

Comment on PNW LNG Draft EA and Conditions
Prepared by L. Roth March 11th, 2016

Comment Topic Summary

1. EA Should address Human Health Risks from dredging and loading plans for the MOF
2. EA should include a proper valuation of Skeena Salmon
3. The Wetlands Function report/analysis used in the EA does not consider the loss of wetland function through the pathway: decreasing insect production, nor the impact considering that insects now provide food to the adjacent smolt population
4. Air Quality Condition 3.1 should define Best Available Technology as “technology that guarantees NOx emissions of less than 5 ppm”
5. Mitigation by compensating for harm to project area salmon habitat is not possible
6. Anchorages and Incident Risk information is missing from the EA
- 7) Carrier and plant sound will impact smolts, larval fish and other marine life
- 8) Need for further analysis of eulachon use of the area

1. The EA must address Human Health Risks from loading and dredge plans for MOF

1(A) The serious human health risks from loading and dredging for the MOF have not been properly addressed in the Draft EA.

- The MOF sediment has high levels of contaminants including dioxin and furan above the CCME ISQG. Dr. Kennedy gave a detailed comment on the various MOF area sediment contaminants and risks they posed in his initial comments May 2014. In our May 2014 comments to PNW LNG EIS, Dr. Kennedy specifically noted risk to human health from the dredging and disposal of dioxin and furan contaminated sediment from the MOF. Our comments: Roth’s Report, Dr. Faggetters’ Report and Dr. Takaro’s letter also emphasized the human health risk associated with dredging contaminated sediment.
- It is clear from the science that resuspension during dredging and loading of these contaminated sediments has the potential and to pose a serious risk to human health.
- The arguments for why the exceedance of CCME guidelines require a human health risk assessment (HHRA) are given in our May 2014 comment and do not need to be repeated here.

- If a HHRA cannot be completed prior to the project there should at least be an assessment which acknowledges the risk and considers proper steps to address it.
- The limited and flawed discussion of human health risk presented in the Draft EA still contains errors which Dr. Kennedy pointed out in our May 2014 comments. The only pathway considered by the proponent was through gills, whereas Dr. Kennedy's May 2014 report lists many other pathways which need to be assessed and included in the EA. A proper HHRA would look at all pathways for dioxin and furan and the heavy metals to get into the human food chain.

"This could temporarily increase exposure to dioxins and furans through the gills of species of marine country foods. There is some risk that humans who regularly consume these organisms could be exposed to increased concentrations of dioxins and furans through this pathway."—pg 87 Draft EA

"The proponent concluded that dredging during Project construction is likely to result in no change to the quality of marine country foods with regard to concentrations of dioxins and furans, and therefore no increase in Hazard Quotients from baseline conditions. Therefore, the proponent concluded that the human health risk from consuming marine country foods is not expected to increase as a result of the Project."—pg 89 Draft EA

Environment Canada asked for more info from the Proponent re disposal and this has been replied to in the technical memorandum Nov 2015 with plans to put the most contaminated sediment on Lelu. However:

- The method to be used for loading and transporting the contaminated sediment has not been completely established or described.
- The method for dealing with the excess water (which will be laden with the lightest fraction of sediment in suspension) has not been fully described or assessed. The lightest fraction usually contains a disproportionately high percentage of the contamination as noted in our May 2014 comments. The EA phase, not the permitting phase, is the place to describe and assess this aspect of the project, so that alternatives can be considered if the risk is too high. For instance clamshell and backhoes are mentioned in the plan but suction dredging is likely the best. Also there is no description of how the run-off water from the dredgers, dump trucks or basin is to be contained – in fact there is a perforated pipe to just release the water back into the marine environment.

A "follow-up program" after the EA is complete is not a substitution for a HHRA.

"The Agency notes that there were some methodological issues with baseline data collection and analysis of marine country foods tissue samples, as well as a lack of quantitative modelling to predict future Project-related changes to health risks from consuming marine country foods. There was also significant concern expressed by Aboriginal groups and members of the public regarding the possibility of country foods contamination, both real and perceived. To address these concerns, and verify the predictions made regarding the health risk from consuming marine country foods as a result of the Project, the Agency supports the proponent's commitment to conduct a follow-up program"-- pg 92 Draft EA

Our experts have clearly specified that the levels of contaminants when compared to the CCME guidelines pose a human health risk. There do not seem to be any duly qualified experts disputing Dr. Kennedy's list of possible pathways. There do not seem to be any duly qualified experts saying it is

safe to ignore exceedance of the CCME guidelines in relation to the MOF dredge. How is a follow-up program going to in any way address the irreparable damage that will already have been done? The project is already plagued by serious problems which cannot be mitigated (GHG, harbour porpoises and many think damage to salmon habitat including wetlands) failing to acknowledge another problem of the project, and one that seems likely to do harm to the local human population, to be discovered after it is too late, is unacceptable. We need to assess some of the most serious risks while we can still say no if we choose. We had previously submitted expert evidence that the human health risk from dioxin and furans include many serious illnesses such as cancer, diabetes, etc. How exactly will a follow-up program reduce the cancer, diabetes or other illness risk or remove the toxins from the local food supply?

Even if it is impossible to fully quantify the HHR, there should be enough further analysis to consider the pathways Dr. Kennedy described and inform the public and decision makers of the serious potential risk prior to approval of the project.

The public also has a right to review the detailed dredging and loading plan during the Environmental Assessment phase of the project.

- The permitting phase is under different regulations and Environment Canada has suggested in meetings with T. Buck Suzuki Environmental Foundation that human health risk during the dredging and loading phase of projects is not their responsibility.
- The CEAA, The Minister of the Environment and Climate Change and Cabinet all need this information to make a decision.

1(B) A closely related issue is: Assessment of MOF dredge water runoff from land disposal on Lelu Island:

*“The remainder of the dredged sediment would be disposed of on Lelu Island in a containment area designed to contain both the peat removed from Lelu Island as well as the dredged sediment. Effluent from the containment area would be monitored prior to discharge into the marine environment, as permitted by the Prince Rupert Port Authority. The proponent has committed that all discharge water would meet applicable water quality guidelines and comply with the Fisheries Act prohibition against the deposition of deleterious substances in waters frequented by fish.” pg 55
Draft EA PNW*

- The EA should specify that the applicable water quality guidelines for Dioxin and Furan and other contaminants in the MOF marine sediment (re-suspended at the dredge site and in the discharge water) is the CCME guidelines for marine sediments. The CCME ISQG guidelines in the case of the MOF dredge, according to our May 2014 expert testimony, point to the need for a HHRA. It is completely unacceptable for CEAA to exclude the risk from the on land disposal plan from the required HHRA. The re-suspended contaminated sediment will likely flow back into the marine environment as a result of allowing the company to dump it on land in a manner designed to runoff back into the ocean. This risk should be evaluated as part of an HHRA prior to approval and not be circumvented by applying less stringent provincial regulation which ought not to apply in the circumstances of this project.

- There needs to be a full assessment by CEAA of the plan to dispose of the dredge sediment on land. So first there needs to be a more detailed plan included in the EA, complete with; volumes of water, suspended solids and level of contamination expected, and the method to deal with it. The following is not good enough:

“Sediment will be dredged using either a backhoe dredger (BHD) or a clamshell dredger (CLD), and subsequently transported to the Lelu Island disposal area by dump truck.” -PNW LNG June 2, 2015 Letter—Annex III—Outstanding Information from Information Request #2

How is the water going to be dealt with prior to the sediment pond? The use of a suction dredge should be considered.

- There may be no acceptable method short of some form of clarification in a mechanical separator. There are numerous examples of failures of berm filtering type disposal of contaminated seawater. We pointed this issue out in our May 2014 comment on the EIS and the EA should deal with it by providing details.
- It is instructive to remember a local Prince Rupert port on land disposal which went very wrong. Harbour sediment contaminated with dioxin and furan was disposed of on the south end of Ridley Island in a project sadly reminiscent of the current project proposal.

In the 1980's the pulpmill's second outfall near the coal port had not been used for several years, but some of the contaminated sediment in the area was subsequently re-suspended during the coal port dredging. The intention was to place the dredge material on land in a constructed lagoon on the southeast corner of Ridley Island shored by Gay Island (sometimes referred to as Dredge Bay). However, the containment was not particularly effective. Leaks in the berm allowed leachate to run into Porpoise Channel to such an extent that a silt shelf up to a meter deep, 200 meters long and 10 to 50 meters broad built up on the shore of Porpoise Channel. The wooden weir in the pond that was supposed to entrain particles in the sump part of the pond didn't work; a lot of sediment just flowed out through the 6 pipes that communicated with Porpoise Channel at high tide. David Tutt reported *"while the dredging operation was in progress, on the June 1982 visit it was observed that the water entering Porpoise Channel had a very high sediment content and indeed appeared almost as black as the dredged material entering the settling pond"* (David Tutt, 1982).

This regrettable incident shows the need for careful assessment of the plans prior to approval.

2. Valuation of Skeena Salmon

The valuation of Skeena salmon should:

- A. be included in the CEA for the public to comment on
- B. take into account long-term average salmon returns in a period of lower than average returns
- C. be based on long-term sustainable catch policy balancing ocean and upriver fisheries (rather than using the current unusually low value resulting from a very limited ocean fishery)
- D. use Gross Economic Value not Net
- E. consider the extremely high nutritional value of ocean caught Skeena salmon

2(A) Value of Skeena salmon relevance to the CEA of the PNW LNG project (PNW LNG Environmental Impacts should include risk to Skeena salmon)

According to the EIS, DFO's Fisheries Protection Policy applies (see 13.2.1 below) and according to that policy the Minister of Fisheries must take into account "the contribution of the relevant fish to the ongoing productivity of ...fisheries.... [and] the public interest" (see 1.2 below).

13.2.1 Regulatory and Policy Setting

DFO's Fisheries Protection Policy Statement (DFO 2013e) applies to all activities in or near water that could result in serious harm to fish by chemical, physical or biological means. The guiding principle of this policy is to 'maintain' or 'improve' the productive capacity of fisheries. A Fisheries Act authorization is required for project activities that will result in serious harm to fish and requires that offsetting be provided through habitat creation, restoration or enhancement.

1.2 Fisheries Act Authorization (from <http://www.dfo-mpo.gc.ca/pnw-ppe/offsetting-guide-compensation/index-eng.html>)

Proponents are responsible for avoiding and mitigating the serious harm to fish that could result from their projects. When proponents are unable to completely avoid serious harm to fish such that some residual serious harm to fish remains, they must seek an authorization under paragraph 35(2)(b) of the Fisheries Act to carry on a work, undertaking or activity.

The information requirements and documentation that proponents must submit in order to obtain an authorization is set out in the Applications for Authorization under Paragraph 35(2)(b) of the Fisheries Act Regulations. Footnote 2 Specific to offsetting, these regulations require that proponents develop offsetting plans (see Part 3 of this guide).

Under Section 6 of the Fisheries Act, the Minister of Fisheries and Oceans must take into account the following factors in reviewing the application for an authorization:

- the contribution of the relevant fish to the ongoing productivity of commercial, recreational or Aboriginal fisheries;
- fisheries management objectives;
- whether there are measures and standards to avoid, mitigate or offset serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or that support such a fishery; and
- the public interest.

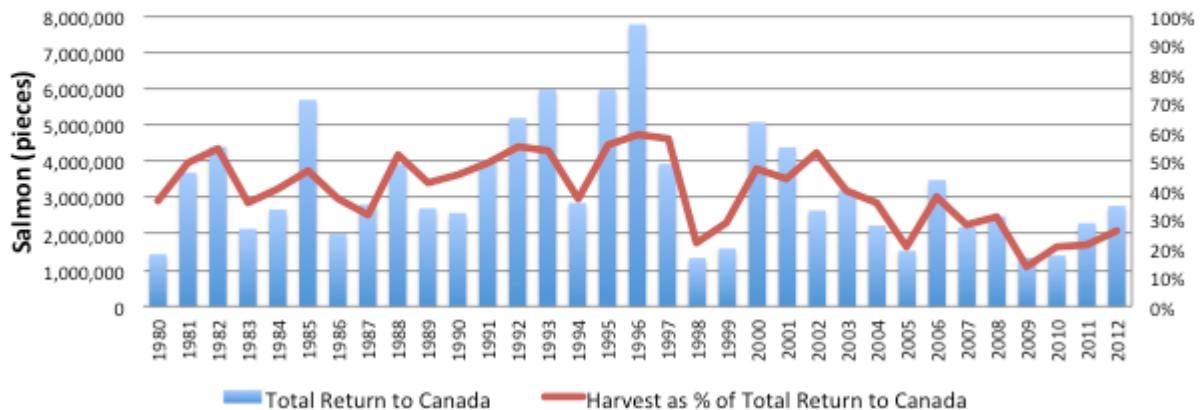
The EA is required to consider the value of Skeena salmon and the public needs to see that valuation to be able to comment on it. The government needs to have an understanding of that valuation to make a decision. The value needs to be understood to weigh the benefits of the project in this location compared to the risks of the project in this location as opposed to an alternative location. The decision related to mitigation by moving the project needs to be informed by Skeena salmon value.

2(B) The EA should include and take into account long-term average salmon returns in a period of lower than average returns

The graph below, from a report supplied to Prince Rupert Environmental Society in 2014 by Eric Angels, shows that both the Skeena sockeye returns and the ocean harvest rate are lower than average in recent years.

- When valuing Skeena salmon it is important to note that returns are variable over time and the present returns may be in a period of growth.
- It is also important to note that the ocean harvest rate is down but this also may change (see discussion in D below).

Sockeye return and harvest in Areas 3, 4 & 5 without Skeena in-river fisheries



2(C) The EA for PNW LNG should consider historic and potential Skeena salmon economic value and should not wrongly identify the current policy of allowing little or no ocean fishery as an indication of low salmon returns or low potential value

The gross economic (and nutritional) value of the Skeena fishery may be greatly increased from present. DFO policy at present has shifted the fishery to be far more heavily weighted towards upriver than the long term average. This policy could easily change back to favour a more balanced approach to ocean and upriver fishing:

Justice Cohen recommended a review of the policy which recently moved the fishery upriver: *“Sockeye caught in marine fisheries are significantly more valuable than sockeye caught in terminal or near-terminal fisheries.”*-Justice Cohen

The Cohen Commission which looked into the Fraser *“missing sockeye”* heard from groups who supported a move to upriver fisheries *“as a potential benefit to inland Aboriginal communities”* and from coastal aboriginal groups who testified *“that a move to terminal fisheries would conflict with the historical and current reliance on the resource by coastal Aboriginal communities.”* His conclusion:

“I find that DFO has not done the work necessary to assess or quantify the actual conservation benefits that can be expected from a shift to harvesting in-river or in terminal areas. In addition, the evidence of the economic viability of in-river or terminal fisheries is limited and not on the whole encouraging. I therefore conclude that DFO should proceed cautiously before it devotes additional resources to support in-river demonstration fisheries.”- Justice Cohen, Cohen Commission

When weighing the risk of negative environmental impact on Skeena salmon against the benefits of the PNW LNG project it is important to look at the long-term potential value of the Skeena salmon, not just an anomalous present period when the gross value is being drastically reduced by an unproven current fisheries policy. The upriver fishery policy was supported by a rationale relying on

analysis using net-value not gross value, however if gross value is used the marine fishery is significantly more valuable than upriver. Also nutritional value was not taken into account and a review of the policy may well result in a change once it is recognized that the nutritional value in the ocean is roughly an order of magnitude (roughly ten times) higher than spawning ground fisheries. Skeena sockeye percent oil content (skin off filet) at the ocean is 11.5% and only 2% at the Babine Fence and even less at the Babine Lake fishery. Plus the upriver fishery suffers from losses related to weight loss, other nutrient and protein loss and in-river mortality. With growing interest in food and nutrition security these facts might be expected to result in a return to a greater level of ocean fishing.

2(D) The EA should Value Skeena Salmon using Gross Economic Value not Net

"It is very difficult to project the future economic value of the natural resources of this area based on present economic worth. "

"Furthermore, there are other values associated with these resources, related to their food value in a world which is now becoming short of food, or their intrinsic value for just knowing they are there."-Economic Value of the Fishing Industry (NEAT Report 1975 Volume 1)

The wild salmon of the Skeena River in Northwest British Columbia generates close to \$110 million annually in direct revenue.

"IBM estimates that the wild Salmon economy of the Skeena River can be valued at approximately \$109,987,000"--Valuation of the Wild Salmon Economy of the Skeena River Watershed, IBM Business Consulting commissioned by the Northwest Institute March 13, 2006 [using gross economic value]

http://northwestinstitute.ca/images/uploads/IBM_skeena_report_06.pdf

Arguments have been made to DFO in the recent past, using net value when evaluating the tradeoffs related to shifting the Skeena salmon fishery upriver. However this method of valuing the Skeena salmon ocean fishery misses out the value of coastal employment (and the lesser upriver employment). The Environmental Impacts from the PNW LNG project related to diminished salmon returns should be assessed based on historic and potential gross economic value of the ocean fishery (as well as to other impacted economic values like indirect, upriver, tourism related and other species and to non-economic values like nutrition, cultural and environmental ecosystem stability).

The unique nature, remoteness and special cultural values of the area mean that people cannot or do not want to move to find employment, this negates the argument for using net value. This is explained in the 1975 Federal Provincial review of the environmental impacts from a proposed terminal on Kitson Island (on the edge of Flora Bank in close proximity to the PNW LNG project location and thus pertinent). The NEAT report discussed this issue and recommended use of gross economic value of the fishery:

There is further rationale for using the gross income as the actual value of the fishing industry. First, to use net value, one must assume those people who would lose their fishing income would be able to find alternative employment. The fact that the unemployment rate in the study area averaged about 9% in 1974 and rose to over 12% in Prince Rupert {30% in Port Simpson) at the close of the fishing season indicates this is not necessarily the case. When allowance is made for the number of students and housewives who seek employment only during the fishing and processing season and therefore do not show up on the subsequent employment roles, more emphasis is added.-pg. 53 Federal - Provincial Joint Committee On

Tsimpsean Peninsula Port Development Prince Rupert Bulk Loading Facility Phase 2
Environmental Assessment of Alternatives VOLUME 1 MAIN REPORT February 13, 1975
Northcoast Environmental Analysis Team <http://saveourskeenasalmon.org/wp-content/uploads/NEAT-Report-Volume-1.pdf>

2(E) The EA of the PNW LNG should include and consider the extremely high food and nutritional value and food security when assessing the risk to the Skeena salmon habitat: Flora and Agnew Banks

Economic Value of the Fishing Industry (NEAT Report 1975 Volume 1)

"It is very difficult to project the future economic value of the natural resources of this area [Flora Bank] based on present economic worth. "

"Furthermore, there are other values associated with these resources [Skeena salmon and other marine resources dependent on Flora Bank area] , related to their food value in a world which is now becoming short of food, or their intrinsic value for just knowing they are there. "

Prince Rupert Environmental Society volunteers used a Distell Meter to test 126 ocean caught Skeena sockeye in 2012 and found their average fat content (skin off filet) was 11.5 %. The extraordinarily high value of Skeena sockeye is well known by local fishermen and their valuation is better appreciated when the Skeena sockeye 11.5% is compared to the USDA average for raw sockeye of 5.6% -www.nal.usda.gov/fnic/foodcomp/search (accessed 9/21/12)

About one fifth of salmon oil is Omega-3 and if that holds true for Skeena sockeye- 11.5% total oil would translate to 2.3 grams of Omega-3 oil per 100 gm serving.

Even a few servings per year of Omega-3 rich wild fish have significant health benefits. One well studied benefit is as a preventative of death by coronary heart disease (CHD). It is estimated that only ¼ gram of Omega-3/day over a 70-year lifetime would result in 7125 fewer CHD deaths per 100,000 individuals. (Mozaffarian and Rimm 2006)

Flora and Agnew Banks are rearing grounds for pinks as well as other salmon species and the food and nutrition contribution of this abundant species may prove even more important than sockeye, in part due to its abundance but also due to its extremely low levels of toxins as a result of its short lifespan and prey.

Valuation of Skeena salmon concluding remark (lack of alternative site for consideration in EA)

The above points regarding value of Skeena salmon relate to the siting of the project – the entire value of the benefits of a PNW LNG project should not be weighed against the risk to wild salmon—the option of shifting the project to an alternative site should be included in the EA and only the cost of relocating PNW LNG to a safer site should be weighed against the risk to Skeena salmon. The CEA process requires an alternative be provided yet no viable alternative is presented in the EA.

3. The Wetlands Function report/analysis used in the EA does not consider the loss of wetland function through the important pathway: decreasing insect production which is now providing food to adjacent smolt population (as much as 88% of stomach contents if the limited sample of chum is confirmed in further sampling)

Destruction of Salmon Habitat Insect Food Supply

The EIS and EA have not considered the impact of destroying approximately 100 acres (this is a very rough estimate) of insect producing wetlands directly adjacent to Flora Bank, in regards to the pathway of reducing salmon production through reduction of the insect portion of their food supply.

This is a serious omission and this risk to salmon production pathway must be analyzed prior to the Draft EA being finalized and issued.

Wetland Function is not to be lost:

“The Project is subject to the Federal Policy on Wetland Conservation, which has an objective of no net loss of wetland functions on federal lands and waters.” Draft EA pg 40

The Prince Rupert Port Authority is responsible for implementing the Federal Wetlands Policy and they submitted a report on the project’s expected effects on wetland function.

“The Port Authority is responsible for providing a land lease and implementing the Federal Policy on Wetland Conservation. The Port Authority provided comments on navigation, movement of vessels, use of Port land including waste management, wetland function compensation, and effects on fish and marine mammals”-- Draft EA PNW LNG Page 38

The summary of functions provided by the relevant wetland (on Lelu Island adjacent to Flora Bank) does not even include production of land insects which form an important part of the Skeena smolts food supply:

6.3.1 Proponent’s Assessment of Environmental Effects

Wetlands

A total of 119.2 hectares of wetland out of the 154.3 hectares found in the local assessment area would be lost, resulting in the loss of wetland functions described below. This area represents 77 percent of the wetlands found in the local assessment area...

Functions provided by these wetlands include groundwater recharge and discharge, flow moderation, sediment stabilization, maintenance of water quality, carbon storage, and habitat for a variety of wildlife species including migratory birds and federal species at risk. Wetlands are also a source for traditional use plants. [Note insect production which ends up in the marine smolt habitat is not included]—Draft EA Page 40

We obtained a copy of the comments from the PRPA (mentioned above) and they do not even mention insect production as a function of the wetlands when there should be a detailed analysis in light of the huge consequences if the tens/hundreds of millions of Skeena salmon smolts on Flora/Agnew Banks have a significant reduction in their food supply (possibly up to 88% for Chums—see table below).

“As federal land Manager responsible for the implementation of the Federal Policy on Wetland Conservation, the PRPA seeks to incorporate the definition (sic) wetland function and guidance as described in “The Federal Policy on Wetland Conservation Implementation Guide for Federal Land Managers (CWS 1996)”. Accordingly, PRPA will work with the Proponent (sic) to prioritize areas for Wetland Compensation initiatives addressing lost wetland function within closer proximity to the project area”.—This scant reference constitutes the totality of the PRPA comment on Wetland Function provided to T Buck Suzuki Environmental Foundation from CEA in response to a request to see the comment on wetland function mentioned above in the draft EA (Table 1 EIS Review Table)

The following compensation plan is meaningless and completely inadequate and needs to be amended to take into account loss of the wetland function of insect production as a smolt food supply:

“The proponent considered effects on wetlands to be significant if they led to a net loss of any wetland functions.”

“The proponent proposed implementing a wetland compensation plan with a ratio of 2:1 compensated areas for impacted areas and a five-year monitoring program for the restored or created wetlands. The plan would be designed to meet the Federal Policy on Wetland Conservation objective of no net loss of wetland function on federal lands and waters. Based on advice from Environment and Climate Change Canada, the compensation plan would favor restoration over enhancement and enhancement over creation of wetlands. The proponent concluded that while the wetland functions would not return at the site where they were lost, the compensation plan would prevent net loss of wetland functions and, as such, the residual effects would not be significant.”-Draft EA pg 40

Salmon Stomach Analysis



- 246 salmon stomachs
- Four species collected
- Five regional sites (Lelu, Inverness, Marcus, deHorsey, Roberts)
- Salmon collected from May to September 2015

- Collected primarily at dusk during feeding periods
- 8.5% empty (15 coho, 5 sockeye, 1 Chinook)
- ~ 50% fullness
- > 75% digested materials

- Crustacean plankton
- Crustacean benthos
- Terrestrial insects

Table 1 Percent by Number (% N) of Prey Organisms and Percent Frequency of Occurrence (% F) in Juvenile Salmon Stomach Contents from Lelu Island, Inverness Passage, Marcus Passage, Roberts Bank and deHorsey Island Sites (May to September 2015)

Stomach Content Prey Taxa	Salmon Smolts									
	Pink		Chinook		Chum		Coho		Sockeye	
	% N	% F	% N	% F	% N	% F	% N	% F	% N	% F
Crustacea (Planktonic)										
Euphausiacea (krill)	-	-	49.1	17.1	0	0	0.3	3.3	11.1	14.8
Copepoda	-	-	16.6	25.7	0.4	30	1.5	8.7	2.7	44.4
Cladocera	-	-	0	0	0	0	<0.1	0.7	62.6	16.7
Decapoda	-	-	1.2	17.1	0	0	6.2	18.7	<0.1	5.6
Crustacea (Benthic/Planktonic)										
Cumacea	-	-	0.1	5.7	6.0	20	0.1	1.3	0	0
Cirripedia	-	-	4.3	14.3	0	0	3.2	6.0	12.0	37.0
Amphipoda/Isopoda	-	-	0.9	22.9	1.4	30	10.9	39.3	<0.1	3.7
Unknown Crustacea	-	-	0	0	3.3	20	0	0	0	0
Insects/Arachnids	-	-	23.5	57.1	88.2	50	41.7	83.3	5.5	38.9
Pisces (fish)	-	-	2.2	57.1	0	0	3.3	13.3	0.8	16.7
Mollusca/Gastropoda	-	-	0	0	0	0	3.7	1.6	<0.1	5.6
Non-food items	-	-	0.2	20.0	0.4	10	0.7	14.7	0.3	24.1
Undetermined materials	-	-	0.2	20.0	-	-	-	-	-	-
% Fullness (Median)	-	-	80	55	50	50	50	50	50	50
% Digested (Median)	-	-	75	80	70	70	70	70	77.5	77.5
Total prey items counted	-	-	3,197	927	3,039	16,042	16,042	16,042	16,042	16,042
Prey items per fish	-	-	88.8	132.4	20.3	297.1	297.1	297.1	297.1	297.1
Empty stomachs (%)	-	-	2.9	0	10.0	9.3	9.3	9.3	9.3	9.3
Total stomachs (#)	0	35	7	150	54	54	54	54	54	54

The PRPA could have obtained the above PNW LNG stomach contents analysis from PNW LNG (just as we did) which showed land insects to be an important component of stomach contents in the area's smolts. See % land insects in stomach content: Chinook -23.5, Chum-88.2, Coho-41.7 and Sockeye-5.5 Certainly the EA cannot be considered complete until experts have had time to review this information in detail and obtain the further information needed to determine if this is a significant risk to Skeena salmon.

Note: As a result of a lack of time, lack of enough data, and limited funding T Buck Suzuki Environmental Foundation and the Prince Rupert Environmental Society were unable to assess this aspect of the project as thoroughly as we would have wished.

Dr. Kennedy and Dr. Faggetter have provided some comment, in addition we have provided the below brief comment which contributes local knowledge and some general science on the subject.

The limited PNW LNG sampling results summarized above (One third to one half of the stomach contents of Flora Bank area smolts is land based insects) is supported by:

- this statement: "Estuaries provide salmon with a good supply of insects and crustaceans, such as tiny shrimps for food." http://www.pac.dfo-mpo.gc.ca/education/documents/sicprimary-secprimaire/english/sic_primary_unit_7.pdf
- Other scientific work has found estuarine smolt stomach contents to be 1/3 to 1/2 land insects: "...Stomach weights of fish at the mouth of the river contained about 1/3 to 1/2 Americorophium amphipod crustaceans and 1/3 to 1/2 insects, primarily dipterans (midges)." https://www.salmonrecovery.gov/Files/Estuary/Final_Estuary_Benefits_9-16-13.pdf

The loss of wetland function if Lelu is cleared could be severe as explained in this excerpt from “*Estuarine wetland area affects salmon production through Insect production*”:

*“Rehabilitation of wetlands in the estuary of the Salmon River in Oregon preceded large-scale habitat improvements in the Columbia estuary. While the Salmon River is much smaller than the Columbia and therefore not directly comparable, findings from the Salmon provide general information about the potential pace of recovery. **Monitoring by Gray et al. (2002) of rehabilitated wetlands in the Salmon River estuary documented rapid improvements that benefit fish, including an initial pulse of productivity in the first two to three years following restoration. The productivity was demonstrated by a surge in insects that provide prey for juvenile salmon and a corresponding influx of fish.**”* (my emphasis)

https://www.salmonrecovery.gov/Files/Estuary/Final_Estuary_Benefits_9-16-13.pdf

The project’s plan to destroy 119 hectares of wetlands adjacent to Flora Bank (77% of the total in the local area) will dramatically decrease insect production and, as insects are a major component of the smolt food supply, it will reduce Skeena salmon production

- The insect production adjacent to Flora Banks is likely an important component of the Flora Bank smolt insect stomach contents and the destruction of 77% of the wetlands can be assumed to result in the destruction of the majority of adjacent insect production unless there is evidence to the contrary.
- Local knowledge and comments to the author tell of swarms of blackflies and other insect life on Lelu Island which come out in clouds far out over Flora Bank when the tide is out (and maybe when it is in- no information on this)
- Without evidence to the contrary we have to assume the majority of the Skeena salmon smolts (who live and feed on Flora/Agnew Banks for one to four weeks) derive their insect food supply from wetlands adjacent to Flora Bank.

In order to assess or comment on the issue of wetland function in relation to insects more study needed to be done but even the existing information was not all given to us. We asked PNW LNG twice for more details regarding their limited sampling of smolt stomach contents: where were individual samples taken (Lelu Island, Inverness Passage, Marcus passage , DeHorsey Island or Roberts Bank and how the samples were chosen, but we were not given further information.

4. Comment on NOx Best Available Technology Condition-- Air Quality Condition 3.1 should define Best Available Technology as “technology that guarantees NOx emissions of less than 5 ppm”

3. Air quality

3.1. The Proponent shall implement best available technology and best management practices to reduce and control air emissions during all phases of the Designated Project to mitigate adverse environmental effects on freshwater fish and fish habitat and human health.

- CEAA Potential Conditions

- Best Available Technology should be defined as “technology that guarantees NOx emissions of less than 5 ppm” as described and recommended in Dr. Esplin’s comment supplied to CEAA by us May 2014 (Esplin-2014)

“The project’s EA (Section 7.6) reports that the projected sulphate and nitrogen PAI input, immediately adjacent to the project site, will be similar to a “critical load” of 150 equivalents per hectare per year. A reduction in gas turbine emissions from 25 down to less than 5 ppm NOx would provide a safety margin and therefore help to prevent acid rain related damage to the ecosystem.” ...

“4 Conclusions and Recommendations”

“This study found that the projected NOx emissions from the proposed LNG plant can be reduced from 4,033 TPY down to 1,415 TPY by using gas turbines that employ the latest lean low-NOx burner technology. This solution would be less expensive and more environmentally acceptable than using SCR scrubbing. The resulting impacts upon the receiving environment should be within government guidelines.

Therefore it is recommended that the proponent use gas turbine technology that guarantees NOx emissions of less than 5 ppm. It is further recommended that the water chemistry of downwind freshwater bodies be periodically monitored to ascertain their health.”-

- Gordon Esplin, M.Sc., P.Eng.
 President, Genesis Engineering Inc.
 Past-Head, Air Pollution Programs at BC Research
 Education-The University of British Columbia, University of Alberta
 (Esplin-2014)

- The condition could end up being a useless gesture without a definition. The proponent could for example argue that the best available technology means that which is available for the price they want to spend. Gordon Esplin supplied examples to show that <5 ppm is available:

“For example, General Electric supplies their 6B, 7E and 7EA heavy-duty stationary turbines with Dry Low NOx (DLN 1+) burner technology and are guaranteed to emit less than 5 ppm of NOx, and typically 3 – 5 ppm NOx. Siemens-Westinghouse has similar capabilities.”—Esplin-2014

- The recent high lead levels found in water in Prince Rupert schools is related to acidity of the water supply as reported on CBC interview with an expert. The further acidification of the Prince Rupert and Port Edward communities water supplies may be an example of “the acid rain related damage to the ecosystem” mentioned above.

Another example of acid related damage is covered in Dr. Faggetter’s full comment included elsewhere in our package (Faggetter- 2016):

Emissions of air pollutants from the proponent's proposed facility are estimated to be as high as 0.47 tpd of SO2, 11.44 tpd of NOX, and 14,019 tpd of CO2 (tpd = metric tons per day) (EIS Addendum, Section 6 - Air Quality, pg. 6-4). Unfortunately, studies on the impact of a coastal LNG facility on ocean acidification have not yet been done, thus the magnitude of the impact that acid deposition from the proponent's facility could have on the marine environment is not known. However, given the serious concerns that the

BC shellfish industry has regarding ocean acidification and its relationship to the recent die-offs of oysters and scallops, coastal areas in BC may already be at risk. Increased ocean acidification can impact juvenile salmon by causing declines in the organisms on which they feed. For example small ocean snails called pteropods, which may make up more than 50% of the juvenile pink salmon diet, are already being affected by the acidification of the ocean.”-Faggetter-2016

5. Mitigation by compensating for harm to project area salmon habitat is not possible

The exceptionally high habitat value of Flora/Agnew Banks makes it unlikely that mitigation plans can in fact “‘maintain’ or ‘improve’ the productive capacity of fisheries.”

13.2.1 Regulatory and Policy Setting

DFO’s Fisheries Protection Policy Statement (DFO 2013e) applies to all activities in or near water that could result in serious harm to fish by chemical, physical or biological means. The guiding principle of this policy is to ‘maintain’ or ‘improve’ the productive capacity of fisheries. A Fisheries Act authorization is required for project activities that will result in serious harm to fish and requires that offsetting be provided through habitat creation, restoration or enhancement.

Offsetting is impossible- The EA does not include a defensible plan to offset the risk of serious harm to salmon and other species. It is hard to imagine such a plan is possible given the unique importance of the area, so PNW LNG’s promise to develop “opportunities” and present one in the future is not acceptable.

The public needs to see the actual plans in order to be able to assess and criticize them, because there is good reason to believe they will prove inadequate resulting in a projection of serious harm to Skeena salmon which could result in the rejection of the project.

Mitigation might normally be possible by enhancing or adding salmon habitat in other areas but in this situation several factors point to the habitat being unique and irreplaceable:

A recent study done for Lax Kw’alaams (Charmaine Carr-Harris, Jonathon Moore, et al) found 25 times more salmon smolts on eelgrass in the project area than on other eelgrass so would there need to be 25 times more eelgrass habitat elsewhere to compensate for habitat lost in the project area.

Even if 25 times the habitat were added or enhanced elsewhere it would not compensate for loss of the unique features of the Flora/Agnew Bank area as pointed out in excerpts from **The Federal - Provincial Joint Committee on Tsimpsean Peninsula Port Development, Prince Rupert Bulk Loading Facility Phase 2 Environmental Assessment of Alternatives, MAIN REPORT February 13, 1975 Northcoast Environmental Analysis Team (NEAT)**

The NEAT report assessed a project in the same area as the PNW LNG project and although there are differences in the project the sections on the area’s salmon habitat value and irreplaceability are pertinent and should be considered in relation to offsetting plans (once those plans are provided to the public in the assessment process)

The 15% Freshwater Contour has not been described in the Draft EA as far as we can locate and this unique feature should be included in the assessment as it describes a quality of habitat which cannot be found in offsetting habitat; it is needed just as the smolts enter the ocean and are adjusting.

**Federal - Provincial Joint Committee on Tsimpsean Peninsula Port Development
Prince Rupert Bulk Loading Facility Phase 2 Environmental Assessment of Alternatives
MAIN REPORT February 13, 1975 Northcoast Environmental Analysis Team (NEAT)**
<http://saveourskeenasalmon.org/wp-content/uploads/NEAT-Report-Volume-4.pdf>

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“the estuary in the Skeena may not be fully utilized in most years, but under certain weather or Skeena discharge conditions, salmon production may depend entirely on areas such as Flora Bank for certain physical conditions. The diversity of habitat available for all phases of the life history is a major factor in salmon survival under adverse conditions.”



After Cameron (1948) and Trites (1956)

* Percentage freshwater in upper 60 feet

15% Freshwater Contour in Normal Conditions

Figure 17

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Figure 17 FRESHWATER CONCENTRATION IN CHATHAM SOUND NORMAL CONDITIONS

Shows that in normal conditions Flora Bank and shouldering Agnew Bank are unique and important habitat for the north turning Skeena salmon smolts because they lie within the 15 percent contour of freshwater, whereas nearby Ridley Island and Digby Island only have this beneficial level of freshwater during freshet.

“Of particular interest is the 15 percent freshwater contour. It is evident in the region of Flora Bank and Kitson Island during normal flow conditions and expands up the west coast of Digby Island during the high flows of the freshet. This transition area is probably of particular significance for young salmon: environments with salinity similar to that of the blood of salmon (isotonic) permit faster growths since less energy is spent on regulating internal water and salt levels than in either freshwater or sea water.”



15% Freshwater contour normal conditions close-up

figure 17

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“Eelgrass is of particular significance for salmon and the marine fishes. Herring spawn deposited on eelgrass has a greater survival rate than that deposited on other substrates (Outram, 1957). Juvenile salmon find protective cover and abundant forage in the eelgrass beds. The eelgrass contributes large quantities of exceptionally rich material to the detritus food chain (bacteria - amphipods - salmon).”

“The relative importance of Fucus sp., Laminaria spp., zostera and Phyllospadix populations in modifying intertidal habitats must be related to the physical conditions in any location, including the height in the intertidal zone, substrate character, and exposure to sun and surf. By modifying the effects of one or more of these parameters, the plant growth provides stability and food for a faunal assemblage much richer than possible without revegetation.”
“Of all four groups, zostera probably plays the most important role in habitat modification by consolidating sand and mud into a stable substrate through extensive rhizome growth.”

Ridley Island

The site studied was on the western shore of this island, about 0.5 mile south of the small cove which Drinnan (1974) found to be seriously affected by the red liquor outfall from the pulp mill on Watson Island. This area is one in which Higgins and Shouwenberg (1973) found very few juvenile salmon during the summer months. Our present knowledge of the physical and biological environments of the area is not detailed enough to understand why this area is not utilized by juvenile salmonids.

Kitson Island Flora Bank/Agnew Bank

Flora Bank is in the plume from Inverness Passage, receiving much of the fine sediments in the Skeena wash load. The continual contribution of; mineral nutrients, rejuvenation of bottom muds, and entrainment of sea water, result in high production in certain estuarine communities.

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3.3.2 Estuarine/Marine Environments

“Flora Bank is unique among the sites studied. It is composed of sand in the higher portions and sandy silt on the associated submerged portions of DeHorsey and Agnew Banks. Extensive

eelgrass (Zostera marina) beds are known to exist on Flora Bank (Higgins and Schouwenberg, 1973)."

"The present study found sparse beds of the related Phyllospadix scouleri in the protected sandy coves of inner Prince Rupert Harbour, but the Flora Bank beds are likely most important in the area. Subtidal and benthic samples showed a very low diversity assemblage on both DeHorsey and Agnew Banks, dominated by dense populations of the small bivalve Tranzenella tantilla; data are presented in Annex C4 (see Table 5). The low diversity results from a hostile environment characterized by substrate movements and salinity fluctuations. Tranzenella is apparently sufficiently robust to survive these stresses and exploit the detritus-rich inner estuary. The substrate itself results in quite different types of fauna than are found in other subtidal environments in the study region".

"This is the area in which Higgins and Shouwenberg (1973) found the highest numbers of juvenile salmon during an intensive investigation between May and July 1972. The Ridley Island shore, in contrast, produced relatively fewer captures. Higgins and Shouwenberg relate this distribution to the availability of amphipods, which they found only in the vicinity of Flora Bank. Kaczynski et al (1973) have shown that for pink and chum salmon (Onchorhynchus gorbuscha and o. keta) in Puget Sound an onshore stage of development can be described in which both species feed mainly on epibenthic harpacticoid copepods and gammarid amphipods. Goodman and Vroom (1972) have reported similar findings. Preliminary results reported by Higgins and Shouwenberg (1973) indicate that sockeye, coho and chinook salmon consume amphipods and insect remains in the Flora Bank area. Chinook and sockeye also take copepods."

"It is difficult to relate the presence of juvenile salmon in this area to the food available, partly because standard sampling methods do not catch epibenthic animals efficiently, and partly because it is not proven that the location of juvenile salmon is governed by food alone. The sampling in this study shows that amphipods are available in other areas, both intertidally and sub-tidally."

"The major interest in the biota of Flora Bank is in reference to the multi-million dollar salmon and steelhead fisheries. Juvenile salmon and steelhead apparently depend on this area for two functions: acclimation to salt water, during which they must become accustomed to progressively higher salinities over a period of several days; and feeding on plankton and benthos, which must permit fast enough growth to minimize mortality from predation."

-- [emphasis has been added] end of excerpts from NEAT report

6) Anchorages and Incident Risk

There should be a Marine Risk Assessment (MRA) done which takes into account the new berth location, increased anchoring issues and is consistent with the actual incident rate in the Prince Rupert harbour. The risk of long-term negative impacts from projected bunker spills as determined by this MRA should be considered by the CEAA.

Issues arising in the EIS in relation to the new berth location are listed below (1-5). They are not adequately addressed in the Draft EA or by the proponent in 15.4.1 and 22.1.1 and 22.8.5.5.

Proponent:

15.4.1 Marine Use

The interaction between shipping and interference with navigation with potential adverse effects has also been ranked as 1, therefore requiring some mitigation. These effects will also be mitigated by existing vessel management procedures, such as utilization of marine communications and traffic advisory services. Because this interaction can be mitigated through these procedures and plans, no additional analysis is warranted.

Section 22.1 1 Accidents or Malfunctions

Project-based scenarios relating to each of these potential accidents or malfunctions have been developed using professional judgment from previous experience with similar projects and results of the quantitative risk assessment completed for the Project (Det Norske Veritas 2013a, 2013b). A hypothetical, credible worst-case scenario for each type of accident or malfunction forms the basis for assessing the potential environmental effects from that incident and intentionally introduces conservatism into the assessment.

Accidents and malfunctions resulting from intentional acts of terrorism are beyond the scope of this assessment.

22.8.5.5 Economic Environment

Economic effects could be experienced near a vessel grounding, allision, or collision that involved a release of hazardous materials or LNG in sufficient quantities to cause mortality to fish species.

Resultant effects on harvesting could be experienced by the sport fishing and commercial fishing sectors, although such effects would be localized to the spill area and would be short term in duration. Recreationalists could also be excluded from the spill area until clean-up measures were completed. Adverse effects on fish populations could lead to adverse effects on the economy through effects on fisheries, especially if regulator concerns led to the closure of fisheries.

6a) Det Norske Veritas 2013 did not take into account specific risks associated with new berth location

The new berth location in the updated EIS is more exposed and will increase the need for anchorages and movement in the harbour on rough days as well as introducing other changes to marine risk.

The berth in the new design is further out in the harbour in a more exposed location. This is obvious to locals who know the area but two specific comments which support the point are:

- Brian Clark, during a meeting with Derek Baker and I (L Roth), acknowledged the initial wind/wave readings near the present berth location were “bad” which is why PNW LNG chose to investigate and initially propose the large dredge to get the berth in to more sheltered water.
- Rodney Phillipson, experienced Captain of oil tankers and with extensive local knowledge of the site in question says the berth site in the new design is in a spot with unusually high steep

waves for the given wind conditions due to several directions of wind converging (including wicked outflows in winter) and currents converging (personal communication with L. Roth). The result of the more exposed berth will be more days when it is unsafe to berth and more days when anchoring will be required.

6b) Anchoring issues present a risk which needs addressing by CEAA

Det Norske Veritas assessment did not address LNG Carrier anchoring issues (If they did and we missed it please direct us to the document)

- DNT didn't address anchoring in the 2012 risk assessment for PRPA and couldn't have addressed the additional anchoring requirements of the new berth location in 2013

The new more exposed berth site will increase need for and risk from anchoring and the NEAT 1975 risk assessment of the PNW LNG approximate site found anchoring issues "*weighed heavily*" against the site:

- ***"Winds are high enough in Prince Rupert Harbour that, combined with poor anchorage, large ships frequently drag anchor and there have been several accidents because of this #1***
- ***Poor anchorages reported in Prince Rupert Harbour are thought to be because a thin layer of mud overlies smooth rock."#1***
- ***"Large ships entering ports at either southern site (Ridley or Kitson/Lelu) would have to use Port Simpson as their anchorage." "weighed strongly against the Ridley and Kitson sites." #2***
- **The North Coast Environmental Assessment Team Report warns that Port Simpson (Lax Kw'alaams) anchorage is the only one suitable for extended anchorage of large vessels: *"Of significance is the fact that ships over 50,000 DWT must use Port Simpson for anchorage for any length of time."#3***
- ***"It was found that the only available sheltered location for long term anchorage of large, i.e. greater than 50, 000 dwt. vessels, was in Port Simpson harbour." #3***

LNG Carriers large sail area (area above water which catches the wind) will exacerbate anchoring risks found in the Prince Rupert Harbour.#4

6c) There is a need for CEAA to provide independent review of marine risk assessment done by DNV and PRPA.

The Det Norske Veritas assessment for PRPA in 2012 projects an incident rate which has a serious discrepancy with the actual incident rate in Prince Rupert Harbour.

Discrepancies in the PNW modelling signaled a need for review by CSAS and thankfully located errors which needed addressing. A marine risk assessment of the project needs to be done and the method

used by PRPA and DNV needs to be independently reviewed and any errors of method causing discrepancies need to be corrected. PRPA/DNV's method in 2012 resulted in this prediction:

"Based on current traffic levels and vessel mix, and after adjusting for local factors, a commercial vessel incident could be expected at a frequency of once every 23 years"- (PRPA website).

The actual incident rate in vessels travelling to and from Prince Rupert Harbour is so much greater than this prediction that there is almost no chance that it is correct. In January 2012 the container ship, the Cosco Yokohama was hit by a rogue wave in Dixon Entrance, it nearly capsized and lost containers overboard, in November 2012 the Hanjin Geneva grounded while piloted and though not officially escorted, a tugboat was only minutes away, and in July 2014 the Amakusa with two pilots on board hit bottom, tore a gash in the hull and took on water. A rough estimate of the odds of three incidents in three years (if the DNV and PRPA prediction is used) is calculated by multiplying 1/23 by 1/23 by 1/23. If CEAA gets a statistician to review the MRA and compare it to actual incidents they might refine the number, but this rough estimate works out to one chance in 12,000 that the PRPA/DNV MRA is correct.

6d) The argument given by PNW that risks can be "mitigated through vessel management procedures... and so no additional analysis is warranted" does not take into account that large residual risks may remain and need to be analyzed and assessed. This is especially true in the PNW LNG case where the risks of choosing a sensitive site outweigh the benefits of that site.

6e) The contention by PNW LNG that negative harvesting effects from spills would be short-term is not supported.

Bunker spills in San Francisco Bay and elsewhere have shown long-term effects. PAHs associated with spills present a long-term concern not just for marine life but human seafood consumers (especially human subsistence seafood consumers). This risk is even more important with the new exposed berth location.

6ref) References for Anchoring and Incident Risk section

#1 A REVIEW OF THE OCEANOGRAPHY AND MARINE ECOLOGY OF PRINCE RUPERT HARBOUR

prepared for R.C.H. Wilson, Institute of Ocean Sciences

prepared by S.A. Akenhead, of G.A. Borstad Associates Ltd., Sidney BC, ~1992

"Although Wainwright and Morse Basins are protected from the wind, Prince Rupert Harbour is exposed to storms and their stirring, and will absorb energy from storm surges. Winds are high enough in Prince Rupert Harbour that, combined with poor anchorage (see section 2.7 Sediments), large ships frequently drag anchor and there have been several accidents because of this (pers. comm., Capt. John Anderson, Institute of Ocean Sciences)." page 8

"2.7 Sediments-- Poor anchorages reported in Prince Rupert Harbour (per.s comm., Capt. John Anderson, Institute of Ocean Sciences) are thought to be because a thin layer of mud overlies smooth rock."- page 11

#2 NEAT Report 1975 Volume 1

“While the local impacts of development at Ridley Island or Port Simpson on the natural environment are small and about equal, the probability of pollution related problems weighed strongly against the Ridley and Kitson sites. Large ships entering ports at either southern site would have to use Port Simpson as their anchorage.” Executive Summary page 3

“Of significance is the fact that ships over 50,000 DWT must use Port Simpson for anchorage for any length of time”. -page.50 (60 in pdf)

**#3 TSIMPSEAN PENINSULA FEDERAL – PROVINCIAL JOINT COMMITTEE
PHASE II BULK MARINE TERMINAL SITES IN THE PRINCE RUPERT AREA OF BRITISH
COLUMBIA**

File: 3198/02 Swan Wooster Engineering Co. Ltd. Consulting Engineers, Vancouver, 1975

“Vessel anchorage locations for the alternative sites were examined . It was found that the only available sheltered location for long term anchorage of large, i.e. greater than 50, 000 dwt. vessels, was in Port Simpson harbour regardless of the terminal location” -Volume 6 appended to NEAT report page 7 of Wooster (page 123 in Volume 6 pdf)

“For a terminal in the Ridley-Kitson Island area anchorage in Port Simpson would, in all probability, only be used by the larger vessels for waiting periods in excess of one day.” page 7 of Wooster report Appendix in Volume 6 of NEAT report (page 123 in pdf)

#4 SAINT JOHN PORT AUTHORITY PRACTICES AND PROCEDURES 2009 4.17 c

<https://www.sjport.com/assets/PDFs/PracticesandProcedures2.pdf>

“given the large sail areas of LNG tankers special provisions may need to be considered on a case by case basis such as traffic density, manoeuvring (sic) requirements for these vessels at anchorage.”

Further reference— 1974. Phase 1 - Bulk marine terminal sites in the Prince Rupert area of British Columbia (engineering aspects). Swan Wooster Engineering Co. Ltd. Rep. for Tsimpsean Peninsula Federal Provincial Joint Committee: 87 p. + appendix.

7) Carrier and Plant Sound Impact on Smolts, Larval Fish and other Marine Life

Reference: Marine Terminal – Environmental Effects Assessment (Oct 2015)

4(a) Mitigation Options

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

This Mitigation Option gives no assurance that underwater noise management will prevent high negative impacts to Skeena salmon. The experience in South Hook UK found the LNG

Carriers had to be expensively retrofitted to avoid human health noise concerns for people living some distance from the berth. In the case of marine life on Flora and Agnew Bank, the negative impacts from sound would be much greater; the distance is much less, sound travels better (ie the energy is transmitted with less loss) through water and the species may be more vulnerable to damage from sound either directly or by changing their behavior to avoid the area.

There are problems including:

- “EMPs will be developed” is not good enough.
Petronas has not been maintaining existing infrastructure as evidenced in the internal audit recently reported on in the Vancouver Sun, therefore it appears likely they will not have a budget for expensive ship silencer upgrades if it is shown they are needed. After PNW LNG have CEA approval and have invested to build the project, there may be no mechanism strong enough to force such expenditure. The project may not have sufficient income to pay for silencing upgrades so a clear costed plan needs to be in place before CEA approval.

- There is a need for and difficulty getting silencer upgrades for human health concerns. This UK example illustrates the problem:

Note—Serious population effects on salmon smolts and other marine life will be less easily recognized and less likely to be dealt with after PNW LNG CEA approval than human concerns.

South Hook LNG Ship Noise Community Group

The 'Bu Samra' Samsung Heavy Industries Q-Max Vessel ...identified as having noise emanating from it, which has amounted to a statutory noise nuisance by officers of Pembrokeshire County Council Port Health Team. This was followed up with the ships' operating company appointing noise consultants to assess the impact posed by vessels in the Qatargas fleet, early in 2010.

This was done by undertaking sound level monitoring of the vessels both at Fujairah, in the United Arab Emirates and, for the ships which had visited the South Hook Terminal, at South Hook LNG Terminal Jetty, according to Pembrokeshire County Council Port Port Health Team.

[As a result they invested in silencer] upgrades...a ship can go from being a 'statutory noise nuisance' to not knowing it is at berth. This is certainly the case of the... - 'Tembek', 'Mozah', 'Umm Slal', 'Bu Samra', 'Al Mayeda', 'Al Mafyar' and 'Mekaines' which initially destroyed the quality of lives of residents on the Milford Haven Waterway to the point that they were left wondering if life would ever be the same after seeing the arrival of as the Qatargas Megaships.

[However] Other vessels in the fleet which were still in the shipyard prior to delivery, such as the 'Shagra', 'Aamira', 'Zarga' and 'Rasheeda' also received upgrade work to their engine silencers at the Samsung Heavy Industries Shipyard, but instead of fitting the silencers which had been successfully retrofitted to the original fourteen ships which were upgraded, it was decided to fit a different type. ...This has resulted in an even greater number of complaints on average with these vessels.

- Sound pollution from LNG carriers and from the liquefaction plant is likely to have negative, even population level, impact on Skeena salmon smolts

Sound would be transmitted through water (in the case of the plant first through rock). Scotland's Marine Scotland Science (MSS) has identified sound as a concern for salmon post-smolts. The sound sensitivity of salmon smolts is likely greater than post-smolts; they are weakened by the transition process and they cannot readily move because the salinity gradient of Flora and Agnew is uniquely suited to them and they

are often in immediate need of food after their downriver journey (NEAT reference in this submission under Flora and Agnew Bank Habitat Value).

MSS has worked with the University of Exeter to establish sound detection threshold curves in wild post-smolts, captive post-smolts and captive adults using the established auditory-evoked potential technique for comparison with existing data from behavioural methods. Models have been prepared of the acoustic outputs of operational offshore wind turbines mounted on jackets, monopiles and gravity bases, and their dispersion in the sea. These outputs will be compared with acoustic frequency-hearing threshold curves for salmon. <http://www.gov.scot/Topics/marine/marineenergy/Research/NatStrat/Theme1>

- Salmon smolts avoid sound pollution

Hearing in fish ...frequency spectrum extends down in the infrasound range (below 20 Hz). For cod, plaice, perch, roach, and salmon, hearing thresholds have been established by a conditioning technique for sound frequencies down to below 1 Hz. Tests on the behavioural reaction to sound in juvenile salmon have been performed in a large tank.

Infrasound (10 Hz) produced spontaneous avoidance responses, while no such responses could be seen at 150 Hz. Tests on down-river migrating salmon smolts have also been performed. During a stimulation period of 170 min, only six fish passed the operating 10 Hz sound source, whereas 338 fish passed during a silent period of the same duration. The 150 Hz stimulation had no evident effect on the migration- Per S. Enger, Hans Erik Karlsen, Frank R. Knudsen, and Olav Sand Enger, P. S., Karlsen, H. E., Knudsen, F. R., and Sand, O. 1993. Detection and reaction of fish to infrasound. - ICES mar. Sei. Symp., 196: 108-112.

- For the above reasons, the EA should include evidence of probable sound levels in the waters over Flora and Agnew Banks and the probable effects these will have on marine life.

8) Eulachon – need for further analysis

The extreme importance of this area for other species indicates it may be important for eulachon as well and their use of the area and possible pathways of impact should be well understood before a project is approved.