Appendix V5-10F

Conceptual Marine Fisheries Offsetting Approach for Phase 2

Memorandum

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Subject: **Conceptual Marine Fisheries Offsetting Approach for Phase 2**

The purpose of this memorandum is to identify a procedural framework and potential offset options for completing a Marine Fisheries Offsetting Plan, should its development be deemed necessary by Fisheries and Oceans Canada (DFO) for the Phase 2 Project.

1. INTRODUCTION

All potential loss/alteration of fish habitat and fisheries productivity in the marine environment will result from the construction of a proposed cargo dock on the western shoreline of Roberts Bay. Anticipated fish habitat losses may include subtidal habitat underneath the footprint of the cargo dock and the rock embankment (i.e., rock armouring placed around its perimeter), as well as intertidal habitat underneath the footprint of the causeway.

Based on the preliminary cargo dock design (SRK 2016), the total habitat loss is estimated to reach approximately 5,500 m^2 (0.55 hectares), which includes the causeway and the riprap armoring (approximately half of which fall below the high water mark). The riprap rock armouring is expected to provide self-offsetting fish habitat through the addition of large three-dimensional (3-D) rock substrate, increasing local habitat heterogeneity relative to the largely fines-dominated habitat.

Other infrastructure constructed near the Roberts Bay shoreline will be built above the HWM, and will be at least 31 m from the shoreline, and is therefore not considered to contribute to the overall loss or alteration of fish habitat. Best management practices will be followed to ensure there will be no impact on fish habitat adjacent to those facilities from construction activities such as the use of mobile machinery and overland flows of contact water and sediment.

As a consequence of the cargo dock being constructed below the HWM, fish habitat and fish populations may be adversely impacted in Roberts Bay resulting in the potential for *serious harm* to fisheries productivity. According to the *Fisheries Protection Policy Statement* (DFO 2013a), if a project is likely to cause *serious harm to fish* after the application of avoidance and mitigation measures, then the proponent must develop a plan to undertake offsetting measures to counterbalance the unavoidable residual *serious harm* to fish. These offsetting measures, also known as offsets, are implemented with the goal of maintaining or improving the productivity of commercial, recreational or Aboriginal (CRA) fisheries (DFO 2013b).

2. REGULATORY AND POLICY FRAMEWORK

The *Fisheries Protection Policy Statement* (DFO 2013a) supports the 2012 updates made to the *Fisheries Act*. The *Fisheries Protection Policy Statement* replaces Fisheries and Oceans Canada's (DFO) no net loss guiding principle for fish habitat within the *Policy for the Management of Fish Habitat* (DFO 1991). The changes to the *Fisheries Act* include a prohibition against causing *serious harm to fish* that are part of, or support, a CRA fishery (section 35 of the *Fisheries Act*); provisions for flow and passage (sections 20 and 21 of the *Fisheries Act*); and a framework for regulatory decision-making (sections 6 and 6.1 of the *Fisheries Act*). These provisions guide the Minister's decision-making process in order to provide for sustainable and productive fisheries.

The amendments center on the prohibition against *serious harm to fish* and apply to fish and fish habitat that are part of or support CRA fisheries. Proponents are responsible for avoiding and mitigating *serious harm to fish* that form part of or support CRA fisheries. When proponents are unable to completely avoid or mitigate *serious harm to fish*, their projects will normally require authorization under subsection 35(2) of the *Fisheries Act* in order for the project to proceed without contravening the Act.

DFO interprets *serious harm to fish* as:

- 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, nursery, rearing, food supply areas, migration corridors, 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 results in fish no longer being able to rely on such habitats for use as spawning grounds, nursery, rearing, food supply areas, migration corridor, or any other area in order to carry out one or more of their life processes.

After efforts have been made to avoid and mitigate impacts, any residual *serious harm to fish* is required to be offset. An offset measure is one that counterbalances unavoidable *serious harm to fish* resulting from a project with the goal of maintaining or improving the productivity of the CRA fishery. Where possible, offset measures should support available fisheries' management objectives and local restoration priorities.

3. FISHERIES OFFSETTING APPROACH

A procedural approach is proposed for developing a Marine Fisheries Offsetting Plan (the Offsetting Plan) for Phase 2, if deemed necessary by DFO. This approach is proposed to satisfy the *Fisheries Protection Policy Statement* (DFO 2013a) and the federal *Fisheries Act*, and to allow for flexibility in finding a solution to offsetting Project-related effects.

The proposed approach for the development of an Offsetting Plan is identified below and will be discussed in the following four sections:

- Assessment of the amount of fish habitat to be lost/altered.

- Assessment of the fish populations and their abundance in Roberts Bay that may use the lost/altered habitat.
- Use of the Habitat Evaluation Procedure (HEP) to assign quality as well as quantity to lost habitat.
- Identification of offsetting options.

The proposed approach was developed based upon the guidance provided in the *Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting* (DFO 2013b). The approach was also based upon the review of existing fisheries and fish habitat information for Phase 2. Based upon this review some key preliminary offsetting options were identified and are discussed in the following sections.

The *Fisheries Protection Policy Statement* (DFO 2013a), the *Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting* (DFO 2013b), and the federal *Fisheries Act* refer to fish productivity as the metric for offsetting. Since fish productivity, defined as the number of kilograms of fish tissue estimated per m^2 of habitat or per hectare of habitat per year, is difficult to measure in practice, fish habitat continues to be used as a practical surrogate for productivity.

3.1 Assessment of Fish Habitat

The first step in developing an offsetting plan for the Roberts Bay cargo dock is to quantify the amount and quality of habitat that will be lost to development after avoidance and mitigation measures have been applied. Avoidance and mitigation measures are planned during Phase 2 activities such that potential serious harm through permanent habitat loss/alteration will be minimized. These measures include mitigation by design, best management practices (including DFO's *Measures to Avoid Causing Harm to Fish and Fish Habitat*; DFO 2013), monitoring, and adaptive management (Volume 5, Section 10.5.3 in TMAC 2016).

Habitat data will form the basis of quantifying the potential serious harm to fisheries required to be offset, validate the habitat-based approach to offsetting, and support future monitoring (a federal requirement of an Offsetting Plan). An offsetting plan typically includes a habitat budget that quantifies the loss of habitat in terms of area (m^2) and habitat units (HU) (to be explained below in Section 3.3 of this memo) and the expected gain in offsetting habitat.

Baseline surveys of marine physical habitat in Roberts Bay were conducted in 2000, 2003, 2004, 2009 and 2010 as part of studies of marine fish communities (Rescan 2001; RL&L/Golder 2003a; Golder 2005; Rescan 2010a, 2011). In 2000, aerial surveys of the shoreline and the intertidal zone were conducted by helicopter. In 2003, a bathymetric map of Roberts Bay was first prepared. In 2004, 2009, and 2010, visual surveys of the intertidal zone were conducted by walking and/or boating along the shoreline. In 2009, the upper subtidal was also visually surveyed. In 2010, the subtidal at three locations along the western side of the bay was surveyed using hydroacoustic techniques ground-proofed by video cameras.

These data allowed an assessment of the typical habitat in the subtidal and intertidal of Roberts Bay. Shoreline substrates consist mainly of bedrock in the northwest and south portions of

Roberts Bay; however, gravel and sand are present in bays and at stream outlets. The eastern portion of the bay is dominated by boulder, gravel, and sand substrates. None of the areas surveyed were vegetated. Habitat quality was rated fair to good in the northern areas and good to excellent in the southern region on the basis of cover provided for fish and invertebrates and on potential for supporting benthic invertebrates.

The detailed intertidal and subtidal substrate surveys of 2010 showed that water depths adjacent to the site of the cargo dock reach 10 m. Nearshore areas are dominated by bedrock or gravel substrates, and subtidal substrates consist primarily of mud with small patches of cobble and/or boulder. No unique features such as stream outlets or uncommon substrates were observed at the site of the cargo dock. In summary, the habitat has low productive value for fish.

A total of 5,500 m^2 of habitat will be lost under the footprint, rock embankment, and causeway of the cargo dock. This is less than 0.04% of the area of Roberts Bay (15 km^2). However, this lost/altered area will likely have to be offset either through self-offsetting approaches, or through the creation of additional habitats

The offsetting plan will include a more detailed description of the lost/altered habitat and will evaluate its value in terms of habitat quality as well as habitat area.

3.2 Assessment of Fish Populations and their Abundance

An associated step in developing an offsetting plan is to map and identify the fish species that use habitat in Roberts Bay and assess their relative or absolute numbers, considering information on migration patterns and seasonal habitat use. This assists in determining the value of habitat.

From 2002 to 2010, the marine fish community in Roberts Bay was surveyed using gillnets, fyke nets, angling, minnow traps, beach seines, crab traps, and long-lines. Most of this sampling was conducted along the southern and western shores of the bay, with sites located slightly to the north and south of anticipated works. From 2002 to 2007, the objective was to determine fish species composition, relative abundance, movement, and biology of the nearshore subtidal area of Roberts Bay for a proposed marine off-loading facility similar to the currently proposed cargo dock. The most intensive sampling was conducted in 2009 and 2010 (Rescan 2010a, 2011).

A total of 23 species of fish were captured in Roberts Bay. None are designated as threatened or endangered by COSEWIC or listed on the *Species at Risk Act* (2002). Of the 8,683 fish captured, Saffron Cod made up 50.85% of the total number, followed by Capelin (30.73%), Arctic Flounder (5.07%), Pacific Herring (3.55%), Fourhorn Sculpin (2.78%), Arctic Char (1.90%), unidentified sculpins (1.89%), and Greenland Cod (1.47%). The remaining 15 species each made up between 0.01% (unidentified Snailfish) and 0.60% (Lake Trout).

Several other species have less variable catches than those two species, suggesting that they may be less migratory than Saffron Cod and Capelin and may reside for longer time periods in Roberts Bay. Arctic Char, for example was caught in seven of the eight sampling years and its catch ranged from 1 to 58 individuals in each of those seven years. It is reasonable to assume that some of those Arctic Char may have reared and overwintered in lakes whose outlet streams flow into Roberts

Bay. Another example is Arctic Flounder, which was caught in six of the eight years and had numbers ranging from 11 to 145 in each of those six years.

It is reasonable to assume that all 23 species have migrated through habitat near the cargo dock at some point in their life histories, but it may be difficult to determine the value that the potentially lost/altered habitat has relative to other surrounding areas in Roberts Bay exhibiting similar habitat.

3.3 Habitat Evaluation Procedure

A habitat evaluation procedure (HEP) will be used to construct a habitat budget for the Roberts Bay offsetting plan. HEP is a generalized procedure for assessing habitat suitability that was developed by the US Fish and Wildlife Service more than 35 years ago (USFWS 1980). It has been widely used throughout North America and is a standard tool for developing habitat budgets for offsetting planning in Canada (e.g., Diavik 1998; BHP Billiton 2002; RL&L/Golder 2003b; Rescan 2005, 2007, 2012). The general concepts developed through its application in freshwater systems will be applied to Roberts Bay.

The HEP approach has two advantages. First, it provides an objective method to characterize the quality or importance of affected habitats to fish species and marine resources. Second, it allows standardization of habitat quality ratings relative to other habitats that have different physical characteristics (e.g., subtidal versus intertidal, complex versus simply substrate structure). This facilitates comparisons among habitat types and ultimately allows affected habitats to be evaluated as a single group for the offsetting calculation.

The HEP produces habitat units (HU, m^2) that are indices of both habitat quantity and quality. HU are calculated by multiplying habitat area (measured in m^2) by a habitat suitability index (HSI) with values ranging from 0.0 (no value) to 1.0 (excellent value). HEP relies upon HSI models for such attributes as water depth, slope, surface salinity, substrate type (Lauria et al. 2011, 2015a, 2015b). Relevant HSI models for CRA fish such as Saffron Cod and anadromous Arctic Char will be reviewed for applicability to Roberts Bay, or will be developed in the absence of applicable models.

Once the number of HUs for the affected habitats is known, the identification and budgeting of offsetting options can commence. The objective is to create at least an equal number of offsetting HUs.

3.4 Identification of Offsetting Options

Identification of offsetting options is an iterative process requiring knowledge of local Inuit fisheries and community interest/priorities, fish distribution, fish population abundance, and habitat quality within the Phase 2 Project area. It requires a combination of stakeholder engagement/consultation, desktop analysis of available data, field-based assessment and sound professional judgement.

A general desktop approach that will be conducted to aid in the identification of potential fisheries offsetting options may include the following:

- Engagement with the local Hunters and Trappers Organization (HTO) and TMAC's Inuit Environmental Advisory Committee;
- Review and analysis of available baseline data on fish and fish habitat in Roberts Bay;
- Review of scientific literature on species-specific habitat limiting factors for valued fish species that are known to use habitat in Roberts Bay based upon peer-reviewed document and professional knowledge;
- Identification of factors limiting fish productivity within and outside of Roberts Bay. For example, identification of species and life history stages present, identification of known key habitats (e.g., spawning areas); and
- Identification of previous fisheries offsetting options implemented in Roberts Bay provided in background literature (e.g., environmental consultant reports for the Hope Bay Project area) or other projects in similar marine environments (e.g., Mary River Project) and evaluate their effectiveness.
- If necessary, identify potential off-site options using satellite imagery (e.g., Google Earth) should the preferred be to enhance fisheries productivity outside of Roberts Bay.

Field reconnaissance of the locations selected for preliminary offsetting options will be conducted. This also provides an opportunity to identify additional offsetting options. Through an iterative process of elimination and refinement, one or more technically feasible offsetting options will be identified.

4. PRELIMINARY OFFSETTING OPTIONS

In advance of the predicted effects on marine fish and fish habitat associated with the Phase 2 Project, a few options have been identified that could offset potential serious harm to fisheries, as defined by the Fisheries Act (1985). The following section presents two preliminary offsetting options in the vicinity of the Hope Bay Project, and then also discusses the potential for off-site offsetting.

4.1 Project Vicinity Options

The following two options are currently the leading candidates for offsetting habitat loss due to the construction of the cargo dock:

- incorporation of self-offsetting habitat through the consideration of additional riprap armouring around the perimeter around the proposed cargo dock; and
- installation of artificial rock shoals (artificial rock reefs) in subtidal habitat.

One of the main objectives during the final design stages of the marine cargo dock will be to minimize the in-water footprint and to incorporate self-offsetting to the extent possible, i.e., through the addition of a rock embankment (i.e., riprap armouring around perimeter of the dock) designed to produce a net increase in fish habitat through choice of rock particle size and slope). Should this self-offsetting approach not provide enough offset habitat because of other design/engineering limitations and/or considerations, then additional habitat additions will be considered through the creation of artificial rock structures (i.e., rock shoals or reefs) installed in Roberts Bay, as done previously for the Roberts Bay Jetty-related compensation. Both of these options above rely on the notion that fisheries productivity can be enhanced through the introduction of high quality (and therefore high value) and structurally complex (i.e., large three-dimensional substrates) structures, particularly in areas where such habitat heterogeneity is limited. These have shown to be useful in sediment bottom areas where no other hard substrate exits (Sherman, Gilliam, and Spieler 2002), which is likely representative of substrates found underneath the seaward footprint of the cargo dock. A greater surface area provides enhanced biomass potential because a greater area may support higher densities of algae and invertebrates. One main benefit of planned, man-made reefs is thus to attract local fish to a known location of suboptimal habitat. Artificial reefs can create an 'oasis-like' environment that provides shelter from predation, increased feeding efficiency and additional habitat (Smiley 2006). Additional information is provided below in support of these options.

The creation of three-dimensional subtidal habitat as an offsetting measure can take many forms including artificial reefs, habitat skirting, articulating ballast mats and/or placement of other three-dimensional rock structure configurations. Regardless of the method for creating three-dimensional structures, the created habitat provides hard and rough surfaces where algae and invertebrates colonize and provide resources for fish populations, thereby increasing overall ecosystem productivity (Hueckel and Buckley 1987; Hueckel and Stayton 1982; Clynick et al. 2007).

Generally artificial reefs are intended to create an ecosystem with a large diversity of organisms. Habitat complexity is directly related in an artificial reef to the diversity of species using the structure (London/UNEP 2009). Structurally diverse and large reefs (e.g., structures with holes, overhangs, and shadows) provide more opportunity for animals and algae to colonize and thus may lead to a higher local biological diversity (Menge et al. 1976). Cavities provided refuge from predators for a variety of species and life stages.

Particularly useful is the creation of ledges, crevices, and similar shelter sites within these artificial structures (Ebata et al. 2011). Gadids (cod) and Cottids (sculpins) are particularly attracted to complex hard substrates (Tupper and Boutilier 1995). In Roberts Bay, this would include four of the most common marine fishes: Saffron Cod (marine fish community VEC), Greenland Cod, Fourhorn Sculpin, and Shorthorn Sculpin. This process of colonization has been documented on the Roberts Bay jetty and compensation shoals (Rescan 2009, 2010b).

There is thus the precedent for the successful creation of artificial rock reefs to enhance overall fisheries productivity due to habitat loss/alteration in Roberts Bay. As part of the existing Doris Project infrastructure, a jetty was constructed in early July 2007 at the south end of Roberts Bay for barge loading and off-loading. The jetty was constructed perpendicular to shore and measured 95 m in length, varying in width from 5.3 to 35 m (Rescan 2009). At the time, construction of the jetty resulted in the alteration and/or loss of 0.176 ha of fish habitat. To compensate, four underwater rock reefs (or shoals), each measuring 31.25 m long by 12 m wide and spaced approximately 19 m apart, were constructed west of the jetty in 2008. The four shoals were equivalent to 0.150 ha of fish habitat. In combination with the below high-water side-slope area of the jetty, which provided habitat for fish and invertebrates, the net gain of fish habitat was 0.138 ha.

The rock reef monitoring program included four main components: (1) periphyton biomass (as chlorophyll *a*), cell density and taxonomic composition; (2) benthic invertebrate density and taxonomic composition; (3) fish community composition and catch-per-unit-effort; and (4) macroalgae community composition and percent cover (Rescan 2009, 2010b). Results of the first year of monitoring (Rescan 2009) indicated that periphyton and benthic invertebrate communities had established themselves on the compensation shoals. Periphyton assemblages were numerically dominated by blue-green algae and diatoms. The benthic invertebrate community composition on both the jetty and compensation shoals was dominated by amphipods, followed by polychaetes.

Visual snorkel surveys indicated that various genera of algae, invertebrates and fish were inhabiting and/or using the compensation structures. Macroalgae were not visually plentiful on the shoals or the jetty in Year 1. This was expected given that the compensation structures in Roberts Bay were new habitat and the natural succession of the algal communities was expected to take several years. By Year-2 monitoring results confirmed that periphyton and benthic invertebrate communities had established themselves on the compensation shoals in Roberts Bay (Rescan 2010b). Periphyton assemblages were again numerically dominated by cyanobacteria and diatoms. The filamentous cyanobacterium, *Anabaena cylindrica*, was the most abundant species on Roberts Bay shoals. The benthic invertebrate community composition was dominated by amphipods. *Lagunogammarus setosus* and *Ischyrocerus anguipes* were the most abundant species on the compensation shoals. Euphausiids (krill, of the order Euphausiacea) were the most abundant invertebrate observed throughout the visual surveys conducted in Roberts Bay. This shrimp-like crustacean plays a key role in marine food webs as it is known to be a main prey item to many marine vertebrates, including anadromous Arctic Char (marine fish community VEC).

Overall, Saffron Cod and Fourhorn Sculpin were the dominant species by number during the first summer sampling of post-construction shoal habitat and side-slopes of the jetty in Roberts Bay (Rescan 2010b). Over the two years of sampling, various species of adult, juvenile and young-of-the-year fish were observed during snorkel surveys in Roberts Bay (Rescan 2009, 2010b). Young-of-the-year fish (probably gadids) were the most common fish observed on the shoals. Their abundance shows that the jetty and shoal structures provide shelter and/or a food source for fish, thereby supporting their use for enhancing fisheries productivity.

In summary, the addition of rock reefs as compensation structures in Roberts Bay showed enhancement success as defined in the *Fisheries Authorization*. Successful establishment of primary and secondary producers on the rock shoals as well as the side-slopes of the jetty of Roberts Bay was observed. Furthermore, the monitoring program confirmed the use of the shoals and riprap slopes of the jetty by fish prey and fish of multiple age classes.

Overall, the successful results of the Roberts Bay Jetty Monitoring Program demonstrate the feasibility for considering the addition of structurally complex habitats to increase overall fisheries productivity.

4.1 Off-Site Offsetting Options

Off-site offsetting may also be considered a suitable alternative where enhancements would be constructed in or around a community in Nunavut, rather than within the Hope Bay Project area.

Off-site offsetting (i.e., community-based offsetting) can provide a broader range of benefits than just improvements to fisheries. These benefits include:

- potential to rehabilitate human-impacted sites such as over-fished populations;
- increased engagement with local community directly through employment and indirectly through increased activity in the community;
- transfer of knowledge by training community members in enhancement and monitoring methods; and
- potential to engage local educational institutions such as the Canadian High Arctic Research Station.

In addition to community consultations to identify options, biological, hydrological, topographical, and engineering investigations will be required to determine the technical feasibility of preliminary off-site offsetting options. The following biological data will be acquired to support the development of the Offsetting Plan:

- habitat assessment and mapping;
- fish passage assessments at potential restrictions; and
- fisheries community, demography, and abundance sampling (e.g., gillnetting, electrofishing, fish stranding enumeration) at potential sites.

Hydrological, topographical, and engineering data requirements are site-specific and will be determined during a field investigation.

5. SUMMARY

A conceptual fisheries offsetting plan, if deemed necessary by DFO, will be developed to identify and compensate for potential serious harm in accordance with the *Fisheries Act*, the *Fisheries Protection Policy Statement* and *the Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting*. The approach to offsetting will include quantification of habitat and productivity losses, identification of offset habitats, and a quantification of habitat and productivity gains relative to losses. This process may involve consultation with the local Hunters and Trappers Organization, TMAC's Inuit Environmental Advisory Committee and DFO to align offsetting goals with local and regional sustainability objectives throughout the Draft and Final Environmental Impact Statements and any required application for a Fisheries Act Authorization.

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