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WESTCOAST CONNECTOR GAS TRANSMISSION PROJECT

CONCEPTUAL FRESHWATER FISH HABITAT OFFSETTING PLAN

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1.0 Introduction

In support of BG Group and their bid to build a liquefied natural gas (LNG) terminal in Prince Rupert, BC, Westcoast Connector Gas Transmission Ltd. (WCGT) proposes to develop a natural gas pipeline system from northeast British Columbia to the proposed Prince Rupert LNG terminal site at Ridley Island. The pipeline is referred to as the Westcoast Connector Gas Transmission Project (the Project). The Environmental Assessment Certificate Application for the Project was formally accepted for review by the BC Environmental Assessment Office (BC EAO) on May 6, 2014.

Throughout the length of the proposed pipeline, many lentic and lotic systems will be crossed. WCGT is committed to preventing serious harm to fish through the application of avoidance and mitigation measures; however, construction of several watercourse crossings may result in residual effects to the freshwater environment. Watercourse crossings that result in serious harm to fish will require Authorization under the *Fisheries Act* (2012) and habitat offsetting, which is defined by Fisheries and Oceans Canada (DFO) as "measures to counterbalance serious harm to fish by maintaining or improving fisheries productivity after all feasible measures to avoid and mitigate impacts have been undertaken" (DFO, 2013a). 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 freshwater CFHOP outlines the strategy and framework for development of the Final Fish Habitat Offsetting Plan (FHOP). A marine 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.

1.1 Regulatory Context

This document considers the 2012 amendments to the federal *Fisheries Act*, the Fisheries Protection Policy Statement (DFO, 2013a) and the Fisheries Productivity Investment Policy (FPIP): A Proponent's Guide to Offsetting (the Offsetting Guide; DFO, 2013b). Amendments to the *Fisheries Act* shifted emphasis from a broad-based protection of fish habitat to one that prevents serious harm to fish that are part of a commercial, recreational, or Aboriginal (CRA) fishery, or to fish that support such a fishery.

The federal *Species at Risk Act* (SARA) was also considered during preparation of this document. It is an offense to kill, harm, harass, capture, or take an individual that is listed as extirpated, endangered, or threatened on Schedule 1 of SARA. Likewise, the residences and critical habitats (as defined by SARA) of species listed as extirpated, endangered, or threatened are legally protected.

1.2 Objectives

The federal *Fisheries Act* and its supporting policies, aim to protect and manage fish habitats that support species comprising or supporting CRA fisheries. The primary objective for the development of habitat offsetting programs is to counterbalance unavoidable (e.g., site avoidance

is not practical) serious harm to fish and loss of productivity of CRA species of importance. DFO defines serious harm to fish as:

- The death of a fish
- Permanent alteration to fish habitat of a spatial scale, duration, and intensity that limits or diminishes the ability of fish to use such habitats as spawning grounds, or as a 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
- Destruction of fish habitat of a spatial scale, duration, and intensity that eliminates the ability of fish to rely upon such habitats as spawning grounds, or as a 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

This CFHOP has been prepared at the conceptual level only as WCGT has not yet determined final routing or completed engineering designs for the Project. These detailed design and routing decisions will ultimately influence development of the FHOP. Following selection of the final route and completion of engineering designs, final calculations of residual serious harm and preparation of the final offsetting plan will be completed.

In addition to discussions with DFO regarding offsets, provincial regulators, First Nations, and stakeholders will continue to be engaged to determine specific locations for offsetting and types of offsetting preferred within each watershed and/or sub-basin. Additional guidance on offsetting is also gathered from relevant Land and Resource Management Plans and other regional documents.

1.3 Potential Project Effects on Freshwater Fish and Fish Habitat

Elements of the Project that may result in adverse effects to freshwater fish and fish habitat include:

- Freshwater watercourse crossings (pipeline, permanent, and temporary access road construction) (Cypress to Cranberry, Kitsault, and Nasoga routes[1]); and
- Temporary (e.g., construction camps, equipment storage sites, borrow sites) and permanent facilities (e.g., compressor stations and meter stations) located within the riparian reserve zones (table 1) as outlined in the Environmental Protection and Management Guide (BC, OGC, 2013).

Potential adverse effects to freshwater fish and fish habitat identified in the Environmental Assessment (EA) submitted to the BC EAO (TERA, 2014) include:

- Alteration or loss of riparian habitat function during construction activities and operations;

[1] Although it is understood that only one of the Kitsault or Nasoga routes will be chosen, development of the conceptual offsetting plan will consider the freshwater portions of both routes until final routing is determined by WCGT.

- Alteration or loss of instream habitat during construction of pipeline crossings and vehicle crossings;
- Temporary increase in suspended sediment concentrations during construction of pipeline crossings and vehicle crossings;
- Fish mortality and injury during construction;
- Increased access to fish and fish habitat resulting in disturbance to fish habitat and fish mortality during operations;
- Temporary blockage of fish passage during construction of watercourse crossings; and
- Potential effects to fish species of conservation concern.

Alteration/loss of habitats during construction of watercourse crossings are the most likely Project-related effects to require Authorization and offsetting. Application of general and site-specific mitigation measures will likely reduce the other potential effects listed above to levels that do not result in serious harm.

2.0 Development of the Freshwater Offsetting Plan

Offsetting plans involve making predictions of potential effects to the existing resources and land base that are likely to occur during construction of a project. The approach must be technically defensible, follow rigorous standards, and the methodologies and assumptions must be transparent to withstand scrutiny and challenge by regulatory agencies, First Nations, and public stakeholders.

This CFHOP follows the steps and procedures outlined in DFO (2013b) and presented in the EA prepared for the Project (TERA, 2014). The major steps involved in preparing a CFHOP include:

1. Assess/minimize Project effects;
2. Identify potential offsetting opportunities;
3. Determine residual harm;
4. Plan evaluation;
5. Plan finalization, application, and implementation; and
6. Monitoring and reporting.

Additionally, the CFHOP will adhere to the four guiding principles of the DFO (2013b):

1. Offsetting measures must support fisheries management objectives or local restoration priorities.
2. Benefits from offsetting measures must balance project impacts.
3. Offsetting measures must provide additional benefits to the fishery.
4. Offsetting measures must generate self-sustaining benefits over the long term.

2.1 Assess/Minimize Project Effects

Measures to minimize Project effects are detailed in the Terrestrial Environmental Management Plan prepared for the Project, following guidance described by DFO's *Measures to Avoid Causing Harm* (DFO, 2013c), including the following:

- Construction timing windows (species- and area-specific)
- Site selection (avoid sensitive habitats as practicable)
- Containment and spill management
- Erosion and sediment control
- Shoreline/bank re-vegetation and stabilization
- Fish protection (e.g., fish screens, fish salvage)
- Avoiding/minimizing the use of explosives in/near water
- Operation of machinery (e.g., refuelling 30 m away from top-of-bank; clean, non-leaking equipment)

Existing fish and fish habitat data collected in support of the EA application have been reviewed to determine the location and nature (species presence, habitat type and quality) of high sensitivity watercourse crossings. The EA prepared for the Project determined the sensitivity (low or high) of all assessed watercourses (TERA, 2014); an estimated 236 watercourses associated with pipeline crossings were considered to be high sensitivity based on the presence of species at risk or species of management concern (and their respective resiliencies), or classification as a "fish-stream" as defined by the *Environmental Protection and Management Regulation* (EPMR). The EA further indicates that Project activities on watercourses with a high sensitivity ranking may require a *Fisheries Act* Section 35(2)(b) Authorization, which would require an offsetting plan. However, with the implementation of standard and site-specific mitigation measures, it is highly unlikely that all 236 crossings on high sensitivity streams will require Authorizations. A preliminary self-assessment procedure (similar to DFO's former Risk Management Framework) was applied to all assessed watercourse crossings (to the extent possible with preliminary crossing methodologies, routing, and proposed mitigation) to determine whether a crossing may require a DFO request for review, or a request for Authorization with subsequent offsetting, as described below.

At each pipeline crossing, a number of metrics associated with species and habitat sensitivities were assigned a score from 0 to 4. Likewise, the probability of residual effects associated with the primary crossing method was determined by assigning a score of 0 to 4 for a number of factors, including crossing type, construction timing, mitigation measures, duration, and reversibility of effects. The total scores for each of the species and habitat sensitivity rankings and probability of residual effects were then plotted against each other to determine the overall risk category (low, moderate, high, or extreme) at each location. Under this methodology, locations that are high risk (based on species and habitat sensitivities, and proposed crossing methodology and mitigation) may result in serious harm. Crossing locations with an overall risk of moderate may require DFO review to determine whether serious harm would occur, and whether an Authorization with offsetting would be required. Although the responsibility for determining whether serious harm occurs lies with DFO, this methodology provided focus for the development of the CFHOP. Determinations of serious harm will also be assessed with input from the EAO and the Working Group (including First Nations) to guide development of the FHOP following the selection of the final route and submissions of applications to DFO during the permitting phase of the Project.

The WCGT Project crosses four Primary Watersheds along its route: Peace River; Fraser River; Skeena River, and Nass River. Preliminary watershed-specific disturbance estimates for all crossings rated moderate risk or higher are summarized in Table 1. Riparian disturbance areas are based on the riparian management area (RMA) and riparian reserve zone (RRZ) from the Environmental Protection and Management Guide (BC OGC, 2013). These values are conservative and consider the total width of the ROW in riparian areas; however, as the final ROW width will likely be restricted in riparian areas, the final impacts will likely be smaller.

Table 1. Summary of impacts for all moderate and high risk watercourse crossings

Watershed	*Total Estimated Instream Disturbance (m^2)*	*Total Estimated Riparian Disturbance (m^2) (based on RMA)*	*Total Estimated Riparian Disturbance (m^2) (based on RRZ)*
Peace River	99,187*	236,500	124,300
Fraser River	3,949	53,900	35,200
Skeena River	4,759	51,700	35,200
Nass River	17,426	169,400	93,500

*Calculation of instream disturbance for the Peace River includes the Williston Reservoir (estimated at 80,850 m^2).

Preliminary results indicate that, with the application of appropriate mitigation measures (e.g., adhering to timing windows, implementation of sediment and erosion control, selecting trenchless crossing methodologies, and/or conducting open cuts under dry/frozen conditions), the majority of moderate-risk watercourse crossings are not likely to result in serious harm to fish that form or support a CRA fishery. However, crossings on large rivers that do not utilize underground trenchless crossing methods (e.g., aerial spans with instream piers), likely chosen due to geotechnical issues, could result in serious harm due to a permanent alteration of instream habitat and/or conversion of large areas of mature riparian vegetation to early seral stage shrubby vegetation. Instream works outside of instream timing windows may also result in serious harm, depending on the species, adult migration, and egg incubation timings, and the specific biophysical conditions and habitats present.

A preliminary list of watercourse pipeline crossing locations that may result in serious harm are summarized in Table 2. This list may be modified following selection of final route, crossing methodologies, and access plans, or following additional engagement with DFO, First Nations, and the Working Group. The few watercourse crossings that have not yet been assessed in the field have not been included in this preliminary risk assessment (e.g., crossings on Nisga'a lands). Alternative pipeline crossing methods (e.g., should attempts at underground trenchless methods fail) and road crossings also have not been included at this conceptual stage as final pipeline route and access plans have not yet been determined; however, alternative pipeline crossing and road crossing methods will also be self-assessed using the above methodology following selection of the final route. The results of the self-assessment will guide WCGT in the submission of applications for DFO review or Authorization.

Table 2. Watercourse pipeline crossings that may result in serious harm

Watercourse Crossing No.	Name	Watershed	Proposed Primary Crossing Methodology	Potentially Affected CRA Species	Fish Habitat Comments
242	Williston Lake	Upper Peace	Bottom lay	Arctic Grayling, Bull Trout, Burbot, Lake Trout, Lake Whitefish, Mountain Whitefish, Rainbow Trout, Kokanee	Important migration habitat; important rearing, overwintering, and foraging habitat for Kokanee and Lake Trout; marginal rearing, foraging, overwintering habitat for trout
483	Bates Creek	Upper Fraser	Isolated open cut	Sockeye Salmon, Rainbow Trout, Dolly Varden, Kokanee	Important spawning, rearing, and migration habitat for salmonids; possible spawning location for early Stuart Sockeye run; no instream timing window
496	Unnamed tributary to Driftwood River	Upper Fraser	Isolated open cut	Sockeye Salmon, Rainbow Trout	Important spawning, rearing, and migration habitat for salmonids; possible spawning habitat for early Stuart Sockeye run, as adult Sockeye was observed approximately 900 m downstream; channel width varies from 4 to 20 m within surveyed reach; no instream timing window
616	Skeena River	Skeena	Aerial with instream piers	Bull Trout, Burbot, Chinook Salmon, Cutthroat Trout, Dolly Varden, Mountain Whitefish, Pacific Lamprey, Pink Salmon, Rainbow Trout, Sockeye Salmon, Steelhead	Marginal spawning habitat; essential migration habitat, important rearing and overwintering habitat for salmonids; important adult foraging habitat for trout and char; instream piers will result in permanent alteration of instream habitat
657	Clifford Creek	Kispiox/Skeena	Isolated open cut	Coastal Cutthroat Trout, Coho Salmon, Doll Varden, Lamprey, Pink Salmon, Rainbow Trout, Sockeye Salmon, Steelhead	TEK information indicates that this site may provide spawning habitat; literature suggests that Pink Salmon are associated with the lower reaches of Clifford Creek (Rabnett et al., 2003); provides important spawning, rearing, foraging, overwintering, and migration habitat for salmonids; numerous Coho and trout fry sampled.

Watercourse Crossing No.	Name	Watershed	Proposed Primary Crossing Methodology	Potentially Affected CRA Species	Fish Habitat Comments
840a	Unnamed trib to Nass River	Nass	Isolated open cut	Dolly Varden, Pink Salmon, Rainbow Trout	Nass River within the ZOI; documented Pink Salmon spawning; channel width approximately 20 m wide, so full isolation may not be possible; no instream timing window
1153	Nass River (Kitsault Alternative Route only)	Nass	Aerial with instream piers	Chinook Salmon, Chum Salmon, Coastal Cutthroat Trout, Coho Salmon, Dolly Varden, Eulachon, Green Sturgeon*, Lamprey, Mountain Whitefish, Pink Salmon, Rainbow Trout, Sockeye Salmon, Steelhead	Important spawning habitat for Coho, trout, and char; essential migration habitat; important adult foraging and overwintering habitat for salmonids; instream piers will result in permanent alteration of instream habitat
1177	Kinskuch River (Nasoga Alternative Route only)	Nass	Isolated open cut	Mountain Whitefish, Rainbow Trout	Gorge and falls downstream of crossing prevents access by anadromous fish; only resident fish species present (MW, RT); offers year-round important habitat for salmonids, including spawning habitat for trout and char; approximately 40 m channel width with partial isolation may result in serious harm depending on timing and approach

*Green Sturgeon is a saltwater, brackish species that is unlikely to be associated with an upstream pipeline crossing

2.1.1 Consultation with Regulatory Agencies and First Nations

Discussions with regulatory agencies, First Nations and stakeholders are necessary for the identification and implementation of offset opportunities that meet regional and local fishery management objectives. Although this CFHOP has largely been prepared to satisfy the potential requirement of a DFO Authorization, provincial authorities (e.g., BC Ministry of Forests, Lands and Natural Resource Operations [MFLNRO] and BC Oil and Gas Commission [BC OGC]) will also have an interest in potential offsetting that targets fish species that are under provincial jurisdiction (e.g., resident, non-anadromous species, and Steelhead). A tracking spreadsheet of comments from these preliminary discussions pertaining to the offsetting strategy is provided in Appendix 1.

To guide development of the offsetting plan, relevant resource management plans (e.g., Land and Resource Management Plans [LRMPs], Fisheries Management Plans [FMPs], Fisheries Management Objectives [FMOs], site-specific water quality objectives [SSWQOs], and First Nations resource management plans [e.g., Nisga'a, Gitanyow]) along the pipeline route were reviewed to determine conservation priorities and objectives (if any) in areas where Project activities may result in serious harm. Additional management plans/objectives and local restoration priorities continue to be identified during ongoing First Nations and regulatory (DFO, EAO, OGC, and MFLNRO) engagement. DFO literature regarding the design and implementation of offsetting programs in accordance with the new Fisheries Protection Policy was also reviewed. All of the regional objectives outlined in the LRMPs that fall within the pipeline footprint have been considered.

The LRMPs reviewed include:

- Dawson Creek Land and Resource Management Plan (BC, 1999)
- Mackenzie Land and Resource Management Plan (BC, 2000)
- Peace/Williston Fish and Wildlife Compensation Program, Fish Program Strategic Plan, 2001-2005 (PWFWCP, 2000)
- Fort St James Land and Resource Management Plan (BC, 1999)
- Xsu gwin lik'l'insuwx: West Babine Sustainable Resource Management Plan (BC MSRM, 2004a)
- Kispiox Land and Resource Management Plan (Kispiox Land and Resource Management Planning Team, 2001)
- Kalum Sustainable Resource Management Plan (BC, 2006)
- North Coast Land and Resource Management Plan (BC MSRM, 2004b)
- Nass South Resource Management Plan (BC MFLNRO, 2012)
- Skeena Stage 1 Watershed-Based Sustainability Plan, Conserving Skeena Fish Populations and their Habitat (Gottesfeld et al., 2002)

Government documents that were reviewed include:

- Northern Pacific Salmon Integrated Fisheries Management Plan (DFO, 2013d)
- Southern Pacific Salmon Integrated Fisheries Management Plan (DFO, 2013e)
- Canada's Policy for the Conservation of Wild Pacific Salmon (DFO, 2005)
- Science Advice on Offsetting Techniques for Managing the Productivity of Freshwater Fisheries (DFO, 2014)
- A Review of Methods Used to Offset Residual Impacts of Development Projects on Fisheries Productivity (Loughlin and Clarke, 2014)
- Fish Habitat Rehabilitation Procedures (Slaney and Zaldokas, 1997)

2.1.1.1 Fisheries and Oceans Canada

In June 2014, representatives from WCGT, TERA and Triton Environmental Consultants Ltd. (Triton) met with DFO representatives to discuss the Project, the DFO review process, and amendments to the *Fisheries Act* and its supporting policies. At that time, it was confirmed that discussions regarding offsetting would not be implemented until the permitting phase. Submission of applications for review or Authorization will require final routing and crossing designs, and, at that point, DFO will make the determination as to whether the Project will result in serious harm to fish. Discussions regarding WCGT's offsetting strategy will include species and/or habitats that will be targeted for offsetting, as well as relevant FMOs and First Nations' habitat restoration priorities. Ongoing discussions will take place with the goal of developing a mutually agreeable offsetting strategy that meets DFO's guiding principles for offsetting, will facilitate the issuance of Authorizations for Project-related effects, and is technically and economically feasible.

2.1.1.2 BC Environmental Assessment Office

This conceptual plan will be submitted to the BC EAO, and will then be distributed to the Working Group, consisting of provincial and federal government agencies, local government, and Aboriginal communities, for review and comment. WCGT will continue to engage with Working Group members throughout the review process. Comments from Working Group members will be considered and incorporated into the final offsetting strategy where applicable.

2.1.1.3 Ministry of Forests, Lands, and Natural Resource Operations

As offsetting sites could occur anywhere along the pipeline right-of-way, WCGT will continue to engage regional (i.e., Peace, Omineca and Skeena) MFLNRO staff to discuss potential offsetting opportunities that target provincially-managed fish species, especially those identified in fisheries management plans (see Appendix 1 for engagement details to date). WCGT will share all relevant information as described for DFO engagement with a goal to achieve consensus and practical solutions for habitat offsetting opportunities.

2.1.1.4 BC Oil and Gas Commission

Although engagement of the BC OGC with regards to the Project will largely be during the permitting phase (e.g., Section 8 and 9 *Water Act* applications), it is anticipated that BC OGC will have an interest in potential offsetting strategies that target fish populations under provincial jurisdiction. They will also have an interest with regards to instream timing windows, as well as with potential effects and proposed offsets in Community Watersheds as listed under the EPMR (e.g., Gitzyon Creek) and potential effects of the Project on Callazon Creek, which is a known spawning location for Pine River Bull Trout (*Salvelinus confluentus*) populations.

Currently WCGT proposes an underground trenchless crossing for the preferred and alternate crossing location at Callazon Creek (see Table B-1 Summary of Watercourse and Fish-Bearing Non-Classified Drainage Crossings in Volume 2 of the WCGT EA). The proposed vehicle crossing structure will be a clear span bridge. WCGT will outline mitigation actions to inhibit adverse effects towards bull trout and other CRA fish and fish habitat. Best management practices (MWLAP, 2004) such as avoiding the bull trout timing window as well as relevant sediment and erosion control and instream best management practices will be conducted.

Triton will continue to engage with BC OGC staff throughout the review and permitting process and during further development of the freshwater offsetting strategy. Results of the risk assessments will be shared for review and comment and potential offsetting strategies will be discussed, along with general and site-specific mitigation measures, with the goal of facilitating the eventual permitting process.

2.1.1.5 First Nations Engagement

Project activities and works may affect freshwater habitats within several First Nation traditional territories; however, only a small portion of crossing locations may require Authorization (as described in Table 2). At this stage, First Nations with traditional territories that overlap with these locations provided the focus for First Nations engagement. Although not all responded, the following First Nations were contacted during the preparation of this plan (see Appendix 1):

- Halfway River First Nation
- West Moberly First Nations
- Saulteau First Nation
- McLeod Lake Indian Band
- Takla Lake First Nation
- Gitxsan Nation
- Gitanyow Fisheries Authority
- Nisga'a Nation

Additional crossings may be added to the proposed list in Table 2 following selection of the final route. Engagement with First Nations will continue throughout permitting and development of the final offsetting strategy, and may include additional potentially affected First Nations groups.

Available First Nations' Resource Management Plans from crossing locations with the potential to require Authorization were reviewed, as well as EA documents specific to First Nations' consultation, traditional use, and traditional ecological knowledge. This information was used to gain a better understanding of the concerns and conservation priorities of the First Nations groups with the potential to be affected by the Project. Documents related to First Nations' land use that were reviewed and considered during preparation of this CFHOP include:

- Gitanyow Lax'yip Land Use Plan, contained within the Gitanyow Huwilp Recognition and Reconciliation Agreement (2012)
- Nisga'a Final Agreement
- A Land Use Plan for Nisga'a Lands (Nisga'a Lisims Government, 2002)
- Atlas of Resource Values in the Gitxsan Watersheds (Nass, Middle Skeena, Babine and Kispiox Watersheds) (BC Forest Service, 2007a, b, c, d)
- The Peace Moberly Tract Draft Sustainable Resource Management Plan (Saulteau First Nations, West Moberly First Nations, and BC MFLNRO, 2006)

WCGT will continue to work with potentially affected First Nations groups to discuss any site-specific concerns associated with pipeline and vehicle crossings of watercourses and to further discuss potential offsetting targets. To date, discussions have largely focused on requests for input into the identification of potential opportunities for freshwater offsetting and information regarding management objectives for freshwater fisheries. Shared information was integrated into this freshwater CFHOP and will also be integrated into the final offsetting strategy.

Further development of this freshwater CFHOP will continue to consider:

- Fish species of concern (e.g., SARA and provincially-listed species) and other species of traditional or cultural importance;
- Enhancing habitat for locally harvested species;
- Research programs which support First Nations' fisheries management objectives;
- Opportunities for training technicians for assisting in the field research; and
- Locally harvested species that are targeted for offsetting (BCFNLC, nd)

2.2 Identification of Potential Offset Opportunities

With the exception of projects identified during regulatory and First Nations engagement (see below), specific offsetting projects have not been identified at this conceptual stage; however, there are a variety of habitat offsetting measures that can be advanced to guide the development of a comprehensive program. Loughlin and Clark (2014) emphasized the benefits of a hierarchical strategy to offsetting, which will be considered when selecting site-specific offsetting measures. The most ideal option is preserving pristine habitat, followed by improving connectivity of high-quality habitats (i.e., removing or bypassing barriers). The third option is restoring hydrologic, geologic, and riparian processes, followed by habitat enhancement, such as the addition of large woody debris (LWD) (Loughlin and Clark, 2014).

The selection of offsetting measures will vary on a site-specific basis depending on the effect type (e.g., riparian vs. instream), CRA species present, effect, spatial extent, intensity, frequency, duration, and magnitude, as well as the resiliency of potentially affected fish species. Recommended freshwater offsetting measures may include a combination of the following:

- Replacement of "orphaned" fish impassable culverts with fish passable crossing structures
- Improving fish passage at natural barriers (see Cranberry River Fishway below)
- Reconnection of isolated off-channel habitats (e.g., oxbows, side channels), or creation of new off-channel habitats, which provide rearing habitat for a variety of salmonid species
- Stabilization of eroding streambanks and planting of riparian vegetation
- Improving instream complexity by addition of large woody debris (LWD) or boulder clusters
- Channel modifications, such as adding meanders, Newbury riffles, etc.

Complementary measures, such as chemical or biological manipulations (e.g., stream or lake fertilization, fish stocking) or relevant scientific research may also be considered, provided that they adhere to the four guiding principles, and other offsetting options are not available. Complementary measures may not form more than 10% of required offsetting (DFO, 2013b).

Detailed field reconnaissance will be required to assess and confirm potential offsetting opportunities. The selection and implementation of each offsetting measure will be site-specific, depending upon, but not limited to, the following factors:

- Physical and chemical conditions of the site (channel gradient, flow, pH, and existing habitat)
- Factors that may be limiting fisheries productivity within a watershed (e.g., absence of a specific critical habitat type)
- Access (degree of difficulty)
- Biological, technical, and economic feasibility

Some offsetting measures may require input from other professionals, including engineers and/or hydrologists. Offsetting should generally be applied within the vicinity of the area being affected or within the same watershed; however, offsetting measures may be undertaken in other areas provided that they are supported by fishery management objectives or regional restoration priorities (DFO, 2013b).

One potential offsetting project was identified by Gitanyow Fisheries Authority, which is summarized below. As First Nations engagement continues, additional potential offsetting projects may be added. The final list will be compiled following the selection of route and detailed engineering design, and the total calculation of residual harm to fish (Section 2.3).

Cranberry River Fishway

Gitanyow Fishery Authority's preference for offsetting is the development of a fishway on Cranberry River at Ginmiltkun Falls, as described by Golder (2010 and 2012). The Cranberry River is a tributary to the Nass River drainage, and has major Coho (*Oncorhynchus kisutch*), Chinook (*O. tshawytscha*), and Steelhead (*O. mykiss*) runs. These runs provide for significant commercial activity from commercial and sportfishing harvests, as well as provide a traditional resource to Aboriginal groups who participate in fisheries for food, ceremonial, and social purposes. The falls are currently considered to be a partial barrier to salmon and steelhead migrations, limiting access to upstream spawning and rearing habitat (Golder, 2012). The fishway would be constructed for all fish species to pass through at all flow regimes by bypassing the falls with a series of step pools. Previous studies have found that there are significant quantities of rearing habitat above the falls; approximately 1.8 million square metres of habitat would be made available following construction of the fishway (Golder, 2010). This project adheres to the four guiding principles of DFO (2013b).

2.3 Determining Residual Harm

This section describes the conceptual plan for determining residual harm on freshwater systems. The final offsetting strategy will not be completed until the permitting stage; at that time, final quantification of residual harm to fish and fish habitat will be completed using two methods:

1. Areal assessment (m^2) of potential residual instream and riparian habitats that may require Authorization and offsetting as determined by DFO or the potentially affected First Nation
2. Productivity assessment (Habitat Unit; HU) of instream and riparian habitats (Habitat Evaluation Procedure [HEP]), as described below.

The HEP will be applied to assess the productive value of the stream and lake habitats affected by the Project. The HEP was developed by the U.S. Fish and Wildlife Service (USFWS, 1980) and is a habitat-based approach that has been widely used across North America for the assessment of environmental impacts of proposed aquatic and terrestrial resource development projects. It is a structured approach that provides a means of assessing both the quantity and quality of habitats by combining the area of various habitat types with a habitat suitability index (HSI) for the various species and life history requirements (e.g., spawning). The HSI value ranges between 0.0 (0% probability-of-use) and 1.0 (100% probability-of-use) and are derived primarily from scientific literature. The HSI represents the capacity of a given habitat to support a particular fish species. The value of the approach is that it produces a dimensionless habitat unit which standardizes the relative importance of habitats with different physical characteristics (e.g., riffle vs. pool vs. lake).

The HEP approach will be used to assess the productivity of the affected stream habitats at crossings with the potential to require Authorization following the final selection of route and crossing methodology. The percent habitat type composition for the affected crossings will be determined in the field, or with existing data, if available. The percent habitat unit type composition will be multiplied by the total area of the crossing (channel width X ROW width) to provide an estimate of available pool, riffle, run, and ephemeral habitat types for each crossing that may result in serious harm to fish. The habitat type area will then be multiplied by the HSI value for the various life history requisites for the target fish species to determine Habitat Units (HUs). The standard measures of areal extent (m^2) of potential effects will also be presented. An example of how the HEP procedure will be implemented in the final offsetting plan is presented below.

During initial site visits conducted in May, August, and September of 2013, the type of habitat (pool, cascade, riffle, or run) and the number of each habitat type were recorded at most crossings to determine the proportion of each type of habitat at each crossing (TERA, 2014). Habitat type data for three of the crossings listed in Table 2 were not recorded; these sites are large rivers or reservoirs (Williston Reservoir, Skeena River, and the Nass River). The large rivers were assumed to be 100% runs for the purposes of this initial assessment. These percentages were assumed to be proportional to the instream habitat within the pipeline ROW. Percentages of habitat types and area were calculated based on these proportions. The percent habitat unit type composition was multiplied by the total area [(length of the proposed ROW (55 m) x channel width (m)] of each reach to provide an estimate (m^2) of available pool, riffle, run, and cascade habitat types for each reach (Table 3).

Table 3. Preliminary instream habitat calculations for pipeline crossings that may result in serious harm (TERA, 2014)

Watercourse Crossing No.	*Site*	*Mean Channel Width (m)*	*ROW width* (m)*	*Habitat Survey Length (m)*	*Instream Habitat (m²) ROW (55 m) x channel width**	*Instream Habitat Pools (% / m²)*	*Instream Habitat Cascade (% / m²)*	*Instream Habitat Riffle (% / m²)*	*Instream Habitat Run (% / m²)*
242	Williston Reservoir	1,470	55	N/A	80,850	100 / 80,850	N/A	N/A	N/A
483	Bates Creek	9.2	55	650	506	2 / 10	0	25 / 126	73 / 369
496	Unnamed trib to Driftwood River	8.9	55	1250	490	6 / 29	5 / 24	17 / 83	72 / 353
616	Skeena River	105.5	55	4,535	5,802.5	0	0	0	100 / 5,803
657	Clifford Creek	6.5	55	750	358	2 / 7	0	9 / 32	89 / 319
840a	Unnamed trib to Nass River	21.7	55	780	1,177	0	0	86 / 1,012	14 / 165
1153	Nass River	89.0	55	4,000	4,895	0	0	0	100 / 4,895
1177	Kinskuch River	39.8	55	2,400	2,189	0	11 / 241	29 / 635	60 / 1,313

* For demonstration purposes, the ROW width was used to estimate instream habitat that will be disturbed. However, to minimize total disturbance, the full ROW width may not be used at stream crossings.

Based on initial site visits and data collected, crossings were assigned coarse scale fish habitat values. Fine scale HSI values will be completed following final route location, detailed engineering designs for the crossings, and additional site-specific data collection of relevant species and life history suitability parameters.

Potential ratings were based on probability-of-use of habitat types by species and life history stage. As an initial assessment, these ratings were assigned a value, and habitat units were quantified on a site basis (presented in Table 4). As an example, an initial habitat rating assessment was completed on the unnamed tributary to the Driftwood River (WC No. 496) as an example. The initial fish habitat potential ratings were multiplied by the instream habitat quantities to determine estimated total habitat units (results presented in Table 5). When a complete HEP analysis is performed, HSI values will be determined based on species and habitat requirements for each crossing, and Habitat Units (HUs) will be derived.

Table 4. Example of Estimated HSI Values by Habitat Type Based on probability-of-use

Habitat Type	Estimated HSI Values (Probability-of-Use) by Life History Stage																			
	Juvenile Rearing					Adult Foraging					Spawning					Overwintering				
	CO	SK	CH	RB	DV	CO	SK	CH	RB	DV	CO	SK	CH	RB	DV	CO	SK	CH	RB	DV
Pool	1.0	0	0.50	1.0	1.0	0	0	0	1.0	1.0	0.25	0.25	0.25	0.50	0.50	1.0	0	0.50	1.0	1.0
Riffle	0.10	0	0.75	1.0	0.25	0	0	0	0.25	0.25	0.75	1.0	1.0	0.25	0.25	0	0	0	0	0
Run	0.50	0	0.75	0.50	0.50	0	0	0	0.75	0.5	0.75	0.75	0.75	0.75	0.75	0.25	0	0.75	0.50	0.25
Cascade	0	0	0.25	0.50	0.75	0	0	0	0.25	0.5	0	0	0.10	0.10	0.25	0	0	0	0	0.25

Table 5. Example of Fish Habitat Unit Calculations Based on Preliminary Ratings (TERA, 2014), Unnamed Tributary to the Driftwood River (WC No. 496)

Habitat Type	Area (m2)	Life History Stage	CO HSI Value	SK HSI Value	CH HSI Value	RB HSI Value	DV HSI Value	CO Habitat Units	SK Habitat Units	CH Habitat Units	RB Habitat Units	DV Habitat Units	Total Habitat Units
Pool (6%)	29.4	Juv. Rearing	1.00	0.00	0.50	1.00	1.00	29.40	0.00	14.70	29.40	29.40	102.90
	29.4	Adult Foraging	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	29.40	29.40	58.80
	29.4	Spawning	0.25	0.25	0.25	0.50	0.50	7.35	7.35	7.35	14.70	14.70	51.45
	29.4	Over-wintering	1.00	0.00	0.50	1.00	1.00	29.40	0.00	14.70	29.40	29.40	102.90
							Pool Total	***66.15***	***7.35***	***36.75***	***102.90***	***102.90***	***316.05***
Riffle (17%)	83.3	Juv. Rearing	0.10	0.00	0.75	1.00	0.25	8.33	0.00	62.48	83.30	20.83	174.93
	83.3	Adult Foraging	0.00	0.00	0.00	0.25	0.25	0.00	0.00	0.00	20.83	20.83	41.65
	83.3	Spawning	0.75	1.00	1.00	0.25	0.25	62.48	83.30	83.30	20.83	20.83	270.73
	83.3	Over-wintering	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
							Riffle Total	***70.81***	***83.30***	***145.78***	***124.95***	***62.48***	***487.31***
Run (72%)	352.8	Juv. Rearing	0.50	0.00	0.75	0.50	0.50	176.40	0.00	264.60	176.40	176.40	793.80
	352.8	Adult Foraging	0.00	0.00	0.00	0.75	0.50	0.00	0.00	0.00	264.60	176.40	441.00
	352.8	Spawning	0.75	0.75	0.75	0.75	0.75	264.60	264.60	264.60	264.60	264.60	1,323.00
	352.8	Over-wintering	0.25	0.00	0.75	0.50	0.25	88.20	0.00	264.60	176.40	88.20	617.40
							Run Total	***529.20***	***264.60***	***793.80***	***882.00***	***705.60***	***3,175.20***
Cascade (5%)	25	Juv. Rearing	0.00	0.00	0.25	0.50	0.75	0.00	0.00	6.13	12.25	18.38	36.75
	25	Adult Foraging	0.00	0.00	0.00	0.25	0.50	0.00	0.00	0.00	6.13	12.25	18.38
	25	Spawning	0.00	0.00	0.10	0.10	0.25	0.00	0.00	2.45	2.45	6.13	11.03
	25	Over-wintering	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	6.13	6.13
							Cascade Total	***0.00***	***0.00***	***8.58***	***20.83***	***42.88***	***72.28***

Total	**490**							***666.16***	***355.25***	***984.90***	***1,130.68***	***913.85***	***4,050.83***

Areal estimates of riparian habitat (m^2) loss or alterations as a result of Project activities will be determined by multiplying the ROW width (55 m) by a riparian buffer or set-back width based on the stream classification (BC OGC, 2013), and doubling the result to account for both sides of the stream. Alternatively, an HU approach can be implemented, as described in the Northern Transmission Line Project – Draft Conceptual Fish Habitat Compensation Plan (Golder, 2010), which considers the value of riparian vegetation. Under this modified Habitat Evaluation Procedure, a numeric value is assigned for each function of riparian areas (large woody debris/small organic debris recruitment, shading, bank stability). The sum of these values would then be converted to a HSI score. The amount of HUs lost as a result of riparian clearing at each crossing is calculated by multiplying the HSI score X the total area removed X a Riparian Vegetation Removal Factor (assessed as a percentage of the riparian vegetation required to be removed, determined on a site-specific basis). The preferred methodology of calculating the amount of offsetting required for riparian losses will be discussed further with regulatory agencies and First Nations.

The habitat loss: habitat gain balance sheet will be provided (in m^2 and HUs) to First Nation and regulatory authorities for review. Site-specific fish habitat offsetting measures could comprise habitat restoration or creation plans based on HUs or m^2, or a combination of both, depending on factors that may be limiting existing fisheries production. Under the example presented in Table 5, a maximum of 4,050.83 HUs is available to offset potential residual effects to instream habitat for all CRA species present in the unnamed tributary to the Driftwood River (in addition to offsetting required to account for riparian losses or alterations). However, the final number of instream HUs will likely decrease as some species have similar habitat requirements for their respective life history stages, and the losses/alterations associated with those habitats would only have to be accounted for once. Quantification of residual harm and the time of implementation of the offsetting plan (i.e., before or after Project-related residual harm) will also determine the final quantity of offsetting that will be required. Typically, a higher quantity of offsetting is required when offsetting measures are installed after Project-related serious harm occurs due to a temporal lag in fisheries productivity.

2.4 Plan Evaluation

The potential offset opportunities will be analyzed for their ability to meet the guidelines outlined in the Offsetting Guide (DFO, 2013b), as well as guidelines established in relevant management plans and priorities discussed during provincial and Aboriginal engagement activities. Additional engagement with regulators and First Nations would be ongoing throughout plan finalization and evaluation.

2.5 Plan Finalization and Application

Once offsetting opportunities have been identified, the detailed FHOP and subsequent DFO permitting process (i.e., issuance of Authorizations) will be finalized. Additional permitting from other regulatory agencies (e.g., BC OGC) 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.

2.6 Monitoring and Reporting

Monitoring and reporting requirements are included as conditions of all Authorizations. The FHOP will also include a compliance and effectiveness monitoring strategy, to be agreed upon by DFO prior to plan finalization. The goal of the monitoring plan is to ensure that 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 of effectiveness, for instance, Routine Effectiveness Evaluation (REE) and measures of fish abundance (e.g., catch per unit effort). Monitoring will be completed at prescribed intervals (e.g., annually or biannually) with monitoring reports submitted to DFO.

Monitoring of offsetting techniques will follow recommendations provided in Assessing the Effectiveness of Fish Habitat Compensation Activities in Canada (DFO, 2012), the Offsetting Guide (DFO, 2013b), and Science Advice on Offsetting Techniques for Managing the Productivity of Freshwater Fisheries (DFO, 2014).

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APPENDIX 1

FIRST NATIONS AND REGULATORY ENGAGEMENT LOG

Date	Organization	Contact	Comments
2014-06-25	DFO	Brenda Rotinsky, Alston Bonamis	Spectra, TERA, and Triton in attendance. Spectra provided a summary of the Project route, and TERA (Dave Evans) and Archipelago summarized the field work completed to date. DFO did not offer project-specific advice and hadn't reviewed the project. When discussing the permitting strategy, Brenda said that Spectra could decide how they would like to submit the Project for review (by watershed, by crossing, or entire Project). She also said that final route and design would need to be completed prior to submitting applications for review. Only after review and serious harm determination will DFO engage in discussions regarding offsetting.
2014-07-04	MFLNRO	Ann Regnier	Contacted to direct us to the appropriate contact for providing comments on the CFHOP. She indicated that MFLNRO may not be able to provide comment outside of the EAO process. She will look into it and call back.
2014-07-08	Gitanyow Fisheries Authority	Mark Cleveland	Left message
2014-07-09	Nisga'a Lands Dept	Mansell Griffith	Left message
2014-07-09	Halfway River First Nation	Kelsey McLeod	Telephone conversation with follow up email discussing goals of the program, ways that FNs can contribute, and request for meeting
2014-07-09	McLeod Lake Indian Band	Eran Spence	Telephone conversation with follow up email discussing goals of the program, ways that FNs can contribute, and request for meeting
2014-07-09	West Moberly First Nations	Lisa McArthur	Phoned but she was on another call, so I followed up with an email discussing goals and request for a meeting
2014-07-09	Gitxsan Nation	Angela Tait	Sent email discussing what I am hoping for (goals of the program, ways that FNs can contribute, request for meeting)
2014-07-10	Halfway River First Nation	Kelsey McLeod	Email response asking that I get in touch and meet with their contracted environmental specialist, Dan Bernier, with Ecora
2014-07-10	Gitanyow Fisheries Authority	Mark Cleveland	Follow up email discussing goals and request for a meeting
2014-07-11	Gitanyow Fisheries Authority	Mark Cleveland	Phone call discussing the offsetting plan. Gitanyow have a plan (Cranberry River fishway). Mark will email specifics. Gitanyow will require offsetting even if DFO does not. Mark will be away until September, but Derek Kingston or Kevin Koch with GFA will be able to assist before then.
2014-07-14	Nisga'a Nation	Warren Fekete, Mansell Griffith	Follow up email discussing goals and request for a meeting
2014-07-14	Saulteau First Nation	Naomi Owens	Email discussing goals and request for a meeting
2014-07-14	Halfway River First Nation	Dan Bernier	Meeting request while Dan is in Prince George week of the 14th
2014-07-14	MFLNRO, Skeena Region	Troy Larden	Left message asking for information regarding potential offsetting opportunities.
2014-07-15	Halfway River First Nation	Dan Bernier	Meeting in PG at Ecora Office - The goals of the offsetting plan were shared, and information was requested regarding potential ideas for offsetting, including potential species or habitats of concern. Dan will relay requests to HRFN Chief and Council.
2014-07-21	Takla Lake First Nation	Dave Radies	Sent email discussing goals and request for a meeting
2014-07-21	Gitanyow Fisheries Authority	Kevin Koch	Email exchange regarding scheduling a meeting. A summary of the Cranberry River Fishway project that will be included in the offsetting plan was emailed. I communicated my availability to meet over the next ten days was communicated, however
2014-07-23	MFLNRO, Omineca Region	Kevin Hoekstra	Discussion regarding offsetting plan and potential offsetting opportunities (e.g., research priorities). He suggested a follow up with Susanne Williamson.

Date	Organization	Contact	Comments
2014-07-23	Takla Lake First Nation	Dave Radies, Brian Toth	Meeting between D. O'Bryan, D. Radies, and B. Toth at Triton office to discuss the conceptual offsetting plan (e.g., goals of the plan, requests for information regarding research priorities/locations for habitat enhancement). Brian and Dave shared a number of research priorities [e.g., sturgeon presence/spawning in/around Takla Lake, cumulative effects related to historical and ongoing forestry, Kokanee populations in Takla Lake (with reference to competition with Sockeye), Rainbow Trout spawning in Driftwood River, matters related to the decline and status of Early Stuart sockeye are a major concern - monitor limnology in Takla Lake and explore options to halt and reverse declines, Chinook enumeration in Driftwood River]. As many resources within the traditional territory are already significantly diminished, TLFN would like to see fish habitat compensation approached from a "no net loss" of habitat productive potential conceptual framework, will be requiring offsetting regardless of the DFO permitting/authorization process, and will need to be intimately involved withi the design and implementation of offsetting within their asserted traditional territory. TLFN is concerned about the long-term impacts of riparian-function loss within the pipeline corridor, and is also concerned about the additional impacts associated within installing two pipelines. If a second pipeline is built, they would expect more offsetting to account for additional impacts to instream habitat. Brian will summarize and forward TLFN's research objectives/habitat enhancement priorities.
2014-07-25	Saulteau First Nations	Naomi Owens	Email asking if fish-bearing crossings would be considered. I responded that the offsetting plan would target potential residual effects on fish-bearing crossings and asked if she had some time to discuss further. She did not hae any time, but suggested that she might have some time at a later date.
2014-07-25	MFLNRO, Peace Region	Megan Watters	Megan was not able to provide specific comment at this time, but more input may come later in the review/permitting process.
2014-07-25	BC OGC	Peter Wijtkamp	Left a message requesting input into development of the offsetting plan
2014-07-28	McLeod Lake Indian Band	Eran Spence	Phone call following up on an email Eran sent on July 25th asking if the report would be circulated to First Nations for review prior to submission to EAO. He was told that Spectra would submit the report to the EAO would would then distrubite it to the First Nations via the Working Group for review and comment
2014-07-29	Ministry of Environment	Susanne Williamson	Discussion regarding potential offsetting and research opportunities in the Omineca Region