DFO Response to CEAA's April 29, 2016 Questions
for the Pacific Northwest LNG Project

Question 1:

The Agency understands from Working Group discussions that DFO does not consider the effects pathways described in the above comments as likely to result in a significant adverse environmental effect. Does DFO have any further comment regarding potential effects of the marine infrastructure on fish migration or predation?

DFO has reviewed the report titled *"Fish and Fish Habitat Impacts Resulting from the Lelu Island/Flora Bank Pacific Northwest LNG Project Pier, Berth, and Jetty"*, March 2016 by Dr. Marvin Rosenau. The review was undertaken to determine if the information provided by Rosenau (2016) would change Fisheries and Oceans Canada (DFO) conclusions on significance of effect on fish and fish habitat.
Rosenau (2016) suggests two primary effects of the bridge and trestle consisting of:

1. that the proposed PNW LNG suspension bridge, jetty, pier, carrier berth and bed-stabilizing riprap will become 'predator aggregators' which will increase predation fatalities of CRA fish.

   > "Of major concern is that the structure will act as a major "wall of death" as juvenile salmonids and other species pass across the Flora Bank from south to north and are intercepted by predatory fishes"; and

2. that the proposed PNW LNG suspension bridge, jetty, pier, carrier berth and bed-stabilizing riprap will disrupt juvenile salmonid migration by bisecting the northern entrance to the Skeena River and estuary at Chatham Sound.

   > "Because of the configuration of the estuary, and the indications that Flora Bank is an important feeding and migration habitat for salmon and other CRA species (Carr-Harris et al. 2013, 2014, 2015, Moore et al. 2015), it is likely that such a large structure has a more profound and damaging impact to the populations of fish that indicated by the Proponent and its consultants via the disruption of migration patterns and predation."

1. "Predator Aggregators"

The concept of in or over-water structures becoming 'predator aggregators' is an unsupported phenomenon in the scientific literature cited in Rosenau's report. Rosenau states that "[i]t has long been recognized that fish in both marine and freshwater environments often associate with anthropogenic structures such as bridges, docks, piers, riprap and pilings. That is, some species use these sorts of structures as habitat. Usually these features are important as cover for predators which use them for ambushing food." This report suggests that the LNG structures proposed will provide suitable habitat to larger predatory fish which will increase

predation mortality, however none of the references cited claim this directly, or do so in the correct context. The only reference which supports the idea of predator aggregation was looking at a large bridge which acts as a physical barrier to smolt passage by extending 3.6 meters underwater. This structure concentrates smolts as they are unable to easily pass under the bridge and the greater concentration of prey attracts marine mammal and piscivorous bird predators, it did not act as preferential habitat for predatory fish as implied in this report. The differences in the structures from the references used in this report to the proposed LNG structure is often significant and would likely change the conclusions, or the severity of conclusions, in this report if structure characteristics were taken into consideration.

The idea that in-water structures provide preferential habitat to larger fish and therefore increase predation on juvenile salmonids is largely taken from the lacustrine environment and out of context in this regard. Studies in lakes and freshwater reservoirs have found that small docks and piers can increase the carrying capacity of the area for predatory smallmouth bass which prey upon Chinook juvenile salmon. These structures are not reported to increase risk to juvenile salmon through direct predation mortality with smallmouth bass using the structures as ambush habitat, rather the dock and piers provide more spawning habitat for the freshwater predatory species. Rosenau also cited a series of studies assessing impacts of large ferry piers on juvenile salmon in Puget Sound, Washington. These papers had no support for increased predation on juvenile salmonids as a result of over-water structures and in one paper the authors stated that no proof of this theory was found despite their awareness of the concept.

Rosenau states that "[i]ncreasingly, scientific studies are now showing that such non-natural shoreline features can have excessive negative impacts to the young of one or another more important species via predation that occurs by undesirable fishes that congregate at these structures." This statement appears to be unsupported by the literature cited in the report, certainly no excessive impacts due to predation were scientifically advocated, however it is understood that when the estuarine environment is subject to changes that take it further from a natural state the overall productivity and health are generally reduced (Weikamp et al. 2014).

2. Disruption of Migration

The second suggestion made in this report is that the structures will disrupt juvenile salmonid migration, particularly through their behavioral reluctance to enter shaded areas, is better supported by the literature cited. The literature cited in this report reach a consensus that the removal or the alteration of shallow zones can have the largest impact on juvenile salmon. When nearshore areas are modified into the shallow subtidal zone a change in fish density and behavior, particularly through changes to depth, slope, substrate and vegetation can occur (Toft et al. 2007). Riprap and structural supports should stay clear of shallow zones near shore or eelgrass beds and the shallow habitat should be preserved. It's important to note that for

the PNW LNG marine structure, there are no anticipated impacts expected to the marine foreshore where the bridge connects with Lelu Island.

Ono et al. (2010) considered large overwater structures (ferry terminals) to have three direct or indirect impacts on juvenile salmonids. They can be 1) a barrier to outmigration, 2) cause a reduction in salmon prey and 3) cause a potential migration delay. They observed dock avoidance behavior which likely delayed migration in some small juvenile pink salmon a few hours per dock encounter as they were reluctant to pass under the structure. In a study of ferry terminals in Puget Sound Simensad et al. (1999) observed schools of juvenile salmon both dispersing when they encountered docks and schooling near the edge of the terminal. Sharp light/dark contrast caused by the structure shadow is thought to disrupt the visual sensitivity of the fish and alter their behavior. The terminal itself was also thought to change fish behavior (Ono et al. 2010). Southard et al. (2006) and Ono et al. (2010) state that the change in behavior is more distinct at high tide, daylight hours and sunny days when the shadows are more pronounced and less ambient light is able to filter underneath the structure.

Unfortunately the size thresholds of large overwater structures and of the amount of shade that cause these behavioral disturbances to fish have not been quantified. The light available underneath an over-water structure is a result of several factors including pile spacing, cloud-cover, in-water visibility, and the width, length, orientation and height of the structure above the water. The proposed PNW LNG jetty and suspension bridge is planned to be 11.2m above the high water mark and this should allow more ambient light to filter underneath the structure compared to the ferry terminals studied in Puget Sound which will in effect mitigate the sharp light/dark contrast which impedes juvenile salmonids migration. Further mitigation for shade impacts could be achieved through more transparent materials, or placing reflective material on the underside of the structures, including the bridge proposed to cross over to Lelu Island from the mainland.

Mitigation Measures from Referenced Literature

An item that is not highlighted in the Rosenau report is the ability to mitigate some of the risk outlined above. The following mitigation measures were taken from the references provided in the Rosenau report.

- Southard et al. (2006):
    - "To minimize the shade-related impacts to migrating juvenile salmonids created by ferry terminals, over water structures (OWS) should be designed and constructed to allow incidental light to penetrate as far under as possible, while still providing the necessary capacity and safety considerations necessary to support their intended function. The physical design (e.g. dock height and width, dock orientation,

construction design materials, piling type and number) will influence whether the shadow cast on the nearshore covers a sufficient area and level of darkness to constitute an impediment. Construction of closely spaced terminal structures should be avoided to minimize the potential cumulative impacts of multiple OWS on juvenile salmonid migration (Nightingale and Simenstad 2001)."

- "Experiment with technologies and designs that can soften the light-dark edge to minimize potential temporary inhibition of movement."
- "Providing even a small amount of light in a regular pattern under a dock may encourage fish to swim underneath. Natural lighting for fish could also be enhanced if the underside of the dock was reflective."

- Ono and Simenstaud. 2014: "Juvenile salmon avoided penetrating under the dock when strong shadow was present underneath it. Conversely, when artificial light was used to attenuate the dock edge shadow, it was able to mitigate to some extent the effect on juvenile salmon swimming behavior by making them swim closer to the dock with a higher directionality. But when light was used on a non-shaded area, it caused them to stay further away. Light could potentially be used as a method to mitigate dock shading but precautions need to be paid."

References:

Ono et al. 2010. Assessing and Mitigating Dock Shading Impacts on the Behavior of Juvenile Pacific Salmon (Oncorhynchus spp.): Can Artificial Light Mitigate the Effects? Washington State Department of Transportation.

Rosenau. 2016. Fish and Fish Habitat Impacts Resulting from the Lelu Island/Flora Bank Pacific Northwest LNG Project Pier, Berth and Jetty.

Simenstad et al. 1999. Impacts of Ferry Terminals on Juvenile Salmon June 1999 Migrating Along Puget Sound Shorelines Phase I: Synthesis of State of Knowledge. Washington State Transportation Center (TRAC) University of Washington.

Southard et al. 2006. Impacts of Ferry Terminals on Juvenile Salmon Movement along Puget Sound Shorelines. Prepared for the Washington State Department of Transportation.

Toft et al. 2007. Fish Distribution, Abundance, and Behavior along City Shoreline Types in Puget Sound, North American Journal of Fisheries Management, 27:2, 465-480.

Weitkamp et al. 2014. Juvenile salmon in estuaries: comparisons between North American Atlantic and Pacific salmon populations. Rev Fish Biol Fisheries. 24:713–736.

DFO Response:

Based on the review of the Rosenau (2016) report, DFO does not have any further comments regarding potential effects of the marine infrastructure on fish migration or predation other than to reiterate the need for a long term monitoring program and implementation of additional mitigation measures as required to mitigate any potential light/dark contrast the bridge may create. As the shoreline under the bridge will not be altered, and based on the height of the bridge, the potential risk of the marine structure significantly affecting juvenile salmon migration is considered low.

Question 2:

Does DFO have any further advice for the Agency regarding effects to eelgrass beds on or near Flora Bank?

As requested, DFO has reviewed the report titled Comments on the Pacific NorthWest LNG Draft Environmental Assessment Report (undated), by B.A. Faggetter. Specifically, DFO's review was focussed on the information provided on the extent and distribution of eel grass on Flora Bank.

As outlined by Faggetter, concern has been raised that the Proponent has not adequately identified all of the eelgrass on Flora Bank:

> *Eelgrass beds are likely larger than estimated by the proponent, extending to subtidal areas under the suspension bridge. Therefore the potential for serious harm effects to fish habitat have been underestimated by the proponent, i.e. serious harm as described in Fisheries Act that would require offsetting (e.g. see comments from Faggetter, Higgins)*

Faggetter identifies a number of shortcomings in the Proponent's eelgrass studies and impact assessment, including:

1. Concern about the time of year that the eelgrass studies were undertaken;
2. Potential for subtidal eelgrass to be present and not represented in the Proponent's findings; and
3. Ability of the Proponent to adequately offset these additional impacts to fish and fish habitat due to the potential for subtidal eelgrass to be present.

Faggetter provides a unique perspective of this issue due to her direct and previous eelgrass studies on Flora Bank. In regards to the three issues identified above, DFO provides the following response:

1. DFO concurs with the Faggetter recommendation that undertaking eelgrass assessment studies in late summer (August) would provide for the most optimum conditions to show distribution and density of eelgrass beds. The Proponent undertook a detailed and thorough Delft3D modeling exercise of the marine structure to determine potential effects on the Flora Bank eelgrass. The results of the study indicates that there are no expected effects on the majority of the Flora Bank, with the most direct effects associated with the two large bridge structures (SW Tower and Anchor Block).

   The PNW LNG studies clearly indicated that the size of the Flora Bank eelgrass beds fluctuated on a yearly basis. As part of the EA assessment, the general size and location of the eelgrass bed is required to determine potential mitigation and offsetting measures. It is anticipated that should this project move to the regulatory stage that the proponent would require to undertake updated eelgrass assessment. The assessment would determine the exact size, distribution and density of the eelgrass at the time of permit application. This information would then be used to support the proponent's *Fisheries Act* Authorization application. Any DFO requirement for information on eelgrass beds and density would require that the studies be undertaken in July/August. This requirement would extend to any long term monitoring studies. Should the Agency have any conditions on eelgrass monitoring, the timing of the study as outlined above should also be included as part of the condition.

2. Based on the information provided by Faggeter (2013), Flora Bank eelgrass is present in both intertidal and subtidal habitats to a depth of 1.8 m. When measured in the summertime, the subtidal eelgrass beds experienced relatively dense growth (average percentage cover of 71%. These findings were based on a single transect located between Flora Bank and Lelu Island.

   Based on the findings of subtidal eelgrass to depths of -1.8 m chart datum, this could then result in the proposed SW Tower and Anchor Block impacting on previously undocumented eelgrass beds as these two structures appear to be located at depths of 0 m to -2 m chart datum. As previously mentioned, should the project proceed to the regulatory stage, the Proponent will be required to provide updated studies on eelgrass beds and density. Based on the information provided by Faggeter, DFO will ensure that these studies are completed in late summer and that they include subtidal areas.

3. An additional concern outlined by Faggeter is the Proponent's ability to offset additional eelgrass impacts which have yet to be defined, such as the subtidal eelgrass beds. DFO's previous advice to the Agency on potential impacts to fish and fish habitat was informed by the Proponent's Delft3D model which indicated that overall the marine structure was

going to result in limited effects to Flora Bank. The study concluded that impacts to Flora Bank were going to be localized to the immediate area of the SW Anchor and Tower Block and that these impacts could be mitigated with the use of rip rap. Based on these findings, it was DFO's opinion that effects to fish and fish habitat due to the structure were of low risk and that they could mitigated and/or offset, subject to continued monitoring.

Based on the potential of eelgrass beds to be found in subtidal sections and in association with the SW Anchor and Tower Block, there is a risk of additional impacts to fish and fish habitat occurring. To date, the Proponent has identified approximately 1800 m^2 of eelgrass to be impacted as a result of the project. Impacts due to the SW Tower and Anchor Block (including scour protection) have been estimated to be approximately 2425 m^2 and 5790 m^2 respectively, for a total of 8215 m^2. Total footprint related impacts for the project were calculated to be approximately 30,135 m^2 which includes the SW Tower and Anchor Block. The Proponent has identified approximately 90,000 m2 of low value habitat around Lelu Island which could be enhanced as part of an offsetting plan.

The Proponent has already identified the footprint of the SW Tower and Anchor Block as potential impacts and included this habitat within their calculations of 30,135 m^2 of impacts. However, the habitat type at these two locations is described as soft bottom subtidal clay-silt habitat. Should eelgrass habitat be found at this location, the proponent will require to quantify the amount and density of the eelgrass beds and ensure that an appropriate offset program is developed.

DFO's previous advice to the Agency on the potential effects of fish and fish habitat due to the marine structures was based on the structures not being located on any eelgrass beds (as per the Proponent's information). In addition, the Delft3D model indicated that impacts due to the structures would be limited in nature and could be mitigated with the use of rip round around these structures. There is the possibility of subtidal eelgrass being found near the two large marine structures. As part of the permitting, these areas will be required to be surveyed, and should eelgrass be found, offsetting measures will need to be included to account for this additional habitat.

Question 3:

Does DFO have any advice for the Agency regarding the effects of underwater noise on fish during operations?

The duration and intensity of LNG Carriers arriving and departing the berth area is considered to be low (1 ship a day). Based on the reduced speed of the vessels arriving at the berth and the distance of the berth to Flora Bank approximately 1 km to the nearest edge, the potential effects of underwater noise on fish behaviour during operations is considered to have a low risk. DFO recommends that an acoustic monitoring plan be developed to confirm the projected effects on fish behaviour during project operations.

Question 4:

The Agency is considering adding the following condition: "The Proponent shall shield and direct lights from the marine infrastructures, including along the deck structures of the marine trestle and suspension bridge, to minimize light spillage onto the water, while meeting safety requirements." Does DFO have any comments for the Agency on the proposed condition or regarding light effects on fish during operations?

DFO expects that the MOF will have lights to facilitate barge loading/unloading during night time operations. Therefore, DFO recommends that the MOF should be included in the Agencies condition.

The effects of light on fish may vary depending on the species, life stage, and location of the light. DFO recommends that ocean lighting be minimized as much as possible.

Question 5:

Does DFO have any further advice for the Agency regarding effects on fish habitat at the MOF?

The Proponent has indicated that the type intertidal soft substrate that will be lost during construction at the MOF (31,569m²) is locally abundant around Lelu Island and in the Skeena River estuary. Though removal of that habitat at the MOF will reduce the amount of habitat directly in that area, there is additional intertidal soft substrate in the Local Assessment Area that will provide the same benefits to fish. DFO will review the Proponents serious harm determination during permitting and determine if the 31,569m² of soft substrate will result in a localized effect that requires offsetting.

The proposed location and type of the offsets proposed to counter act the residual *serious harm to fish* from development of the MOF is consistent with DFO's 'Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting' (November 2013). Provided that the proposed offsets function as intended (which will be determined through effectiveness

monitoring), DFO is of the opinion that the ongoing productivity and sustainability of commercial, recreational, and Aboriginal fisheries will be maintained.

Question 6:

The Agency understands that effects to marine water quality from Project NOx emissions and from non-point sources of pollution, such as minor hydrocarbon spills and stormwater run-off, are not likely to result in significant adverse effects to fish given the tidal flushing of the waters around the Project and the offsetting proposed for habitat at the MOF. Does DFO have any further advice for the Agency on this point?

As the above noted question is in regards to deleterious substances, this issue should be directed to the Ministry of Environment and Climate Change (ECCC) as it relates to S. 36(3) of the *Fisheries Act*. In 2014, the *Order Designating the Minister of the Environment Responsible for the Administration and Enforcement of Subsections 36(3) to (6) of the Fisheries Act* was issued which delegated this authority from DFO to the Minister of ECCC.

Question 7

Q: Does DFO have any suggested changes to condition 6.1 as currently worded?

DFO anticipates that these conditions will be revised to include the results of the June 14th, 2016 meeting and subsequent conversations. Once these revisions have been included DFO will review and comment on condition 6.1.

Question 8:

Q: Offsetting for serious harm as required by the *Fisheries Act* is a key mitigation measure in the Agency's analysis. Please describe what DFO would require as monitoring to assess the effectiveness of any offsetting required for the Project.

DFO will require effectiveness monitoring to take place for a time period long enough to ensure the offsets are functioning as intended. The length of the effectiveness monitoring program will be determined during the permitting stage.

Effectiveness monitoring should assess, but not be limited to, fish utilization including species and life stage and spatial extend and health of created habitats. Monitor data will be assessed against baseline data to determine if the habitats created provide comparable benefits to fish.

DFO will review the final effectiveness monitoring plan during permitting to ensure it is consistent with DFO policies.

Question 9:

Q: Does DFO have any suggested amendments to condition 6.22.7?

DFO does not have any recommended changes to this condition.

Question 10

Q: In January 2016, DFO advised the Agency that the methodologies of the proponent's 2015 fish studies are sufficiently rigorous to determine the seasonal timing of the various fish species in and around the project area, information that could be used to create more accurate least risk timing windows based on local fish populations and distributions. Please comment on the adequacy of those methodologies to provide a fish baseline against which to compare future follow-up monitoring results.

DFO did not provide any recommendations to the Proponent's original terms of reference for the fish studies. However, based on the methodology and sampling effort proposed, DFO were of the opinion that the results of the study would be beneficial to assist in determining seasonal timing of various CRA fish species which utilized the project area. DFO cannot comment on the adequacy of this study to provide a baseline study for a follow up monitoring study. Rational being that the specific objectives or terms of reference for a follow up study have yet to be developed. The data collected in the fish study by the Proponent will likely be of value for a baseline study. However, until objectives of the follow up study have been determined, a determination on adequacy cannot be made.

Question 11

Q: Does DFO have suggested amendments to conditions 6.22 and 6.23?

The primary purpose of the follow-up monitoring program is to ensure that mitigation measures are effective in mitigating unanticipated harmful effects to fish and fish habitat. The follow-up monitoring program should be specific to each work activity (i.e. construction and operation) and will likely involve multiple monitoring parameters with individual purposes and criteria to confirm mitigation effectiveness.

DFO recommends that detailed monitoring objectives and conditions be undertaken in consultation with Aboriginal groups and the Proponent to ensure that an effective monitoring program be achieved.

Question 12:

Q: Taking into consideration the potential loss of shoreline habitat in and around the Project area, does DFO have any concerns regarding the potential for likely significant adverse cumulative effects?

In developing the project, the Proponent has provided both mitigation and offsetting measures to provide for the sustainability and ongoing productivity of commercial, recreational and Aboriginal fisheries. Mitigation measures include providing a 30 m riparian buffer around most of Lelu Island and a proposed offsetting plan for impacts on the marine foreshore. Based on these combined measures, DFO does not have any additional comments to provide in regards to likely significant adverse cumulative effects.