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Conceptual Marine Fish Habitat Offsetting Plan

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on behalf of **Westcoast Connector Gas Transmission Ltd.**

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1 Introduction

The Westcoast Connector Gas Transmission (WCGT) Project is a proposed natural gas transmission system from the Cypress area of northeast British Columbia (BC) (approximately 100 km northwest of Fort St. John and 210 km south of Fort Nelson) to Ridley Island, near Prince Rupert. The transmission system will transport natural gas to a liquefied natural gas (LNG) plant. A single route option is being assessed from Cypress to west of Cranberry Junction (referred to as the Cypress to Cranberry route). Two route options with marine segments (referred to as the Kitsault and Nasoga routes; Figure 1) are being assessed west of Cranberry Junction, but only one of these options will ultimately be used.

The two marine options under consideration are:

The Kitsault Route - traversing northwest from Cranberry Junction, across the Nass River to Kitsault, at the head of Alice Arm. From here, the Kitsault route continues on the seabed through Alice Arm, Observatory Inlet, Portland Inlet and Chatham Sound before terminating at Ridley Island. The overall length of the marine portion of this route option is 181.2 km.

The Nasoga Route - traversing southwest from Cranberry Junction along the lower Nass River, across Nisga'a Lands south of the Nass River, then west and south to Echo Cove. The route enters the marine environment through Iceberg Bay, returns onshore south of the Chambers Creek estuary and runs to the head of Nasoga Gulf. From the head of Nasoga Gulf, the route continues on the seabed through Nasoga Gulf, Portland Inlet and Chatham Sound before terminating at Ridley Island. The overall length of the marine portion of this route option is 104.9 km including the segment through Iceberg Bay.

The marine portions of the Kitsault and Nasoga routes share the same routing from approximately 5 km south of the junction of Nasoga Gulf with Portland Inlet, traversing Portland Inlet and Chatham Sound to Ridley Island.

The diameter of the marine pipelines will be up to 1,067 mm (NPS 42) with the exception of the of the marine pipelines across Iceberg Bay which will be up to 1,219 mm (NPS 48). Initial plans are to develop a single pipeline within a 400 m Application Corridor with potential to include a second pipeline in the same corridor, if and as commercial circumstances allow.

1.1 Purpose

This plan has been prepared to support the review of the WCGT Project. The BC EAO has requested that WCGT submit a Conceptual Fish Habitat Offsetting Plan (CFHOP) that considers impacts to the marine environment and high risk freshwater crossings that have the potential to result in serious harm to fish.

This marine CFHOP outlines the strategy and framework for development of the Final Fish Habitat Offsetting Plan (FHOP). A freshwater CFHOP companion document has also been prepared. The FHOP will be developed via discussions with regulatory agencies and input from potentially affected First Nations groups.

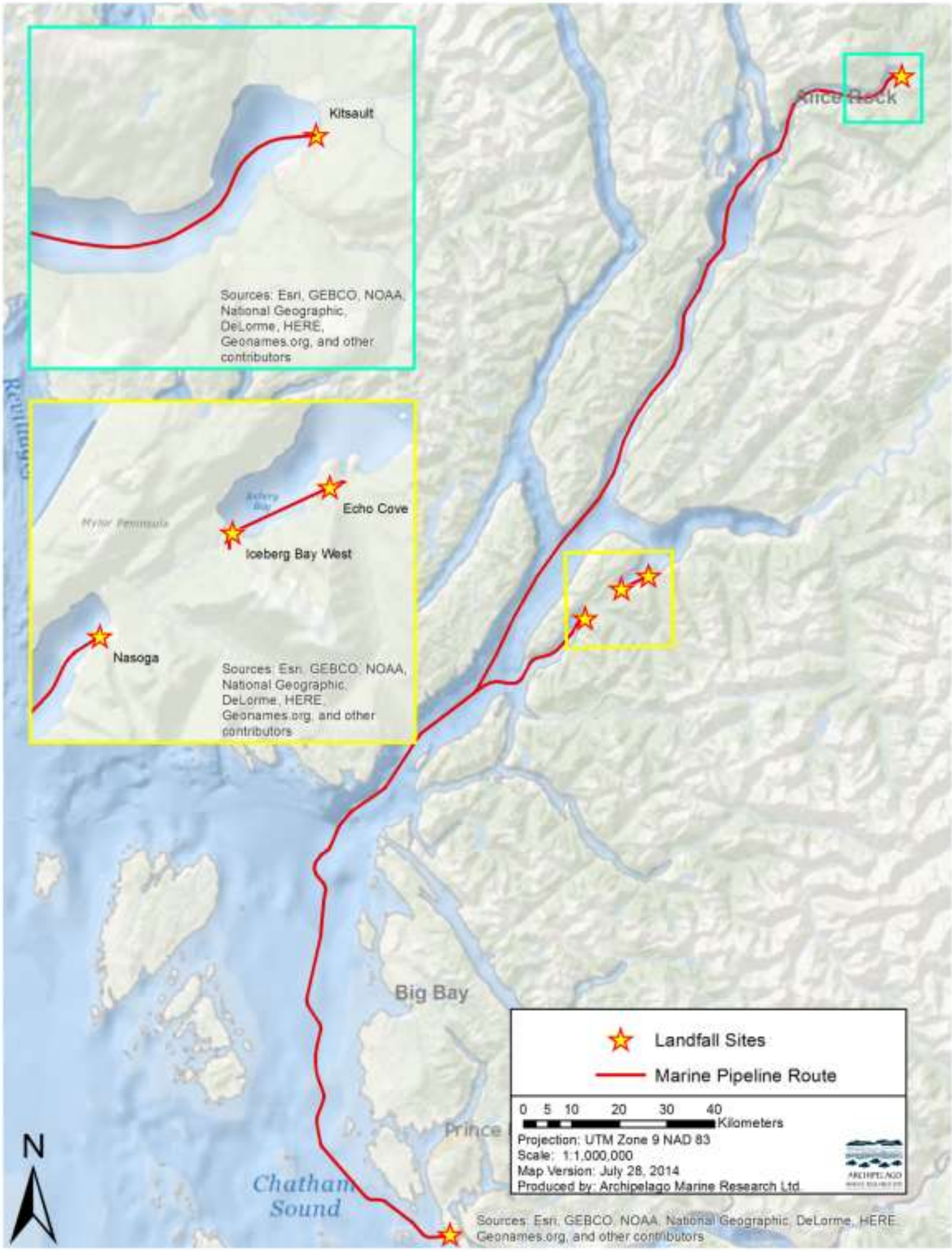

Figure 1. Marine portions of the proposed Westcoast Connector Gas Transmission (WCGT) route, showing the Kitsault and Nasoga route options and associated landfall sites.

1.2 Regulatory Context

1.2.1 Fisheries Act

The fisheries protection provisions of Canada's *Fisheries Act* (2012) were developed *"to provide for the sustainability and ongoing productivity of commercial, recreational and Aboriginal (CRA) fisheries"* (*Fisheries Act,* Section 6.1). In particular, activities that could cause *serious harm to fish* are addressed under Section 35 of the *Act*:

> *"35. (1) 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."*

However,

> *"(2) A person may carry on a work, undertaking or activity without contravening subsection (1) if..… (b) the carrying on of the work, undertaking or activity is authorized by the Minister and the work, undertaking or activity is carried on in accordance with the conditions established by the Minister."*

Serious harm to fish includes:

- the death of fish;
- a permanent alteration to fish habitat of a spatial scale, duration or intensity that limits or diminishes the ability of fish to use such habitats as spawning grounds, or as nursery, rearing or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes;
- the destruction of fish habitat of a spatial scale, duration or intensity that fish can no longer rely upon such habitats for use as spawning grounds, or as nursery, rearing or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes (DFO, 2013a).

The term *fish*, as defined in the *Act* (Section 2), includes (a) parts of fish, (b) shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, (c) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals.

Proponents are responsible for avoiding and/or mitigating the serious harm to fish that could result from their projects. When proponents are unable to completely avoid serious harm to fish such that residual serious harm to fish remains, they must seek an authorization under paragraph 35(2)(b) of the Fisheries Act *Regulations* (DFO, 2013b). In reviewing the application for an authorization, Section 6 of the *Fisheries Act* requires that "*the Minister shall consider the following factors:*

a) the contribution of the relevant fish to the ongoing productivity of commercial, recreational or Aboriginal fisheries;
b) fisheries management objectives;

c) *whether there are measures and standards to avoid, mitigate or offset serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or that support such a fishery; and*
d) *the public interest."*

The contribution of relevant fish relates to the role of the fish and fish habitat affected by the project in the overall productivity of the CRA fishery (DFO, 2013a). Ongoing productivity is the potential sustained yield of all fish populations and their habitats that are part of or support CRA fisheries (DFO, 2013a). Fisheries management objectives are the stated socio-economic, biological and ecological goals for a fishery that are typically established by federal, provincial or territorial fishery managers.

Measures and standards to avoid, mitigate or offset serious harm to fish refer to the hierarchy of practices that are intended to reduce risks to fish. This hierarchy emphasizes that efforts should be made to completely prevent (avoid) serious harm to fish first. When avoidance is not possible, then efforts should be made to minimize (mitigate) harm, by reducing its spatial scale, duration or intensity. After these actions, any remaining (residual) impacts would normally require authorization and should then be addressed by offsetting.

1.3 Conceptual Fish Habitat Offsetting Plan Objectives

The overall objective of this Marine Conceptual Fish Habitat Offsetting Plan (CFHOP) is to provide the BC Environmental Assessment Office with a an understanding of the type and amount of residual impact to fish habitat which may require offsetting and a review of offsetting options available to address residual harm to fish and fish habitat resulting from the WCGT project. The conceptual habitat offsetting strategy presented here provides (a) an overview of the avoidance and mitigation strategies proposed to prevent or reduce residual effects, (b) the nature and extent of the potential loss or alteration of marine habitats associated with the marine section of the pipeline route, and (c) options to address the potential offsetting requirement.

It is understood that a detailed Fish Habitat Offsetting Plan (FHOP) is required at a future date in support of issuance of authorization under Section 35(2) of the *Fisheries Act* and that additional consultation with regulatory agencies, First Nations and other stakeholders is required in order to complete the detailed habitat offsetting plan.

1.4 Offset Planning

Offsetting measures are intended to provide measureable, on-the-ground fisheries conservation outcomes that maintain or improve the productivity of fisheries. The choice of offsetting measures will be guided by threats to fisheries productivity and fisheries management objectives. The development of offsetting measures will require consultation with DFO, Aboriginal groups, provincial regulators as well as other stakeholders.

Offsetting may be applied through project-specific measures, or through the use of proponent-led habitat banks, usually established in advance of the impact (DFO, 2013c). General categories of offsetting include:

- Habitat Restoration and Enhancement - physical manipulation of existing habitat where habitat conditions are considered poor or degraded;
- Habitat Creation - development or expansion of aquatic habitat into a terrestrial area;
- Chemical or Biological Manipulation - chemical manipulation of water bodies, stocking of fish or shellfish, and management or control of aquatic invasive species.
- Complementary Measures - investments in data collection and scientific research related to maintaining or enhancing the productivity of CRA fisheries. Complementary measures may be considered only in exceptional circumstances where there are limited opportunities to offset fisheries productivity and where there is limited understanding or data on fisheries populations. Complementary measures may comprise up to 10% of the required amount of offsetting, the remaining 90% to consist of habitat enhancement, restoration or creation measures (DFO, 2013b).

The guiding principles of offsetting for fisheries protection include (DFO, 2013b):

1. Offsetting measures must support fisheries management objectives or local restoration priorities.
    - Offsets should be designed to contribute to objectives of fisheries management plans.
    - Fisheries managers, Aboriginal groups, local organizations and stakeholders may help identify areas that need restoration or management.
2. Benefits from offsetting measures must balance project impacts.
    - Offsets should be proportional to impacts caused by the project.
    - Offsets which benefit the specific fish populations and areas that are affected by a development project are preferable. Offsetting measures could be undertaken in water bodies or for fish species other than those affected by the project, provided the measures are supported by clear fisheries management objectives or regional restoration priorities.
    - With an “in-kind” approach to offsetting, the habitat that is lost is replaced by the same quantity and quality of the same type of habitat, with additional habitat to account for uncertainty and productivity lost during time lags.
3. Offsetting measures must provide additional benefits to the fishery.
4. Offsetting measures must generate self-sustaining benefits over the long term.
    - The offset’s benefits to the fisheries should last at least as long as the impacts from the development project.

Two approaches may be taken when developing an offsetting plan. The in-kind approach replaces the same quantity, quality and habitat type that was permanently altered. The out-of-kind approach targets other areas for improvement, typically in areas where productivity is limited or degraded. Wherever possible the in-kind approach should be used however in some instances the out-of-kind approach may be more appropriate if economies of scale can be combined for large scale improvements to fisheries and habitat.

The following steps are a general description of how the offsetting plan may be developed (DFO 2013b). The exact steps, order and timing may be altered depending on project specific details.

Step 1: Assess/Minimize the Project's Effects

Step 2: Identifying Potential Offset Opportunities

Step 3: Determining Residual Harm

Step 4: Plan Evaluation

Step 5: Plan Finalization and Application

Step 6: Monitoring and Reporting

2 Potential Project Effects and Mitigation Planning

The project activities with the potential to cause serious harm to fish (fish mortality, alteration or destruction of fish habitat) include:

1. Trenching and sidecasting of intertidal and subtidal sediments at all landfall sites.
2. Direct placement of the pipe on subtidal (offshore) seabed.
3. Modification (dredging and rock placement) of the seabed to eliminate excessive seabed roughness along the pipeline route.
4. Underwater and nearshore blasting activities, if required.

A summary of construction methods for these activities is provided in Appendix 1.

Standard and site-specific measures to avoid and minimize potential residual effects of the Project have been identified in Section 4.4 of the Project's Environmental Assessment Application and the Marine Environmental Management Plan. These are summarized briefly below, with detailed mitigation measures provided in the documents referenced above.

2.1 Measures to Avoid and Minimize Project Effects

2.1.1 Landfall and Nearshore Marine Habitats and Ecosystems

Specific avoidance and mitigation measures for the landfall/nearshore environment to minimize residual fish and fish habitat impacts include:

- Avoid, to the extent practical, valued and sensitive nearshore habitats, such as eelgrass beds, intertidal clam beds, important spawning areas and dense kelp beds including canopy kelps.
- Develop and implement site specific construction timing windows to reduce direct effects (disturbance, injury, mortality) on the fish community.
- Reduce the area of the proposed Project Footprint in vegetated areas, leaving as much existing nearshore vegetation intact as practical.
- Avoid sidecasting material to vegetated areas such as salt marshes.
- Develop and implement a site-specific restoration plan for each landfall site including restoration of salt marsh areas by replanting and recolonization by algal vegetation through placement of suitable substrate placed at the correct elevation for vegetation recruitment. Based on previous experience, recolonization of rockweed and bladed kelps will occur within 1-3 years, with bladed kelps colonizing within 1-2 years and rockweed displaying a more variable settlement time frame.
- Replace sidecasted soft sediments over the trenched area to restore pre-existing mud flat and subtidal muddy habitats in order to facilitate benthic infaunal community recovery (estimated to be within 1-2 years).
- Conduct on-site monitoring of adjacent salt marsh and eelgrass areas. Install protection (e.g., silt curtains, wave attenuation structures) around worksites if warranted.

2.1.2 Offshore Marine Habitats and Ecosystems

Specific avoidance mitigation measures for the offshore environment to minimize residual fish and fish habitat impacts include:

- Avoid pipe placement over documented sensitive benthic habitats identified by geophysical and ROV survey, including areas of glass sponges, hard corals, and dense soft coral (e.g. sea whip) areas.
- Maintain a 200 m buffer between the pipeline and all glass sponge reefs in Chatham Sound.
- Develop construction timing windows in consultation with DFO for specific locations and activities (dredging, rock placement).
- Map sensitive and valued environmental features for each seabed area subject to modification by dredging or rock placement. Where feasible, modify cut and fill plans to avoid disturbing sensitive and valued seabed habitats and sessile invertebrate features.
- When feasible stockpile colonized rock material from excavation areas and place on top of fill material to seed colonization.
- Do not dredge, plough, or jet the pipeline into the seabed in areas immediately adjacent the glass sponge reefs in Chatham Sound (KPK 140-160).
- Follow the Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky 1998) and recent internet updates.

2.2 Summary of Project Effects on Fish Habitat

The following sections summarize estimates of fish habitat loss or alteration based on the installation of two 42" pipes for the Kitsault route option and two 42" pipes for the Nasoga route option with the exception of the Iceberg Bay portion of the Nasoga route which will consist of two 48" pipes.

2.2.1 Kitsault Route

Landfall Sites

Two landfall sites will be required for the Kitsault route; Kitsault - the point of pipeline entry to the marine environment and Ridley Island - the point of pipeline exit. At Kitsault the alignment crosses the southeast edge of the delta complex at the head of Alice Arm. The intertidal zone is defined by a broad (500 m), mostly bare, mudflat. There is a narrow fringe of salt marsh along the high water line and drainage channels occur across the flats. The lower edge of the delta drops off steeply from the low tide line to depths of 100 m in the upper Alice Arm basin. Key habitat features at this site include salt marsh and rockweed areas. Intertidal mudflats also are important foraging habitat for some juvenile fish and invertebrate species, although cover is lacking.

The pipeline will be trenched to a depth of 5 m across an intertidal mudflat terminating at a water depth of approximately 25 m chart datum (CD), approximately 600 m from the high water mark. At depths deeper than 25 m, the pipeline will lie on the seabed. The areas of intertidal and subtidal habitats potentially disturbed at the Kitsault landfill site from trenching, material sidecasting and dredging vessel access are summarized in Table 1. A total estimated volume of 186,000 m^3 of material will be dredged and sidecast at the Kitsault landfall site. This sidecast material will be replaced in the trenched area once the pipe is in place. Over 80% of this material will be gravel that underlies the mudflat, and approximately 20% will be fine sand/silt/clay sediments. Core samples taken across the intertidal mudflat indicate that the overlying fine sediment layer is approximately 0.5 m thick in the upper intertidal zone and 1.2 m thick at low tide elevation.

Table 1. Nearshore habitat areas potentially disturbed by pipeline construction at the Kitsault and Ridley landfall sites.[1]

Habitat Type	Area Disturbed (m^2)			% of Total Area
	Kitsault	Ridley	Total	
Salt Marsh	3,800	30	3,830	1.4%
Non Vegetated Gravel	0	600	600	0.2%
Fucus	400	600	1,000	0.4%
Kelps/Red Algal Community (gravel and bedrock)	0	11,700	11,700	4.3%
Intertidal Mudflat	84,800	0	84,800	31.3%
Subtidal Mud	8,400	160,200	168,600	62.3%
Total	**97,400**	**173,130**	**270,530**	**100.0%**

Note:

1. Area estimates are based on excavated and sidecast areas.

The Ridley Island landfall site is located immediately south of a small bay on the southwest side of Ridley Island. The intertidal zone is a vegetated rock ramp and boulder beach. The subtidal zone is predominantly muddy seabed extending over 1 km offshore to a depth of approximately 20 m.

The intertidal zone within the bay adjacent to the Ridley Island landfall site contains a diversity of habitats, including perched salt marsh, rockweed, bladed kelps and several small eelgrass patches. These areas are biologically productive and provide moderate to highly valued rearing habitat for several fish species, including juvenile salmon.

The area potentially disturbed at the Ridley landfill site from trenching, material sidecasting and dredging vessel access is summarized in Table 1. A total estimated volume of 180,000 m^3 of sediment (primarily sand, silt and clay) is expected to be dredged and sidecast at this site. An additional estimated 280,000 m^3 of soft sediment (primarily silt and clay) is expected to be removed by cutter suction dredging. The dredged material will be loaded onto a barge or vessel for transport to an offshore location for disposal or temporary storage if it is determined that the material is suitable and can be used for backfill.

Offshore

Most of the Kitsault offshore route involves direct lay of the pipeline on the seabed. Approximately 80% of the seabed habitat within the Kitsault corridor is comprised of soft sediments (Table 2). The natural

[1] Estimates of areas of habitat disturbed at the landfall sites (Table 1 and Table 4) are largely based on measurements made in the field and are provided in m^2; estimates of areas of disturbed seabed (Table 2, Table 3 and Table 5) are based on preliminary engineering design, are subject to change and, for this reason, are provided in ha.

gas pipeline placed directly on the seabed will result in an increase in hard seabed habitat (concrete coated pipe) over the soft seabed habitat.

Four seabed modification areas (Pearson Point, Alice Rock, Liddle Channel and Brooke Shoal) have been identified on the northern 30 km of the Kitsault route corridor (Figure 2). These areas will require modification (dredging, rock placement and possibly underwater blasting) to the seabed in order to reduce bottom roughness and provide the correct bending radius for the pipe as well as provide adequate draft for the pipe lay vessel.

Table 2. Seabed habitat types within the Kitsault route option summarized as linear distance along pipeline route and estimated area of disturbance related to direct pipe lay on the seabed.[2]

Seabed Type	Length (km)	Area Disturbed (ha)
Fine-grained	117.5	28.1
Medium-grained	26.8	6.2
Gravel (till)	29.3	6.9
Bedrock	7.6	1.8
Total	**181.2**	**43.0**

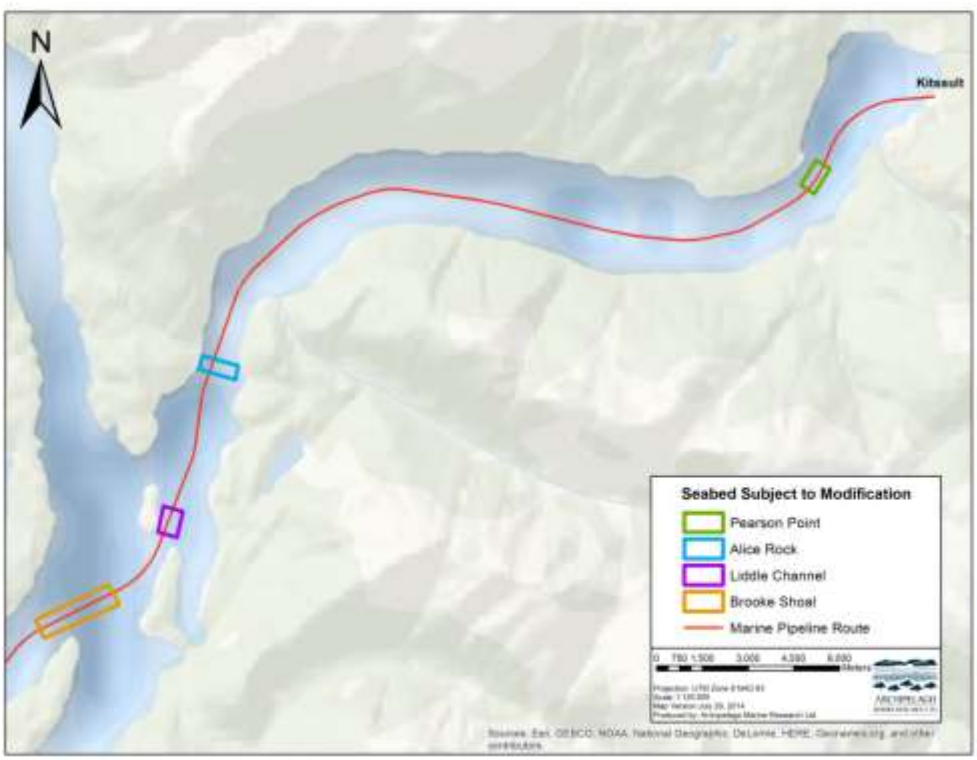

Figure 2: Seabed areas subject to modification.

[2] Estimates of areas of habitat disturbed at the landfall sites (Table 1 and Table 4) are largely based on measurements made in the field and are provided in m^2; estimates of areas of disturbed seabed (Table 2, Table 3 and Table 5) are based on preliminary engineering design, are subject to change and, for this reason, are provided in ha.

Seabed Modification Areas

The four seabed modification areas (Pearson Point, Alice Rock, Liddle Channel and Brooke Shoal) are described below. The estimated area of disturbance of existing seabed habitat type as well as the estimated area of "as planned" seabed habitat for each modification area is shown in Table 3.

Table 3. Estimated area of disturbance of seabed modification areas summarized by habitat type. E = Existing, AP = As Planned.

Seabed Habitat Type	Seabed Modification (ha)									
	Pearson Point		Alice Rock		Liddle Channel		Brooke Shoal		Totals	
	E	AP	E	AP	E	AP	E	AP	E	AP
Fine Grained Seabed (Muds)	1.3	0	0	0	1.42	0	0	0	2.72	0
Medium Grained Seabed (Sands)	0.37	0	0	0	0	0	7.23	4.31	7.6	4.31
Gravel (till)	0	1.67	2.45	4.72	1.05	2.47	0	2.92	3.5	11.78
Bedrock	0	0	2.27	0		0	0	0	2.27	0
Total	**1.67**	**1.67**	**4.72**	**4.72**	**2.47**	**2.47**	**7.23**	**7.23**	**16.09**	**16.09**

Notes:

1. These areas are based on preliminary and subject to change as a result of detailed engineering.
2. As Planned gravel to be blast rock and excavated till material.
3. Seabed modification area estimates based on plane view.

Pearson Point

The seabed modification area offshore of Pearson Point is located approximately 1 km southwest of the former town of Kitsault at depths of 50 - 155 m (Figure 2). The sea floor is a relatively flat basin approximately 100 m deep which drops steeply to 180 m depth just west of Pearson Point. The seabed is predominantly mud however there is an area of glass sponges on the bedrock slope north of the fill area and a bed of sea whips on the south side at approximately 100 m depth which appears to be rearing habitat for walleye pollock.

Rock fill will be placed on approximately 1.67 ha of seabed in this area at depths between 155 and 105 m in order to meet the required bending radius of the pipe on the seabed. The total volume of rock required for the fill operations is estimated to be 38,000 m^3, with a maximum fill thickness of 10 m. No dredging or blasting is anticipated at this site. The planned fill area will avoid the two primary habitat features of this area (glass sponges and sea whip bed) outlined above. Over the medium-term (5 to 10 years) the placed rock material will likely be colonized epifauna in a manner that resembles the community now present on the bedrock off Pearson Point.

Alice Rock

Alice Rock is a terminal moraine located approximately 1 km north of the mouth of Alice Arm (Figure 2). Predominant seabed substrate in this area is gravel (boulder, cobble and pebble). This area has current dominated benthic community, with relatively dense and diverse suspension and filter feeding sessile invertebrates (anemones, bryozoans complexes, hydrocorals, demosponges, feather stars) growing on cobble and boulder substrates as well as sea whips and subtidal mussel beds on less coarse substrates and sparse bull kelp in shallower areas.

At Alice Rock, 2.27 ha of seabed is subject to dredging or a combination of dredging and blasting and 2.45 ha subject to rock placement. The cut area is located on the shallowest portion of Alice Rock at depths of 5 to 30 m CD. In some places depths will increase by 15-20 m as a result of the dredging and blasting. The rock placement area is located north of Alice Rock over the steeply sloped northerly approach to Alice Rock. The maximum thickness of rock placed in this area is about 15 m. The estimated volume of excavated material is 122,000 m^3 and the required fill volume is 81,000 m^3. Figure 2 illustrates the conceptual cut and fill requirement at Alice Rock.

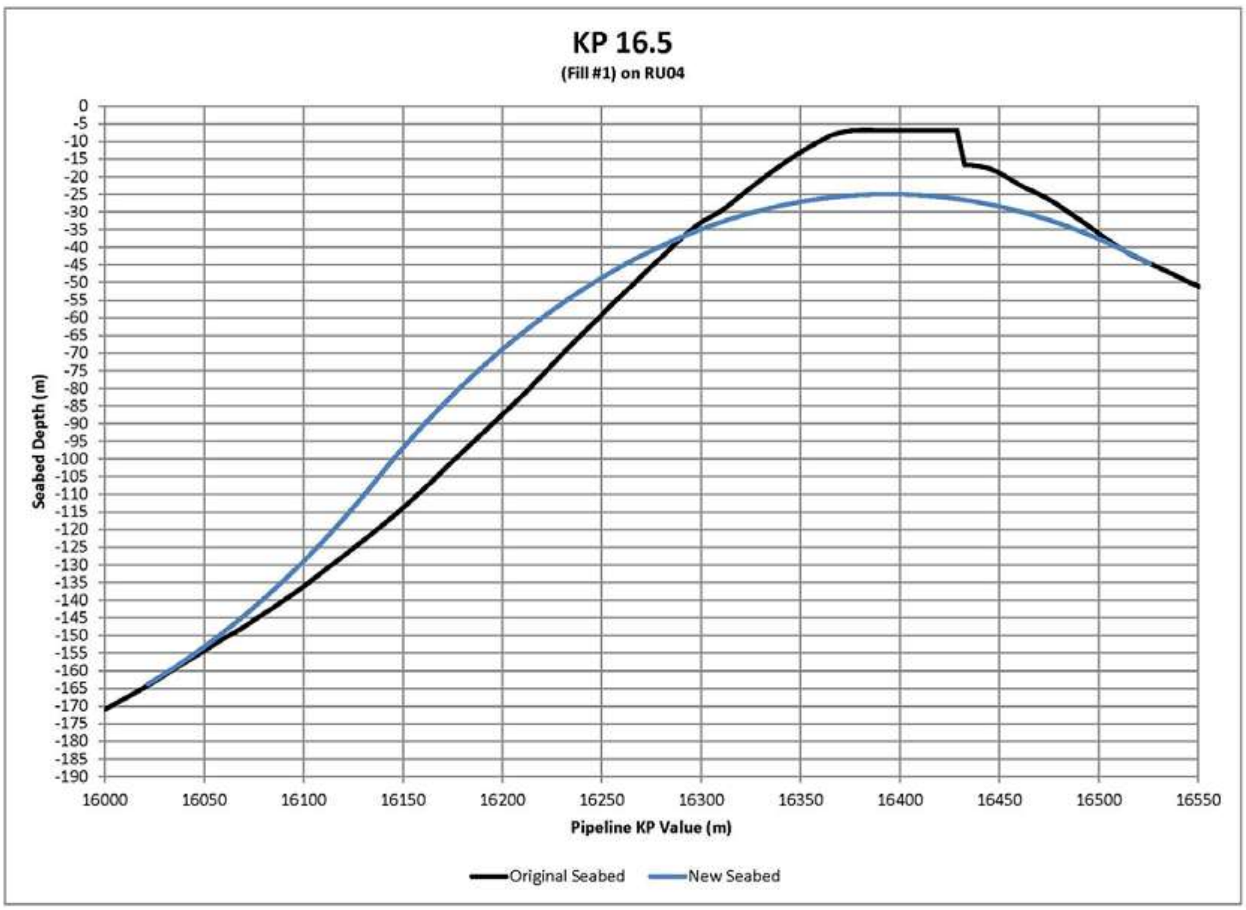

Figure 3. Conceptual cut and fill requirement for Alice Rock shown in vertical profile.

Liddle Channel

Liddle Channel is located between Perry Peninsula and Liddle Island, approximately 1 km south of the mouth of Alice Arm (Figure 2). The channel is characterized by a shallow sill running between Hyde Rock and the southeastern shore of Liddle Island. The dominant substrate is gravel (boulder, cobble, and pebble) to depths >50 m. Vegetation is sparse cover of bladed kelps and foliose red algae.

At Liddle Channel, approximately 1.05 ha of seabed is subject to dredging and blasting and 1.42 ha are subject to rock placement. The cut area is located on the northerly approach to the sill as well as the top of the sill at depths of 10 to 40 m. Over the shallowest portion of the alignment at Liddle Channel, depths will increase by approximately 10 m as a result of the dredging and blasting. The rock placement area is located south of Liddle Channel over the moderately sloped descent into the northern portion of Observatory Inlet. The maximum thickness of rock placed in this area is about 8 m. The estimated volume of excavated material is 40,600 m^3 and the required fill volume is 39,200 m^3. The majority of the fill material will be derived from the excavation operations and will consist of a mix of gravels and fractured rock.

Brooke Shoal

Brooke Shoal is located approximately 450 m north of Williams Point on Brooke Island (Figure 2). The shoal dries at low tide. The dominant substrate is gravel to the northeast of the shoal and gravel with sand to the northwest. Gravel is primarily boulder and cobble.

At Brooke Shoal approximately 4.31 ha of seabed is subject to dredging and blasting and 2.92 ha is subject to rock placement. The cut area is located over the shallowest portion of the shoal, which dries at low tide. Over the shallowest portion of the alignment at Brooke Shoal, depths will increase by approximately 25 m as a result of the dredging and blasting. There are two small areas on the northerly approach to Brooke Shoal where rock placement will be required. The estimated volume of excavated material is 855,000 m^3 and the required fill volume is 25,600 m^3.[3] The fill material will be derived from the excavation operations and will consist of a mix of dredged gravels and blast rock.

2.2.2 Nasoga Route

Landfall Sites

Landfall sites along the Nasoga route, from east to west, include two sites on Iceberg Bay (where the pipeline route briefly transits the marine environment) and the Nasoga landfall, the point of entry leading to the Ridley Island landfall site, described above.

Nasoga Landfall

At the Nasoga landfall site the pipeline crosses a beach shoreline south of the extensive beach and marsh flats at the head of the gulf. The intertidal zone is composed of a narrow coarse grained (cobble/boulder) beach with a fringe of salt marsh along the high water line. There is a former log dump site immediately south of the route on a steep rocky shore. Subtidally, the route runs roughly parallel to the old log sort shoreline, traversing to a depth of 25 m approximately 125 m from the high water point of entry. Key habitat features at this site include salt marsh, rockweed/blue mussel and bladed kelp areas. These areas are biologically productive and provide moderately valued rearing habitat for several juvenile fish species, including juvenile salmon.

[3] Recent refinements to the pipeline routing over Brooke Shoal will likely result in a substantial reduction in the excavation volume for this area.

The pipeline will be trenched to a depth of 5 m across the intertidal zone to a water depth of 25 m. At depths >25 m, the pipeline will lie on the seabed.

Table 4 provides a summary of nearshore habitat areas potentially disturbed from trenching, material sidecasting and dredge vessel access. The total estimated volume of dredged material is 35,000 m^3, of which much will be gravel in the intertidal zone. The material will be sidecast then replaced in the trench to cover the installed pipe. Rock fracturing or blasting may be required in the upper intertidal area but no underwater blasting is anticipated.

Table 4. Nearshore habitat areas potentially disturbed by pipeline construction along the Nasoga Route.

	Area Disturbed (m^2)					**% of Total Area**
Habitat Type	**Echo Cove**	**West Iceberg Bay**	**Nasoga Gulf**	**Ridley**	**Total**	
Salt Marsh	2,300	3,300	900	30	6,530	2.5%
Non Vegetated Gravel	0	12,900	1,500	600	15,000	5.7%
Fucus	1,100	5,600	3,800	600	11,100	4.2%
Green Algae on Gravel	0	2,500	0	0	2,500	1.0%
Kelps/Red Algal Community (Gravel and Bedrock)	0	400	5,900	11,700	18,000	6.8%
Intertidal Mudflat	23,900	0	0	0	23,900	9.1%
Subtidal Mud	9,900	7,300	8,400	160,200	185,800	70.7%
Total	**37,200**	**32,000**	**20,500**	**173,130**	**262,830**	**100.0%**

Note:
Area estimates are based on excavated and side cast areas.

Echo Cove

The Echo Cove landfall site is the point of entry to the marine environment for the Iceberg Bay segment of the Nasoga Corridor. Echo Cove is a narrow pocket cove on the east side of Iceberg Bay. The marine pipeline enters the head of the cove through a fringe of salt meadow, and marsh and fringing rockweed before crossing a broad, gently sloped mudflat. The proposed pipeline trench to be excavated at Echo Cove is approximately 800 m from the high watermark to a depth of approximately 20 m CD.

Key habitat features include the salt marsh and rockweed zones, which are biologically productive and provide moderately valued rearing habitat for several juvenile fish species, including juvenile salmon. The intertidal mudflat is partially degraded due to log storage, which compacts the sediment, reducing biological function. However, intertidal mudflats are important foraging habitat for shorebirds and some juvenile fish species.

The pipeline will be trenched to a depth of 3 m across the intertidal zone to a water depth of approximately 10 m CD.

Table 4 provides a summary of nearshore habitat areas disturbed at the Echo Cove landfall site from trenching, sidecasting and dredge vessel access. An estimated volume of 15,500 m^3 of material will be dredged and sidecast at the Echo Cove landfall site. This material will be replaced over the pipe once it is in place. Approximately 90% of the excavated material will be soft sediments and the remainder will be fractured rock generated by cutting or blasting at the high intertidal zone, where the pipe enters the marine zone. No underwater blasting is anticipated.

Iceberg Bay West Landfall

The Iceberg Bay West landfall site is the point of exit from the marine environment in Iceberg Bay. The pipeline route crosses a broad cobble/boulder beach on the southwest side of Iceberg Bay, about 300 m from Chambers Creek, an important salmon spawning stream. The gently sloping beach (approximately 500 m from the high watermark to 20 m CD) drops steeply at lower low tide elevation. Key habitat features include salt marsh, green algae, rockweed and vegetated cobble/pebble areas.

The pipelines will be trenched to depth of 3 m across the intertidal zone to a water depth of approximately 10 m CD.

Table 4 provides a summary of nearshore habitat areas potentially disturbed at the Iceberg Bay West landfall site from trenching, sidecasting and dredging vessel access. An estimated volume of 21,960 m^3 of material will be dredged and sidecast, with approximately 90% of the excavated material being soft sediments and gravel. The remainder will be fractured rock generated by cutting or blasting at the high intertidal zone, where the pipe enters the marine zone. No underwater blasting is anticipated.

Offshore

Approximately 80% of the seabed habitat within the Nasoga corridor is formed of soft sediments (Table 5). The placement of the pipeline directly on the seabed will result in an increase in hard seabed habitat (concrete coated pipe) over the soft seabed habitat. On the Nasoga corridor, no seabed modification is currently planned and the only disturbance will be due to the footprint of the pipeline on the seabed (Table 5).

Table 5. Seabed habitat types along the Nasoga route option summarized as linear distance along pipeline route and estimated area of disturbance.

Seabed Type	Length (km)	Area Disturbed (ha)
Fine-grained	77.8	19.2
Medium-grained	6.0	1.5
Gravel (till)	18.2	4.4
Bedrock	2.8	0.7
Total	**104.8**	**25.8**

Notes:

1. Total length of Nasoga Route is 102.6 km plus 2.2 km for the Iceberg Bay crossing.
2. Two 42" pipes except for 2 x 48" pipes across Iceberg Bay.

3 Potential Residual Harm and Offset Opportunities

Much of the north coast region currently provides undisturbed and pristine fish habitat. As such it is challenging to indentify appropriate offsetting opportunities, especially in remote areas. For this reason the approach taken has been to avoid the need for offsetting to the extent possible by avoiding impacts to highly valued habitats and actively restoring habitats subject to disturbance.

3.1 Landfall Sites

The approach to minimizing serious harm to nearshore fish habitat focuses on avoidance and restoration, summarized as follows:

1. No loss of eelgrass, intertidal clam beds, or documented spawning areas are anticipated at any of the potential landfall sites (both for the Kitsault and Nasoga route options).
2. Restoration of pre-existing habitat features (upper intertidal marsh, *Fucus* or kelp vegetated areas, intertidal mudflat and subtidal mud substrate) is feasible for all potential landfall sites.
3. Recolonization of these restored habitats should occur over a 1-5 year time frame, being shortest for infaunal colonization of soft substrates and longest for intertidal marsh and *Fucus* habitats.
4. Marsh grass areas will require a replanting program; all other areas should re-colonized naturally if appropriate substrate is provided at suitable tidal elevations.
5. If two pipes are installed sequentially at the landfall sites, restoration will be initiated after installation of the first pipe and repeated following installation of the second pipe.

With the successful implementation of this approach no habitat offsetting requirement is anticipated for the landfall construction component of the project. A restoration monitoring program, likely of 5 years duration, will be required to measure the success of the landfall restoration program. This monitoring program will incorporate thresholds for benthic community and vegetation cover recovery and planting success (for intertidal marsh).

3.2 Offshore Habitats

For areas modified by normal lay operations (43.0 ha for the Kitsault route option, 28.8 ha for the Nasoga route option, Table 2 and Table 5), existing benthic habitats will be replaced by a larger surface area of concrete coated pipe. The total area of concrete coated pipe will be approximated 1.5 times higher than existing disturbed seabed areas for pipe which subsides in the seabed to ½ the pipe diameter (65.9 ha for the Kitsault route option, 38.4 ha for the Nasoga route option) and 1.75 times the disturbed area for pipe which subsides to ¼ the pipe diameter (75.2 ha for the Kitsault route option, 50.4 ha for the Nasoga route option).

Addition of hard substrate to the seabed, in the form of either the pipe or of rock fill, will favour the growth of sessile, attached invertebrates providing cover for fish and mobile invertebrates generally not found on softer sediment seabed. Surveys of the existing Strait of Georgia natural gas pipeline showed extensive colonization of the steel pipe by a variety of organisms including cloud sponges 9 years after installation. The Bazen Bay (Sidney BC) sewage outfall pipe (steel, enamel coated) was also extensively colonized 2.5 years after installation (Glaholt et al. 2000). Further detail on marine pipe colonization is provided in Section 4.4.5.5 of the EA volume. The concrete coating on the proposed pipe is likely more suitable to colonization by epiphytes than the smooth coated steel pipes described in the studies above. Conversely, the pipelines will result in a loss of infaunal dominated, softer seabed habitats.

The overall effect of direct pipe lay on the seabed will result in localized change in habitat type and associated function and value, but is considered to be a neutral effect (positive for reef associated communities and marginally negative for soft bottom communities). No habitat offsetting requirement is anticipated for the normal pipelay operation if sensitive habitat features such as glass sponge and hard coral areas area avoided, as currently planned.

On the Kitsault route dredging is required at Alice Rock, Liddle Channel and Brooke Shoal. These areas may also require underwater blasting to enable bedrock removal. Seabed modification at Pearson Point does not require dredging or blasting, only the deposition of rock material over a soft substrate.

At present, Alice Rock, Liddle Channel and Brooke Shoal are current dominated benthic communities, with relatively dense and diverse community of suspension and filter feeding sessile invertebrates (anemones, bryozoans complexes, hydrocorals, demosponges, feather stars) growing on cobble and boulder substrates as well as sea whips and subtidal mussel beds on less coarse substrates. Macroalgae, including bull kelps, were noted in the shallower areas (<20 m depth) of Brooke Shoal and Alice Rock.

Table 3 summarizes the removal and redistribution of coarse substrates by cut and fill operations at these sites. In general the seabed modification activity will not result in a net loss of seabed habitat but will generate a net increase in areas of coarse gravel habitat due to the placement of rock material over finer sediments in order to reduce bottom roughness. Overall (for all four seabed modification sites) there is an estimated increase of 8.3 ha of gravel substrate and a corresponding loss of 2.7 ha of fine sediment seabed, 3.3 ha of medium grained seabed and 2.3 ha of bedrock seabed. Most of the constructed coarse gravel habitats will be deeper than the existing rocky habitat in these areas. Table 6 provides an estimate of the amount of seabed <20 m deep subject to excavation at Alice Rock, Liddle Channel and Brooke Shoal. At Alice Rock and Liddle Channel most of this material is gravel or bedrock suitable for benthic and canopy kelps. At Brooke Shoal the excavated material is smaller and less suitable for kelps. In addition recent refinements to the Kitsault routing suggests the amount of shallow area excavated at Brooke Shoal can be significantly reduced (from 5.67 ha to 0.66 ha). This overall loss of shallow (<20 m) rocky substrate will result in less suitable substrate for macroalgae including canopy kelps (bull kelps).

Table 6. Summary of loss of shallow (<20m depth) habitat at the Kitsault Route option seabed modification areas.

Habitat Type	Alice Rock (ha)	Liddle Channel (ha)	Brooke Shoal (ha)	Total (ha)
Medium Grained	0	0	5.56	5.56[1]
Gravel (till)	1.75	0.56	0	2.31
Bedrock	0	0	0	0
Total	0	0	0	7.87

[1] Recent refinements to the route design at Brooke Shoal indicate that this area can be reduced to 0.66 ha.

In summary, no offsetting requirement is anticipated for landfall site construction or normal pipelay operations with implementation of the avoidance, mitigation and restoration initiatives outlined in Section 2.1 above. As such no offsetting should be required for the Nasoga route option unless ongoing geophysical survey indentifies areas requiring modification to address seabed roughness which also contain valued habitat features (e.g. vegetated areas, glass sponge or hard coral areas).

For the Kitsault route, habitat offsetting is anticipated to address the loss of vegetated gravel or bedrock habitat at Alice Rock, Liddle Channel and Brooke Shoal. The total area subject to an offset requirement is estimated to be approximately 3.0 ha based on Table 6 adjusted for the recent refinements to routing at Brooke Shoal. This should be considered a preliminary estimate based on current route design and is subject to change as detailed design proceeds and further field surveys are undertaken to map vegetated habitats at these sites.

3.2.1 Offsetting Options for Alice Rock, Liddle Channel, and Brooke Shoal

Offsetting options for the loss of shallow rocky habitat at these three areas include:

1. Construction of rock reefs,
2. Remediation of the seabed at the former log dump site in Nasoga Gulf, and
3. Remediation of other degraded areas within Observatory Inlet, Portland Inlets and Chatham Sound as identified by regulators, First Nations and stakeholders.

Additional discussions with regulatory agencies, particularly DFO, First Nations and other stakeholders are necessary to identify additional offset opportunities that meet regional and local fishery management objectives in the marine environment. DFO representatives confirmed in a June 2014 meeting that discussions regarding offsetting would not be implemented until the permitting phase which follows EAO approval, and could also not be undertaken until final routing decisions were made. The offsetting options outlined below are provided to illustrate that options are available to meet the anticipated requirement outlined in Section 3.2 above.

DFO guidance recommends that like-for-like habitat offsetting, in close proximity to the area of habitat loss, is the preferred approach. Consequently the offsetting option suggested for these areas is to use excess large rock material excavated at Brooke Shoal, Liddle Channel and Alice Rock to create shallow rock reef habitat (2-15 m deep) at suitable sites adjacent to these areas to offset the loss of shallow rocky habitat.

The rock reef areas are anticipated to be colonized by both sessile epifauna (e.g., bryozoans, hydrozoans, sponges) as well as benthic and canopy (bull) kelps. Establishment of these communities will take longer (2 to 6 years) than infaunal colonization of soft seabed areas. It may be possible to reduce the time to recolonize rock fill areas by “seeding” the reef areas with the cobble and boulder containing epifaunal species and algae excavated from cut areas. Figure 4 provides an illustration of a similar reef installation in Esquimalt Harbour immediately post construction contrasted with a reef installation in Victoria Harbour after several years of natural recruitment. Siting of any reef installation will be made in consultation with DFO and other stakeholders and will require approvals from Transport Canada under the Navigation Protection Program.

An additional offsetting option is the remediation of seabed habitats at the former log-dump site adjacent to the Nasoga landfall site. This log dump is thought to have operated in the late 1990s and early 2000s. The nearshore towed video survey identified an area of approximately 0.6 ha at depths of 0 to 30 m relative to chart datum which are impacted by bark debris (Figure 5). The subsequent ROV survey suggested that the bark impacted area may extend to a depth of 50 m (Figure 5). Remediation options include capping with suitable clean sediments (preferred) or the removal of existing bark debris. This site is only moderately impacted by bark debris as suggested by the partial seabed cover by bark debris and lack of evidence of anoxic sediments which are often associated with patches of white bacterial mat (Beggiatoa). DFO and other stakeholders may identify other former log dump sites in the region which are more highly impacted and would be more suitable candidates for habitat offsetting.

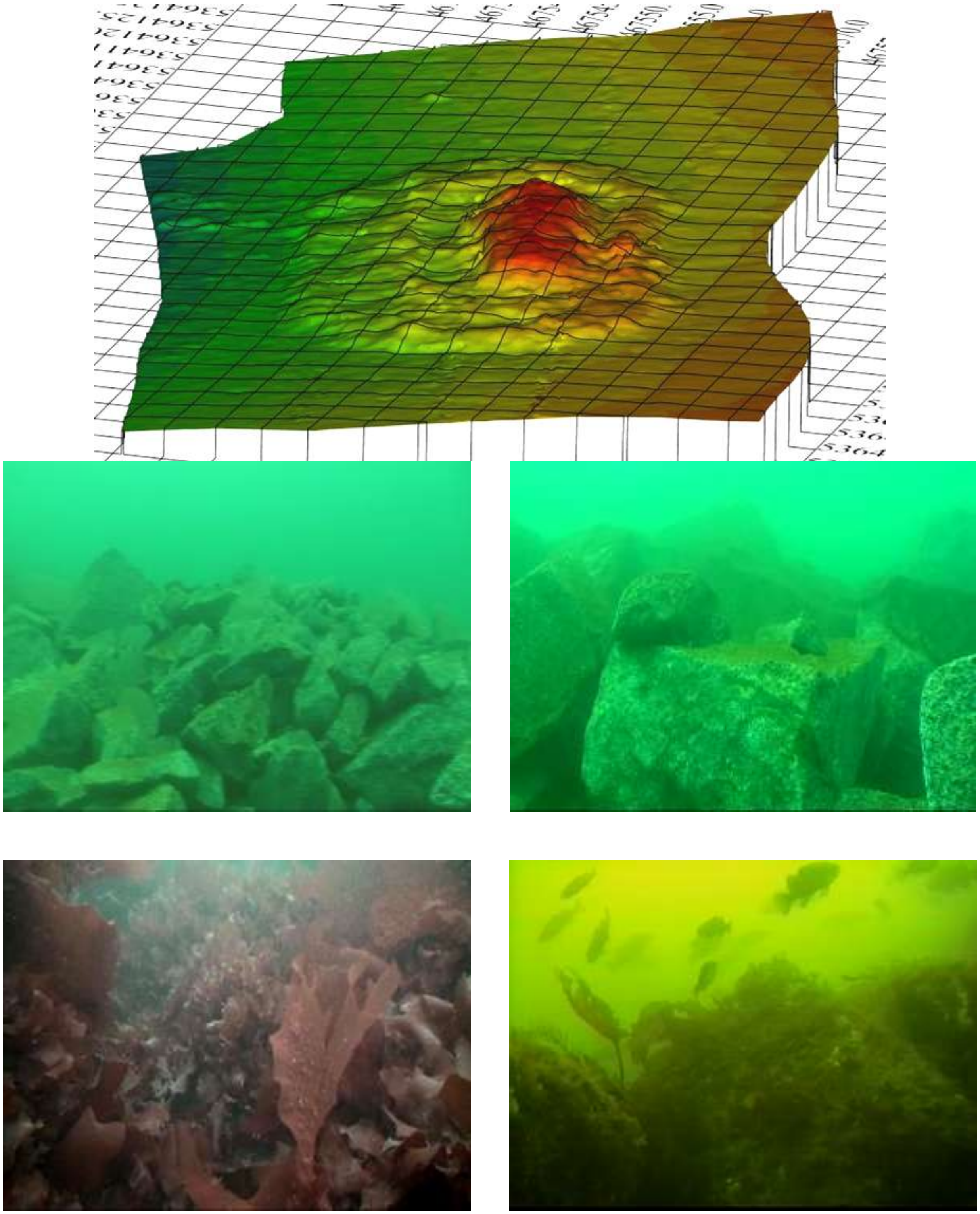

Figure 4. 3D profile of a rocky reef constructed in Esquimalt Harbour (top) and images from immediate post construction (centre) as well as a fully colonized rocky reef constructed in Victoria Harbour (bottom).

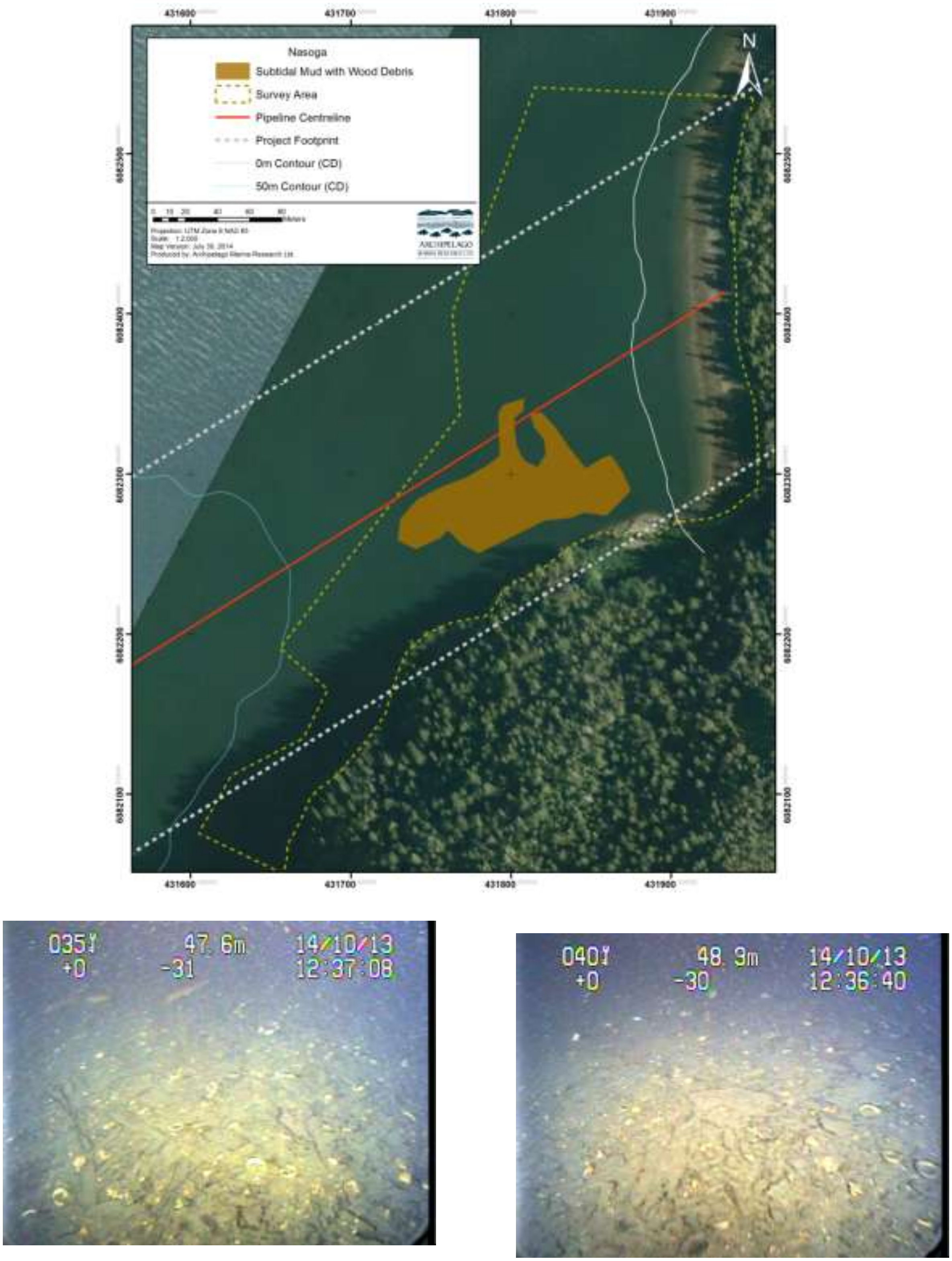

Figure 5. Location of wood waste accumulation identified by towed video survey at the Nasoga landfall site (top). Images of wood debris on seabed from ROV survey at approximately 50 m depth.

3.3 Plan Evaluation, Finalization and Application

The potential offset opportunities will be further assessed as to their ability to meet the guidelines outlined in the FPIP (DFO, 2013b). Consultation with regulators, First Nations and other stakeholders will be ongoing. Subsequent to an EAO approval of the Application an Application for Authorization under Paragraph 35(2)(b) of the Fisheries Act Regulations (DFO, 2013c) will be prepared. The Application to DFO will document alteration or loss of seabed habitats in greater detail and will more fully address the requirement for habitat offsetting, both with respect to habitat type and quantity, to be addressed in the detailed FHOP. Additional permitting from other regulatory agencies (e.g. Transport Canada) may be required prior to installation of offsetting measures. All agreed upon offsetting measures will be implemented in accordance with the FHOP and applicable permits.

3.4 Monitoring and Reporting

Monitoring and reporting will be undertaken according to the conditions of the Authorization, and following the recommendations provided in Assessing the Effectiveness of Fish Habitat Compensation Activities in Canada (DFO, 2012), and FPIP (DFO, 2013b). The goal of the monitoring plan is to ensure that both restoration and offsetting measures are implemented in accordance with the FHOP, and that they balance Project-related adverse effects on CRA fisheries productivity. The monitoring plan will include appropriate indicators or thresholds for effectiveness. Monitoring will be completed at prescribed intervals (e.g., annually or biannually) and monitoring reports will be submitted to DFO. It is anticipated that monitoring will be required for up to 5 years post construction or implementation of the offsetting initiative.

4 References

DFO (2012) Assessing the effectiveness of fish habitat compensation activities in Canada: Monitoring design and metrics. DFO Canadian Science Advisory Secretariat Science Advisory Report 2012/060.

DFO (2013a) Fisheries Protection Policy Statement (2013) Fisheries and Oceans Canada, October, 2013.

DFO (2013b) Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting (2013) Fisheries and Oceans Canada, Ecosystem Programs Policy, Ottawa, ON. Catalogue No. Fs23-596/2013-PDFNovember, 2013. 19p.

DFO (2013c) Applications for Authorization under Paragraph 35(2)(b) of the Fisheries Act Regulations. SOR/2013-191. Last amended on November 25, 2013. http://laws-lois.justice.gc.ca

Glaholt R, Fung T, Ong S (2000) Investigation of the potential for a bottom-founded marine pipeline to act as a barrier to the dispersal of Dungeness crab (*Cancer magister*), California sea cucumber (*Parastichopus californicus*), green sea urchin *(Strongylocentrotus droebachiensis*) and other species. Prepared by Tera Environmental Consultants Ltd. For the Georgia Strait Crossing Pipeline Project Ltd. 21pp.

Wright D and Hopky G (1998) Guidelines for the use of explosives in or near Canadian fisheries waters. Canadian Technical Report of Fisheries and Aquatic Sciences 2107: 34 pp.

Appendix 1

Marine Pipeline Construction Methods

Open Cut Trench Methods

Open cut trench methods will be used at all planned landfall sites. An open cut shore approach method consists of dredging a trench that runs from onshore to offshore followed by pulling the pipestring ashore using an onshore linear winch. Dredging the pipeline trench is accomplished by clamshell, bucket or backhoe dredges. At Ridley Island a suction dredge may be used to excavate the deeper section of the open cut trench. Spoil materials are sidecast and, post-pullback, used for backfill in the trench. The onshore equipment for an open cut trench shore approach, along with a view of the offshore equipment, is seen in Figure 2.

Figure 2: Open Cut Trench Shore Approach

Pipe Lay

Pipelay of the marine pipeline will primarily be performed using a dynamically positioned lay vessel. Dynamic positioning (DP) is a mooring method that uses thrusters to maintain the position of the vessel. The S-Lay pipeline installation process will be utilized by the DP lay vessel. This designation is derived from the S-shaped profile of the pipe as it transitions from the stern of the vessel to the seabed. To assist the line pipe in transition from the lay vessel to the seafloor, an adjustable structure, called a “stinger” is attached to the stern of the barge. Adjustable rollers are positioned in predetermined locations on the lay vessel and the stinger to develop a specific bending profile. A combination of tension and stinger positioning ensures the pipeline will not be overstressed during the installation process. The stinger can be raised or lowered to provide a range of acceptable profiles and account for changes in water depth or pipe lay tensions. A typical S-Lay vessel lay process profile is shown in Figure 3. A remotely operated vehicle (ROV) is used to monitor the pipelay on the seabed.

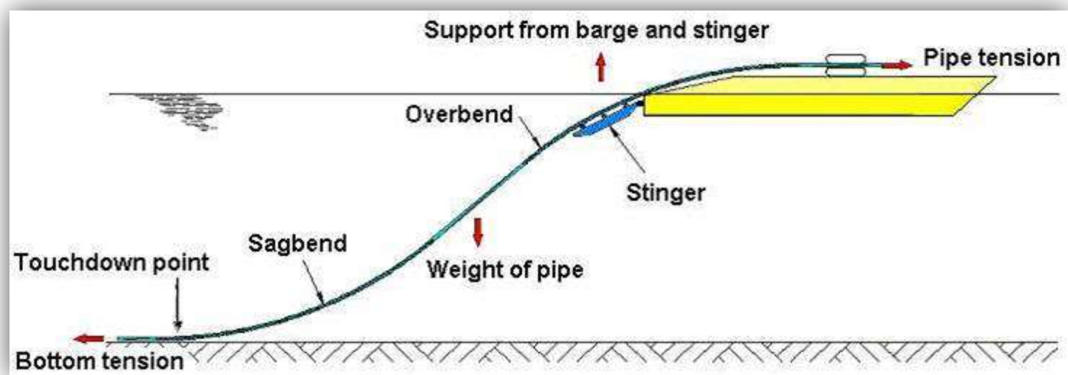

Figure 3: S-Lay Vessel Lay Process Profile

Seabed Preparation

Dredging, underwater blasting and placement of rock fill material on the seabed may be required in areas of uneven or hard seabed to provide a stable foundation for the pipe.

Subsea Rock Fracturing and Removal

In areas of near surface rock or rock outcroppings along the sea floor that impede the dredging of the bottom, controlled blasting may be utilized to break up the rock in preparation for removal or replacement. Subsea blasting consists of drilling holes in predetermined locations and depths within the rock structure and sealing explosive charges within the holes. The charges are then detonated in order to fracture the rock in to smaller, more manageable pieces. A typical offshore blasting rig can be seen in Figure 3.

Another method for managing subsea rock formations includes the use of a marine rock breaker. This hydraulic breaker is used in more shallow water applications. The breaker uses mechanical force to fracture the rock. A typical marine rock breaker can be seen on the right in Figure 4. In both cases, depending on the depth of the sea floor, once the rock is fractured, the pieces may be recovered and removed or relocated using a clam-shell dredge.

Figure 4: Subsea Rock Fracturing Equipment

Bedding

In locations of uneven or hard bottom sea floor, placement of fill material provides a stable bottom for the pipe to rest upon. A specialized vessel, seen in Figure 5, lowers a fallpipe (2) into the water which allows for the loading of materials (1) into the pipe tower (3) down to a specific location which is monitored and controlled by a fallpipe remotely operated vehicle (ROV) (4). Additional material can be delivered to the fallpipe vessel via barges.

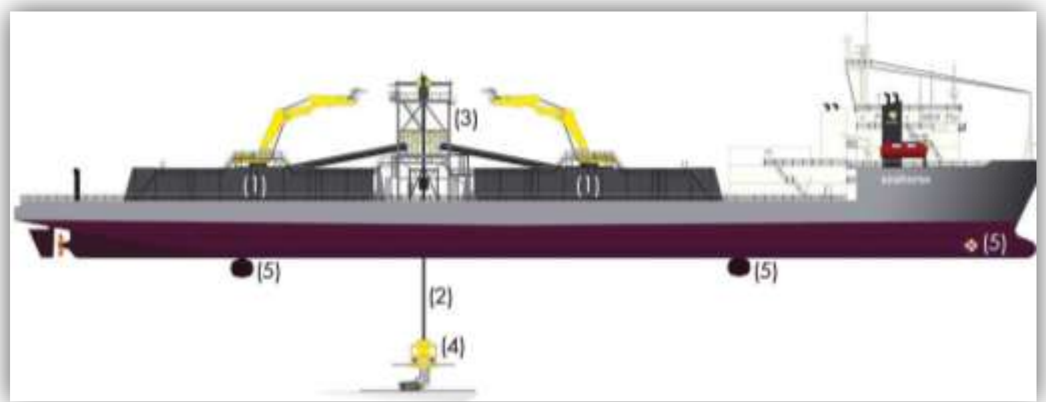

Figure 5: Fallpipe Vessel

In the case of an unsupported span of pipe due to a shallow valley on the seafloor, fill material, typically rock, can be placed to provide support in the proper locations to prevent over stressing of the pipeline. The result of this engineered rock placement method can be seen in Figure 6.

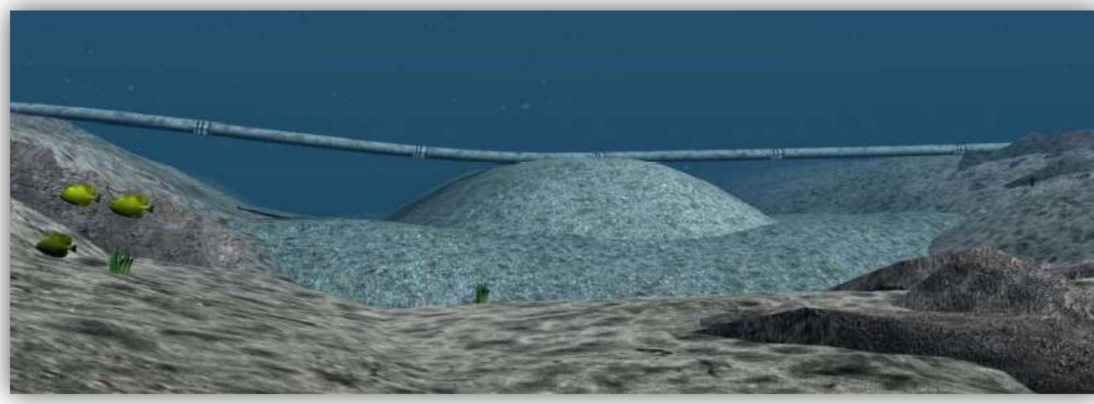

Figure 6: Span Correction through Fill Material