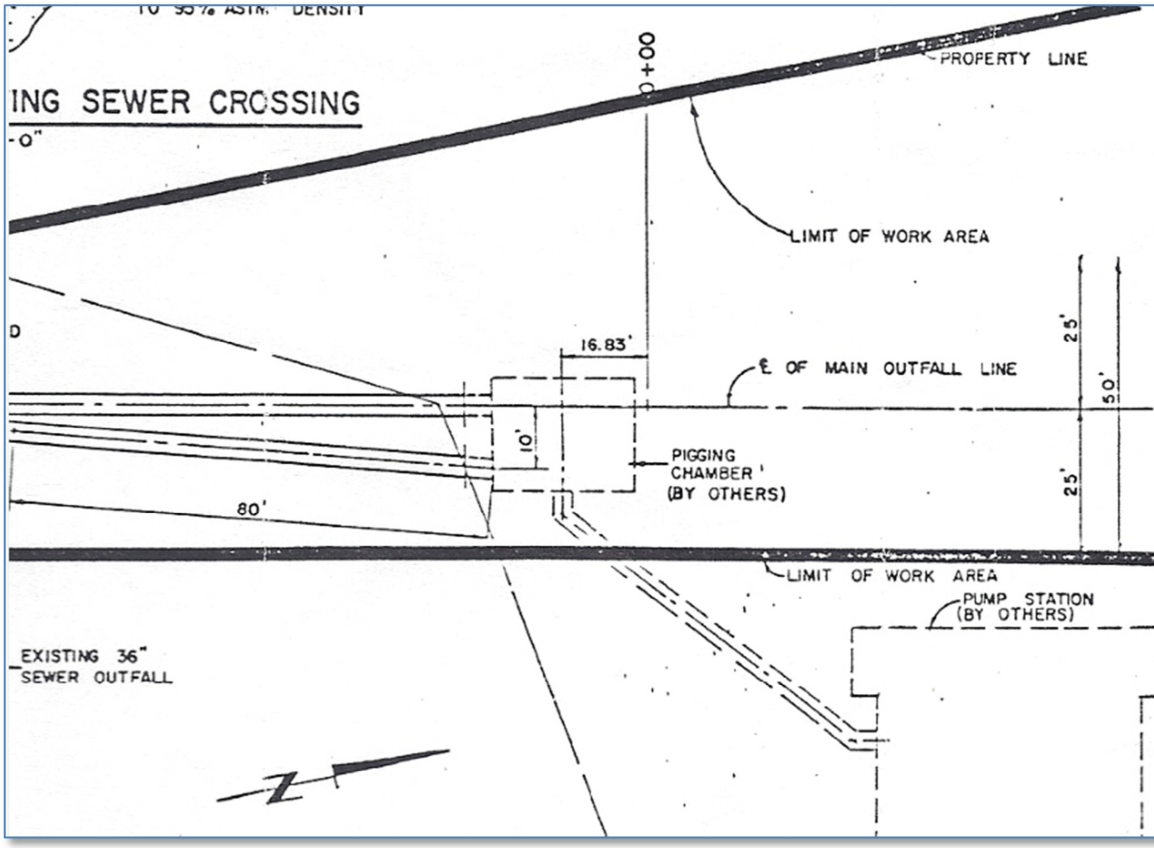
Design features of the Macaulay Point outfall include:

- pigging chamber at shoreline terminus;
- emergency overflow;
- inspection man way (man hole);
- pig removal hatch;
- protection in the intertidal / shallow subtidal zone;

Pigging Chamber at Shoreline Terminus and Emergency Overflow

At the top of the bank prior to the outfall entering the ocean, there is a "pigging chamber" which allows physical access to the outfall (see Figure A). Both the outfall and an emergency overflow can be accessed from this facility.

Figure A **Pigging chamber**



Source: Associated Engineering Services Ltd. 1970

Although the frequency of use of this facility over the lifetime of the outfall is unknown, it is certain that the overflow was accessed at least once during the repair to the diffuser in 1987. It is likely that it was also used in 1971 when the HDPE replacement diffuser was attached.

Although the applicability of "pigging" a large diameter outfall is questionable, the concept of providing physical access is worthy of consideration. In the case of the Macaulay Point outfall, the "pigging chamber" provides access for the diversion of flows from the primary outfall to the emergency overflow. A facility of this nature would also provide physical access for a tethered inspection vehicle to do internal inspections. ROV technology is available to conduct internal inspections through large diameter outfalls, and this facility can be incorporated into the design to launch and retrieve ROV's as well as to easily divert flows between the primary and emergency outfalls.

Emergency Overflow

The capability to flow to an emergency overflow is essential for an outfall of this significance (note that there is an emergency outfall for the Clover Point outfall as well). An overflow will be required when there is the need for maintenance or repair of the primary outfall.

Inspection man way (man hole)

The Macaulay Point outfall has three “inspection man ways” along the outfall. On the record drawings these are located at stations 15+00, 30+00 and 45+00. Details of these appurtenances are not shown on the record drawings, but WorleyParsons has observed them through the completion of an outfall inspection. The man way is simply an access hatch that is curved to match the pipe circumference and bolted to the pipe wall. There is a neoprene seal between the hatch and the pipe. This seal deteriorated on the nearshore man way within ~25 years and had to be repaired to stop excessive “nearshore” leakage. Other than this event, there is no reported use of these appurtenances.

Pig Removal Hatch

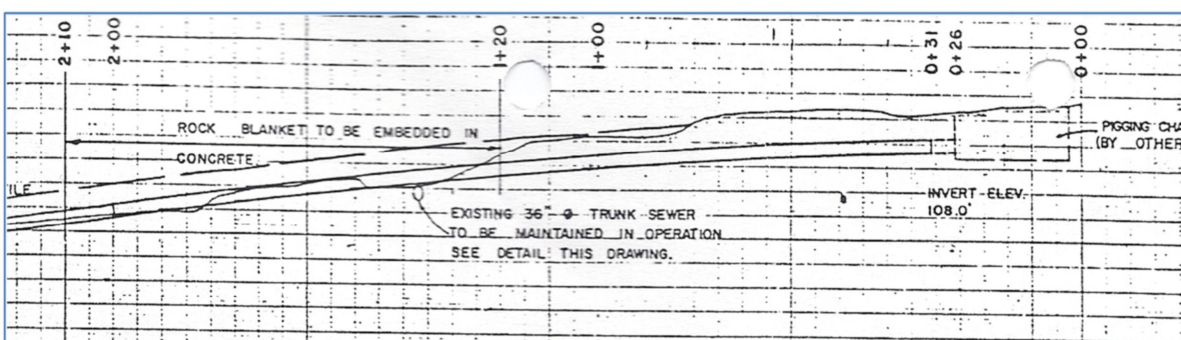
Immediately upstream of the diffuser, at station 56+33 there is a “pig removal” hatch. As with the man ways, there is no reported use of this feature in the lifetime of the outfall. However, there have been instances of inspection equipment / pigs getting “stuck” in outfalls. For example, a pigging device got stuck in the Harmac Mill Outfall, Nanaimo, circa 1987, and the outfall had to be opened up to retrieve the pig. This was accomplished at relatively high expense because of the water depth. More significantly, this retrieval exercise curtailed operation of the mill for an extended time period with the associated loss of production.

An access hatch in the vicinity of the diffuser would be a prudent consideration. The installation of a hatch at the time of initial construction is significantly (orders of magnitude) less expensive than implementing later if required.

Protection in the Intertidal / Shallow Subtidal Zone

The shoreline fronting the Macaulay Point outfall is a shallow irregular overburden of marine clay over an irregular rock surface. The outfall was trenched to grade through the overburden / rock (see below, horizontal gridlines are on 5 feet intervals). Where the outfall emerged from the rock, it was protected with blasted rock embedded into a concrete capping over the pipe (Station 1+20 through 2+10 in Figure B).

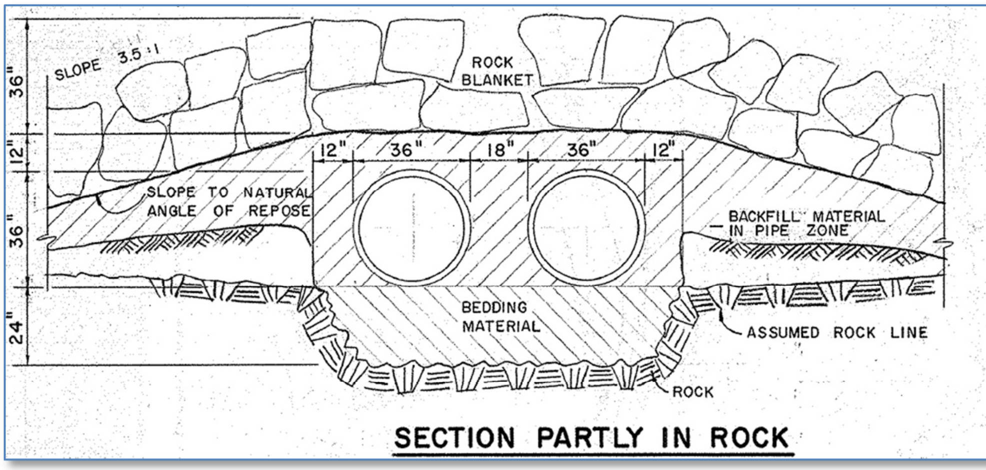
Figure B Macaulay Point Outfall Profile



Source: Associated Engineering Services Ltd. 1970

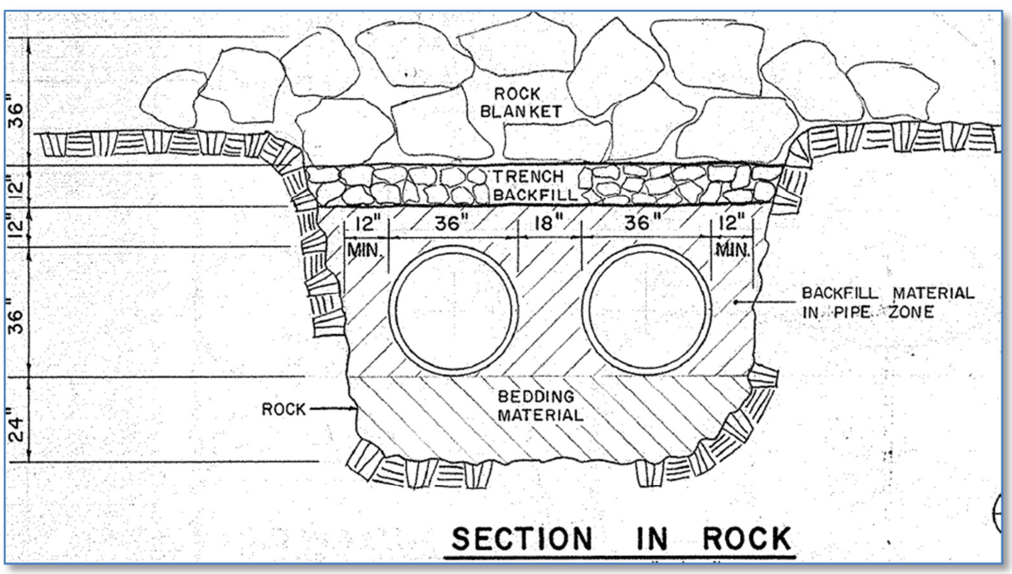
Where the pipe was trenched into rock, the pipe was bedded in a granular material, capped with a graded crushed rock and then protected with rock backfill (specifications of rock gradation unknown). The details of this section are shown in Figure C and Figure D:

Figure C Macaulay Point Outfall –Protection Section 1



Source: Associated Engineering Services Ltd. 1970

Figure D Macaulay Point Outfall –Protection Section 2



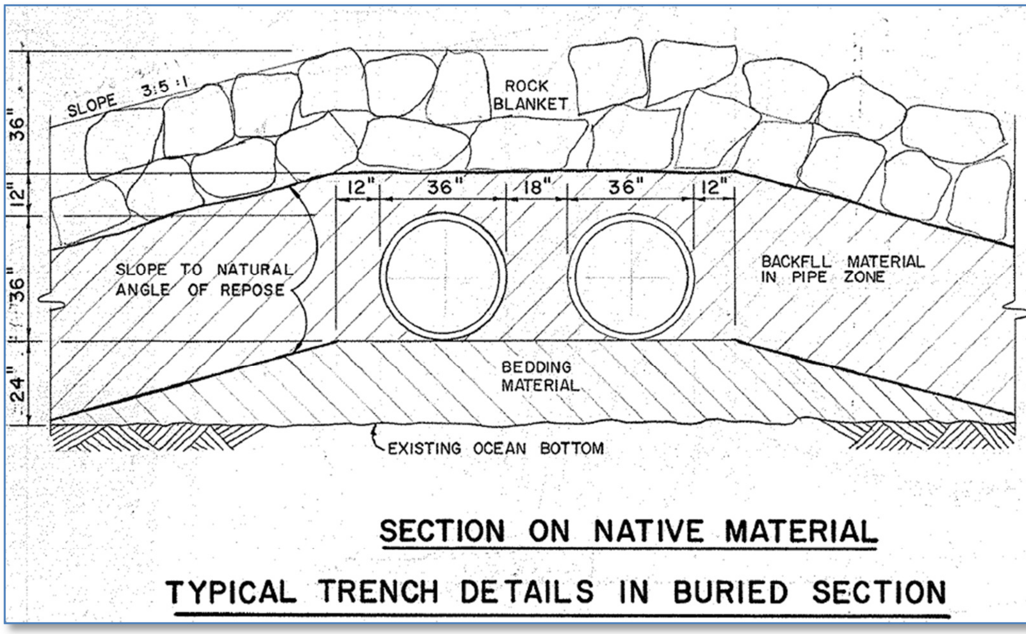
Source: Associated Engineering Services Ltd. 1970

In this detail it is imperative that the layer identified in "trench backfill" and "rock blanket" be properly graded to prevent the fines of the bedding material from washing through. A geotextile wrap around the "bedding zone / pipe zone" material could be used to prevent wash out of the bedding material.

Geotextile was not available in 1970 so the pipe protection materials would have been graded and specified accordingly to mitigate movement of finer material through the more dense material.

Steel pipe, being relatively rigid was placed on a continuous and shallow grade, creating areas where the pipe was partially in or above the bedrock. The detail was similar to that in rock, but was without the "trench backfill" filter blanket (Refer to Figure E).

Figure E Macaulay Point Outfall –Protection Section 3



Source: Associated Engineering Services Ltd. 1970

The detail "buried section" on the seafloor continues until a water depth of approximately 10 m (chart datum) is attained. It is understood that the selection of this depth was based on protection of the pipe from pounding by "dead heads" (partially sunken logs floating upright in the water column) which were prevalent in the days of active log booming through this area.

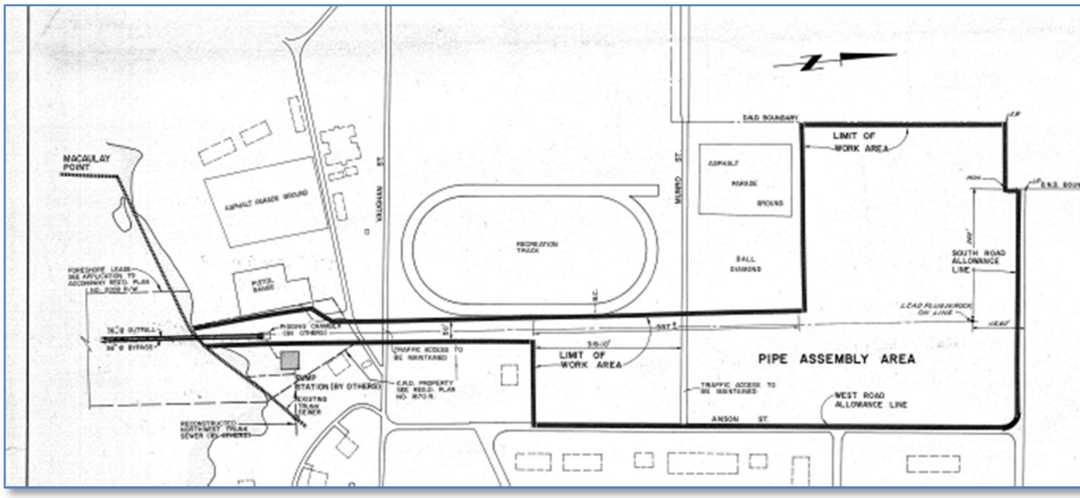
The buried section ends at station 8+20 (approximately 240 m offshore), the bypass terminates at station 10+06 (~ 300 m offshore) at a depth of approximately 15 m (below chart datum).

1.4 Construction Method

The Macaulay Point outfall was pre-assembled onshore in several prefabricated wrapped and coated lengths which were sequentially butt welded together, the welds field coated, and the assembled pipeline dragged / pushed out to sea. On shore, the pipes were moved on custom dollies.

The pipeline was floated into position then lowered to the seabed by flooding from the shore end.

Figure F Macaulay Point Outfall – Construction



Source: Associated Engineering Services Ltd. 1970

The pipeline was launched through a pre-excavated trench into the irregular rock shoreline to accommodate the pipeline launch. Once installed the near shore trenches were backfilled to the design noted previously.

1.5 Application to McLoughlin Point Outfall Construction

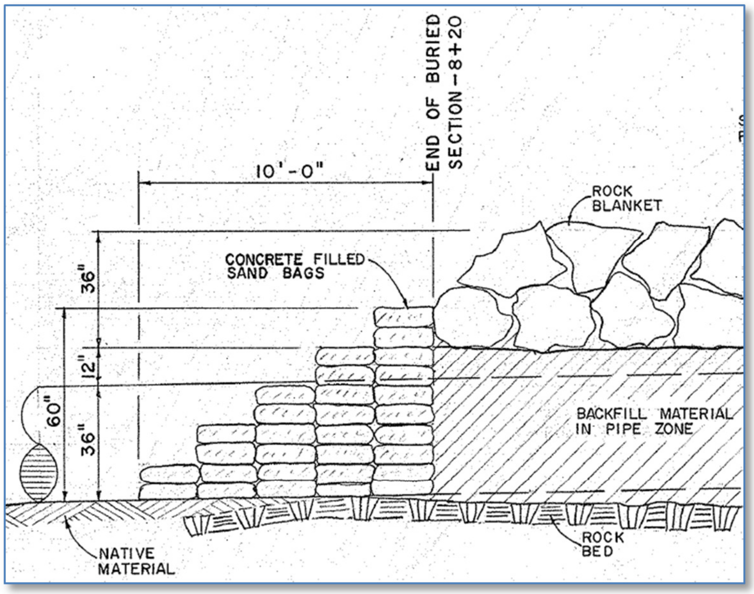
1.5.1 Near Shore Areas

The outfall must be protected throughout the nearshore areas. It is likely the most economical method will be open trench and burial, in which case the depth of the overburden must be pre-determined. Trenchless technologies could also be used like horizontal directional drilling, or tunneling. At Macaulay Point (with comparable exposure) rock embedded in concrete, shown on the record drawings, has proven to be suitable. Concrete should have the appropriate admixtures to resist erosion and chemical attack in seawater.

1.5.2 Transition to Seabed

Where the pipe emerges from the trench to the seabed, the protection should be continued until there is sufficient water depth over the pipe to protect the pipe from damage by wave forces or “dead head” logs. For protection from logs, this is generally in the order of 10 m below low water (as was chosen at Macaulay Point). The depth of protection from wave forces should be pre-determined based on the wave climate. Wave force relative to water depth would determine the extent of the protection. The pipe protection material was terminated with a “retaining structure” using concrete bags (see Figure G).

Figure G **Macaulay Point Outfall – Retaining Structure**



Source: Associated Engineering Services Ltd. 1970

Should such be adopted for the McLoughlin Point Outfall, concrete lock blocks placed from a spud barge may prove to be an economical alternative to "diver placed" concrete filled sandbags. In addition to rock ballast, alternative protective measures should be considered, including but not limited to:

- Articulated concrete ballast mats (ACBM)
- Interlocking doghouse weights (with or without concrete fill)

2. REFERENCES

Associated Engineering Services Ltd. 1970. Macaulay Point Outfall. Drawings # SG70-102-4. Miscellaneous Sections and Details Contract No. SG70-102 B.C. Conservation Data Centre (CDC) 2010. Ministry of Environment (MOE). Mapped Known Locations of Species and Ecological Communities at Risk. Accessed online at: http://www.env.gov.bc.ca/atrisk/ims.htm. Accessed July 2012.

Appendix 6 Alignment Options Comparison Table

Table A Outfall Alignment Option Comparisons

Item Description	Option 1 or 2	Option 3
Installation Methods Suitable for the Alignment	Surface lay via float and sink; trench excavation for sections requiring protection	HDD or Tunnel full length, or in combination with surface lay technique for portion of route.
Pipe Material	HDPE or Steel	HDPE or Steel (HDD) Concrete lined tunnel
Advantages	Likely the most economical combination of construction method and alignment Limited geotechnical information is required for design Most of the outfall construction can occur off site and be installed anytime during treatment plant construction Twin pipelines can readily be accommodated.	Avoids seabed disturbance and sensitive areas (e.g. Fish habitat, migratory bird sanctuary) to mitigate regulatory risk Tunneling becomes economical when large diameters are required Marginally shorter, direct route to the terminus. Drill/tunneling equipment will already be mobilized on site to execute the forcemain crossing of Victoria Harbour
Risks/Challenges	If a pipe diameter larger than 1,600 mm is required, then HDPE pipe supply will likely be outside North America. Potential to mobilize sediment contaminants by trenching/dredging activities Potential for regulatory risk due to disruption and disturbance to shallow nearshore zone (fish habitat and migratory bird sanctuary)	If a pipe diameter larger than 1,600 mm is required, then HDPE pipe supply will likely be outside North America. Generally higher cost for design and construction than surface lay. Construction of the outfall would likely have to occur prior to Waste Water Treatment Plant (WWTP) construction due to the large on-site area needed for HDD or tunneling equipment set-up, operation, and associated spoil material handling (~a third to half the site dedicated) More geotechnical data would be required for design (confirmatory drill holes every ~50 - 100 m of sub-surface route length)

Item Description	Option 1 or 2	Option 3
	Potential for disruption of navigation to harbour entrance during construction.	Water management in relation to maintaining a dry tunnel or in relation to management of drilling fluids. Tunneling should ideally be progressed on an incline so water drains away from the boring machine back to the entry shaft. An incline could be accomplished for the full route length, but downhill grade would likely be needed if surface lay is implemented for offshore portion. Potential difficulty maintaining an opening at the drill exit if daylighting the HDD bore out of the seabed Management, dewatering and transport of spoil material from the site (truck or barge) HDD may not be feasible to install pipe diameters larger than ~1,600 mm diameter over long distances (eg. > 1km) depending on substrate conditions. Higher costs to accommodate an emergency overflow (ie. 2 boreholes). A small portion of the alignment at the shoreline potentially trespasses on DND property