
To:	Catherine Ponsford	From:	Brian Clark
	Canadian Environmental Assessment Agency		Pacific NorthWest LNG
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Reference: Marine Terminal – Environmental Effects Assessment

BACKGROUND

This technical memo is intended to clarify how Pacific NorthWest LNG (PNW) intends to update its environmental effects assessment for fish and fish habitats arising from the presence of the marine terminal infrastructure on Agnew Bank. The analysis will be undertaken in response to the information still outstanding from Information Request No. 3 dated February 23, 2015 (as articulated in the June 2, 2015 letter from the Canadian Environmental Assessment [CEA] Agency).

The assessment process articulated in this document is a systematic approach that considers project-environment interactions, the likely adverse effects arising from these interactions, mitigation and habitat offsetting measures to address the potential adverse effects, and a description of the residual effects. Based on the outcome of this assessment process, PNW will provide an opinion on the significance of the residual effects.

The effects assessment will build upon past work and incorporate new hydrodynamic modelling outputs and marine resources information collected between winter 2014 and July 2015. Based on the interim modelling results available at the end of July 2015, PNW does not anticipate material amendments to the information provided in the EIS submitted in February 2014 and/or the EIS Addendum submitted in December 2014 or to the methods applied to the effects assessment.

MARINE RESOURCES EFFECTS ASSESSMENT PROCESS

PNW has worked with Fisheries and Oceans Canada (DFO) and the CEA Agency with the objective of achieving alignment on how to update the marine resources effects assessment (with a focus on fish and fish habitats) in light of the new information coming forward relative to the potential physical changes on Agnew and Flora banks resulting from the presence of the Project's marine terminal infrastructure.

PNW has developed the following sequential process steps that will be applied to refine the assessment of adverse effects to marine resources and the resulting mitigation/off-setting options:

1. Confirmation of the impact pathways
2. Identification of fish habitats potentially altered or destroyed
3. Assessment of effects on marine resources via the impact pathways
4. Identification of mitigation and offsetting measures

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1. Impact Pathways

PNW LNG has identified four distinct impact pathways that may be induced/triggered/activated by the marine infrastructure and lead to adverse effects on fish and fish habitat. These include:

- a. Direct harmful alteration or loss of fish habitat on Agnew Bank from construction of the infrastructure and placement of scour protection and/or armouring of suspension bridge substructures, trestle pipe pile bents and the berths for erosion control.
- b. Potential for indirect harmful alteration or loss of eelgrass due to induced erosion and/or deposition on Flora Bank.
- c. Potential for an increase in total suspended solids (TSS) that may directly affect fish or limit a fish's ability to feed (the threshold for TSS concentrations will be based on Canadian Council of Ministers of Environment [CCME] guidelines)
- d. Potential for a material increase in currents around the tower and west anchor blocks that affects the ability of CRA species to move through the water and use the habitat.

The footprint of the infrastructure, Pathway a), will be updated based on the most current understanding of the marine infrastructure and anticipated armouring to prevent erosion. Pathways b), c), and d) will be informed by the new hydrodynamic modelling outputs.

2. Identification of Habitat Potentially Altered or Destroyed

The assessment will identify potential permanent alteration or destruction of fish habitats in the vicinity of the Project. As stated above, the direct alteration or loss of fish habitat due to the footprint of the marine infrastructure will be calculated based on the most current understanding of the marine infrastructure and anticipated armouring to prevent erosion. For indirect effects resulting from induced erosion and/or deposition of sediments, potential impacts to eelgrass will be the focus as erosion of silt/sand sediments or deposition of sand onto silt/sand sediments will not alter the habitat type or value for fish. For this part of the assessment, the focus will be on sediment erosion or deposition exceeding 5 cm/year on eelgrass beds during the growing season. Scientific literature indicates that eelgrass may be negatively affected at deposition or erosion levels greater than 6.5 cm/year therefore 5 cm/year is a precautionary threshold.

3. Marine Resources

Marine species potentially subjected to an adverse effect will be updated based on additional information assembled from:

- Proponent fish and fish habitat studies
- Aboriginal knowledge
- Commercial and recreational harvest records
- Literature review

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4(a). Mitigation Options

Mitigation measures to avoid and reduce the potential for adverse effects on fish and fish habitat from the marine terminal's intertidal and subtidal substructures have been developed and described in the EIS and EIS Addendum.

In summary, the material mitigations include:

- Suspension bridge substructures, the trestle and berths are to be constructed outside Flora Bank.
- Vibratory pile driving, bubble curtains, and pipe pile-in-pile construction techniques will be used.
- Environmental management plans (EMPs) will be developed with Aboriginal groups and regulatory agencies (e.g., sediment / erosion / silt control, marine mammal avoidance, underwater noise management, etc.) and implementation of EMPs will be monitored.
- The west bridge anchor and tower blocks will be constructed in isolation of marine waters by using cofferdams around the work areas.
- Scour protection will be engineered and placed around the bridge, trestle and berth substructures to prevent erosion and suspension of sediments.
- Design refinement of bridge tower anchor blocks to reduce magnitude of erosion and deposition (i.e., will the shape of the structure influence the erosion and subsequent deposition patterns?)

4(b). Habitat Offsetting

Where there is a residual permanent alteration or destruction of fish habitat that is harmful, the Project will undertake a robust fish habitat offsetting program. The plan will take into consideration important species uses of habitat and adopt a precautionary approach by restoring or enhancing fish habitats in a manner that provides greater productive capacity than that which is destroyed or altered.

Habitat offsetting may involve:

- Replacement of habitat (e.g., like for like)
- Restoration of habitats (e.g., clean-up of shoreline areas)
- Creating new habitats that have greater diversity by enhancing known or important species-dependent habitats or by adding important habitat attributes to ecosystem functions
- Complimentary fish and fish habitat enhancement research initiatives

DETERMINATION OF SIGNIFICANCE OF ADVERSE EFFECTS

The marine resources effects assessment process for the marine terminal will be used to provide an opinion of the significance of residual adverse effects in a manner consistent with the CEAA 2012 process. The approach will be consistent with the methodologies and thresholds applied in the PNW LNG EIS and EIS Addendum.

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The process articulated in this memo refines what was included in the EIS submission(s) and responds to the outstanding information request that was articulated to PNWLNG in the CEA Agency June 2, 2015 letter. This includes characterization of measurable residual effects through changes in fish and marine mammal populations or changes in habitat quality or quantity.

AN EXAMPLE

Table 1 (below) demonstrates an example of how to work through the process to determine the level of habitat offsets required for each impact pathway to ensure there is no long term impact to CRA fisheries.

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Table 1

Impact Pathway	Estimate of Change to Habitat or Water Quality	Potential Adverse Effect on Fish	Mitigation and/or Habitat Offset Option(s)	Confidence in Effectiveness of Mitigation and/or Offset Option(s)	Will Model Results Confirm or Modify the Impact Estimate
Direct harmful alteration or loss of habitat from infrastructure footprint including scour protection	XX sq. meters of subtidal mud/sands on Agnew Bank	<ul style="list-style-type: none"> Loss of foraging habitat for forage fish, flatfish and crab but abundant habitats in vicinity. Effects will be localized and are not likely to affect the sustainability of CRA fisheries 	Enhanced intertidal habitats to improve habitat quality for forage fish species off Lelu Island within the project development area.	High	No
Indirect harmful alteration or loss of eelgrass on Flora Bank due to erosion and/or deposition	YY sq. meters of eelgrass loss. Deposition of sediments on silt/sand habitats not sufficient to affect productivity. Area calculations to be refined through revised modeling outputs and application of marine terminal sub-structure engineering design mitigations during permitting process.	<ul style="list-style-type: none"> No large, catastrophic change to Flora Bank predicted Possible alteration of forage habitat used by juvenile salmonids, herring, surf smelt, sand-lance and crab. 	Habitat enhancement, including new eelgrass beds, at strategic locations around the perimeter of Lelu Island. PNW exploring the development of additional eelgrass beds elsewhere in Chatham Sound along salmon migration routes.	Moderate to high	Yes

¹ Subject to refinement on the basis of further analysis of data and discussion with DFO.

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Increased total suspended solids (TSS) at non-natural timeframes	<p>Notwithstanding high levels of natural background TSS within the PDA, some discrete areas may be subject to higher than normal TSS concentrations. This may include:</p> <ul style="list-style-type: none"> • During construction: short term increases in TSS concentrations above CCME guidelines associated with specific activities • During operations: Modest TSS concentration increases within CCME guidelines during periods with higher currents <p>Operational TSS levels to be established through revised modeling outputs.</p>	<ul style="list-style-type: none"> • Potential reduction of feeding success (for species that are visual predators) • Potential increase energy expenditure by fish to clear gills and injury due to gill abrasion <p>Effects will be localized and not expected to affect sustainability of CRA fisheries</p>	<p>Adaptive management protocols in place to support mitigation measures and design improvements / changes to avoid and limit variation in TSS over local existing background conditions.</p> <p>Long-term in-situ monitoring of Flora Bank, TSS concentrations and, sediment transport process and physical and biological features and resources.</p>	Moderate to high	Yes
Increased currents around the west suspension bridge tower block and anchor block	Current velocities may be altered around sub-structures that may prevent fish from using this portion of the water column at higher ebb/flood currents.	<ul style="list-style-type: none"> • No measurable effects on fish access to important habitats are anticipated. • This is a lower energy area and the new currents are not expected to be greater than burst speeds. 	Application of marine terminal substructure design mitigations during permitting process.	High	Yes