WRITTEN REPLY EVIDENCE

OF

NORTHERN GATEWAY PIPELINES LIMITED PARTNERSHIP

July 20, 2012

I. INTRODUCTION TO REPLY EVIDENCE

Q.1. Please describe the purpose of this Written Reply Evidence of Northern Gateway Pipelines Limited Partnership ("Northern Gateway") (“Reply Evidence”).

A.1. The purpose of this Reply Evidence is for Northern Gateway to respond to positions taken by intervenors through their evidence and responses to information requests on that evidence.

Q.2. Should the fact that Northern Gateway does not respond to all points in a particular intervenor’s evidence or to all intervenor evidence be taken as acceptance by Northern Gateway of any of the positions of intervenors?

A.2. No. Northern Gateway does not accept any of the intervenor positions that are contrary to the Application or additional material filed by Northern Gateway. Some of those positions will be dealt with by Northern Gateway in cross examination and argument rather than reply evidence, and others will simply be left to the JRP to determine on the basis of the filed evidence alone.

Q.3. How is this Reply Evidence organized?

A.3. This Reply Evidence is organized into the following sections:

- Reply to recommendations provided by the Government of Canada;
- Reply to economic need and public interest issues and concerns;
- Reply to engineering issues and concerns;
- Reply to environmental issues and concerns;
- Reply to marine issues and concerns;
- Public consultation reply and update; and
- Aboriginal consultation reply and update.

II. GOVERNMENT OF CANADA RECOMMENDATIONS

A. Natural Resources Canada (“NRCan”)

Q.4. Has Northern Gateway reviewed NRCan’s recommendations?

A.4. Yes.

Q.5. NRCan made the following recommendation at paragraph 118 of its evidence:

> A description be provided of the Semi-Quantitative Hazard Analysis (SQHA) that Enbridge will do for landslides. Since there are several methodologies available, this should include the type of method used and the method used to validate the results for the SQHA inside the Project Development Area PDA and outside of the PDA for areas that could affect the pipeline.
>
> Rationale: This will allow a better interpretation/understanding of the locations along the pipeline route most likely to be affected by landslides. (A2K4T9)

Does Northern Gateway have any comments on this recommendation?

A.5. Yes. Northern Gateway can confirm that it filed its *Semi Quantitative Risk Evaluation* with the JRP on May 10, 2012. (A2T0E5) In addition, Northern Gateway can confirm that the *Report on Quantitative Geohazard Assessment, Proposed Northern Gateway Pipelines* was filed as part of the SQRA.

Q.6. NRCan made the following recommendation in its evidence under 2.2.3 Forestry:

> NRCan recommends to the JRP that commitments from Enbridge to undertake the following would be appropriate and improve certainty regarding the project:
>
> - Follow-up to Enbridge's commitment to incorporate the following into its plans prior to construction:
> - Operational planning for slash burning will make use of the Canadian Forest Fire Weather Index System.
> - The Fire Response Contingency Plan will be consistent with the Canadian Incident Command System used by fire agencies in Canada.
> - Fire Management strategy will be updated to be consistent with current provincial legislation.
> - A commitment to engage in scenario-based planning and impact projections for terrestrial pipeline ruptures in forested ecosystems for the development of its Pipeline Oil Spill Response Plan (in addition to the four hypothetical terrestrial/inland spill scenarios already in Vol. 7B of the Application).
> - A commitment to monitor the impacts and persistent effects on forested ecosystems for all terrestrial hydrocarbon spills from the

pipeline, and to make the results of monitoring freely and publicly available.

A.6. Northern Gateway agrees with these recommendations as noted below.

Fire Response and Management

Following approval, Northern Gateway will undertake detailed design of the pipelines. Detailed planning will include the development of alignment sheets that include environmental protection measures, including commitments on management of fire risk. In addition, Northern Gateway will prepare a detailed Environmental Protection and Management Plan that will address operational planning for slash burning, a fire response plan, and a fire management strategy.

Effects of spills on Forested Ecosystems

Northern Gateway has completed and filed with the JRP an Ecological and Human Health Risk Assessment ("EHHRA") for pipeline spills (A2U9D6). The assessment examines both acute and chronic effects for four different locations (one in Alberta and three in British Columbia) with a focus on ecological and human health risks associated with spills into water courses and associated transport of hydrocarbons in these systems. However, the assessment also discusses effects of spills on forests, agricultural land and wetlands, as well as measures for responding to spills in these areas. A full EHHRA was not conducted for land based spills given the approach for spill containment, removal and site rehabilitation on land. As contaminated soils and vegetation are typically either removed or cleaned in-situ, recovery of hydrocarbons on land spills typically result in the majority of hydrocarbons being successfully removed or remediated.

As part of the response planning for hydrocarbon spills from the pipelines, Northern Gateway will address responses specific to spills in forested areas in relation to containment, removal, clean-up and rehabilitation. Details will be provided in the Pipeline Oil Spill Response Plan. Information will be provided on establishing objectives for spill response and clean-up, including the use of Net Environmental Benefits Analysis ("NEBA")(Application Volume 7B, Section 5.8).

Northern Gateway has committed to establishing baseline environmental quality conditions in representative habitats along the pipeline Right of Way ("RoW"). If a pipeline spill was to occur, Northern Gateway has committed to implementing an Environmental Effects Monitoring Program (Application Volume 7B, Sections 7.3.4, 7.3.5, 7.6.3 and 7.6.4). In the event a spill occurs in a forested area, this would include monitoring of forest soils and vegetation relative to established objectives for the spill response.

B. Department of Fisheries and Oceans ("DFO")

Q.7. Has Northern Gateway reviewed the recommendations made by the DFO in its evidence?

A.7. Yes.

Q.8. Has Northern Gateway made any changes to watercourse crossing methods?

A.8. Yes. Northern Gateway has determined that three proposed crossings will now have to be crossed using a trenchless method. The subject streams are Latornell River, Pinto Creek, Little Smoky River. Northern Gateway will file Preliminary HDD Feasibility Assessment Reports with the JRP for any additional trenchless crossings proposed as a horizontal directional drills.

Q.9. DFO made the following recommendation:

> 3.2.8.1. DFO recommends that the Proponent provide an additional or revised table that identifies mitigation measures for potential impacts to fish and fish habitat associated with all activities related to construction and operation in or near freshwater and includes primary and contingency crossing methods (for pipeline, road and powerline crossings). This table will more clearly link mitigation measures with potential impacts and increase the understanding of the appropriateness of proposed mitigation.

Does Northern Gateway have any comments on this recommendation?

A.9. Yes. Northern Gateway agrees with this recommendation. Northern Gateway will prepare a table that will provide preliminary details of recommendations and meet with DFO to discuss appropriate mitigation and finalize the table.

Q.10. DFO made the following recommendation:

> 3.2.8.2. DFO recommends that the Proponent employ a trenchless crossing method for all stream crossings that have a risk category of medium to high, all stream crossings where there is no LRP [Least Risk Period] and where important anadromous fish habitat occurs. Where the Proponent does not select a trenchless crossing method, DFO recommends that rationale be provided.

Does Northern Gateway have any comments on this recommendation?

A.10. Yes. Based on Route U, Northern Gateway is planning to employ trenchless crossing methods at 36 watercourse crossing sites.

Northern Gateway is currently reviewing all of the proposed trenched pipeline watercourse crossings that have been assessed as having a medium to high risk ranking, have no Least Risk Period ("LRP") and where important anadromous fish habitat occurs.

At present there are 83 such crossings. Each of the crossings falls into one or more of the following categories which determines how Northern Gateway progresses the review:

1. The crossing risk ranking was based on a previous route alignment which is no longer applicable. The watercourse is either dropped from the review or a new risk ranking is being conducted based on the revised crossing alignment. Examples include:

    - Two Creek
    - Gold Creek
    - Big Mountain
    - Bald Mountain

2. The crossing has not been visited by Northern Gateway, and requires a field investigation in particular, for biophysical, constructability and geotechnical assessments. Results from the field investigation will include recommendations as to the most appropriate crossing method and timing based on the Northern Gateway's decision framework set out in the Application, Volume 3, Appendix G-1, Figure G-7: Pipeline Watercourse Crossing Decision Flowchart, Stage 2 – Review Sites and Table G-1 Watercourse Crossing Methods for Review Sites. At least 24 of these are planned to be visited this summer by the Strategic Watercourse Assessment Team ("SWAT"). These include:

    - Calahoo Creek
    - Tributaries to Necoslie River (numerous)
    - Tributaries to Gosnell Creek (numerous)
    - Trout Creek
    - Duck Creek

3. The crossing evaluation requires additional data such as detailed flow rates, geotechnical assessments and/or additional biophysical field investigations. Any revision to the proposed crossing method and timing is not expected until detailed engineering. Examples of these crossings include many of the larger watercourses which are currently proposed as having an open cut or isolated crossing method, such as:

    - North Saskatchewan River
    - Sakwatamau River
    - Deception Creek

4. The crossing is presently being reconsidered for a change in crossing method and/or timing of construction that would lower the risk. Examples include:

- Chickadee Creek
- Deep Valley Creek
- Anderson Creek

5. The crossings that do not fall into any of the categories above have been field assessed and the Project considers that the current method and timing is appropriate for the crossing based on its channel size, expected flow rate at time of construction and fish habitat at, or within, the zone of influence ("ZOI") of the crossing location. Many of these medium to high risk crossings have a small channel width and/or limited fish habitat. Examples include:

- Paddle River
- Tributary to Chickadee Creek
- Tributary to 24.5 Mile Creek

Northern Gateway will have an update on the crossing methods and timings for all of these pipeline watercourse crossings under review, prior to completion of the Hearings. However, Northern Gateway is keen to discuss its rationale and work with DFO as soon as possible in order to determine the most appropriate methods and timings to lower risk, particularly for those crossings included in categories 4 and 5 above.

Q.11. DFO made the following recommendation:

> 3.2.8.3. DFO recommends that the Proponent proceed with its commitment to develop a compensation plan through 2012. DFO also recommends that the Proponent submit draft and final versions to the Panel for its consideration in the environmental assessment.

Does Northern Gateway have any comments on this recommendation?

A.11. Yes. Northern Gateway agrees with this recommendation. Northern Gateway has updated and continues to update the Conceptual Habitat Compensation Plans to provide further detail on habitat alterations and losses, as well as compensation opportunities. On July 12, 2012 Northern Gateway filed a Conceptual Freshwater Fish Habitat Compensation Plan (A2U9E7) and a Conceptual Marine Fish Habitat Compensation Plan (A2U9E8) with the JRP as committed to in Northern Gateway's response to Federal Government IR 2.8a) and JRP IR 8.18a) and b). Northern Gateway will develop specific habitat compensation plans to address effects on fish habitat through a cooperative process with DFO. Participating Aboriginal groups will also be provided the opportunity for engagement. Northern Gateway will meet with DFO to review the draft Habitat Compensation Strategy. Northern Gateway will provide further updates on the results of these consultations.

Q.12. DFO made the following recommendation:

> 3.2.8.4. DFO recommends that the Proponent reconsider the contingency crossing method for the Endako River and develop an environmental management and protection plan that includes specific mitigation measures that avoid all harm to the sturgeon population. In addition, DFO recommends that the Proponent identify (and implement) specific mitigation measures that avoid all harm to the Nechako populations of white sturgeon during construction and operation, or provide an alternative assessment.

Does Northern Gateway have any comments on this recommendation?

A.12. Yes. Northern Gateway agrees with this recommendation. Northern Gateway is reviewing contingency crossing methods for the Endako River and is prepared to commit to proposing a trenchless technique for both the primary and contingency crossing method for this watercourse. Northern Gateway has developed a preliminary environmental management and protection plan that includes specific mitigation measures for the noted sturgeon populations and has been filed with the JRP as Attachment JRP IR 10.4 (A2T9E5). The plan will be reviewed with DFO and will be further developed during detailed design.

Q.13. DFO made the following recommendation:

> 3.2.8.5. DFO recommends that the Proponent reconsider the appropriateness of its intended use/placement of block valves, particularly at all major salmon stream crossings and at all other watercourse crossings that rank as high or moderate risk.

Does Northern Gateway have any comments on this recommendation?

A.13. Yes. Northern Gateway agrees with this recommendation. Northern Gateway is considering the placement of block valves in the current engineering risk assessment process, with specific reference to protection of high and moderate value fish habitat. Northern Gateway will review the revised block valve locations with DFO.

Q.14. DFO made the following recommendation:

> 3.2.8.6. DFO recommends that the Proponent follow the "Impact assessment protocol for works and developments potentially affecting abalone and their habitat" (see Lessard and Campbell 2007) and identify effective mitigation measures to avoid harm to the northern abalone during construction and operation or provide an alternative assessment.

Does Northern Gateway have any comments on this recommendation?

A.14. Yes. Northern Gateway agrees with this recommendation. Northern Gateway will consider abalone habitat in the Environmental Effects Monitoring Program. Although

abalone have not been found in the terminal area, if this species is found to occur in the area around the terminal, Northern Gateway will work with DFO and other parties to identify opportunities to enhance or restore habitat for these species as part of the marine habitat compensation plan. Northern Gateway will also work with DFO and other parties, including LNG projects and Rio Tinto, to address other threats to these populations.

Q.15. DFO made the following recommendation:

> 3.3.9.1. DFO recommends that the Proponent provide a mitigation table that identifies mitigation measures for potential impacts to fish and fish habitat associated with all marine activities related to construction and operations. This table will more clearly link mitigation measures with potential impacts and increase the understanding of the appropriateness of proposed mitigation

Does Northern Gateway have any comments on this recommendation?

A.15. Yes. Northern Gateway agrees with this recommendation. Northern Gateway will prepare a table that will provide preliminary details of the recommendations and will meet with DFO to discuss appropriate mitigation and finalize the table.

Q.16. DFO made the following recommendation:

> 3.3.9.2. DFO recommends the Proponent to further develop the blasting management plans and sediment monitoring plan in consultation with DFO and other appropriate parties and submit updated versions to the Panel.

Does Northern Gateway have any comments on this recommendation?

A.16. Yes. Northern Gateway agrees with this recommendation. A blasting management plan and sediment monitoring plan will be developed in consultation with DFO and other appropriate parties once the marine terminal design is advanced and additional information is acquired on specific blasting requirements and schedule. Northern Gateway will meet with DFO to discuss the details of the plans.

Q.17. DFO made the following recommendation:

> 3.3.9.3 DFO recommends that the Proponent continue with its efforts to characterize distribution, abundance and density (including rarity and uniqueness) of coldwater sponges and corals near the proposed Kitimat Terminal to help provide an accurate characterization of potential impacts of terminal construction.

Does Northern Gateway have any comments on this recommendation?

A.17. Yes. Northern Gateway agrees with this recommendation. Northern Gateway will provide DFO with a technical report that summarizes results from a subtidal survey of Kitimat Arm completed in 2011. Northern Gateway will meet with DFO to discuss the report and determine if further work is merited.

Q.18. DFO has made the following recommendation:

> 3.3.9.4 DFO recommends that the Proponent continue to design and implement a study that better describes the spatial and seasonal occurrence and densities of marine mammals in the CCAA and PDA. DFO also recommends that the risk assessment of ship strikes in the OWA be expanded to quantify the likelihood of injury or mortality to grey whales during their spring migration through Hecate Strait and Dixon Entrance. In addition, the Department recommends that the Proponent review recent literature which indicates that ship strikes causing serious injury to or death of large whales do regularly occur at vessel speeds of 10 knot or less and consider additional mitigation measures as necessary. DFO is able to provide the Proponent with references.

Does Northern Gateway have any comments on this recommendation?

A.18. Yes. Northern Gateway agrees with this recommendation. Northern Gateway has contacted DFO, Raincoast Conservation Foundation and North Coast Cetacean Society to request data on marine mammal densities. It is recommended that these three groups and Northern Gateway form a working group to guide a vessel strike analysis for the Confined Channel Assessment Area ("CCAA") and Open Water Area ("OWA"). Other marine operators and potential operators in the area will also be encouraged to participate. Northern Gateway will meet with DFO to discuss additional grey whale data and appropriate inclusion of DFO's marine mammal sightings data. Recent literature on vessel strikes will be reviewed as part of the vessel strike analysis. Based on the vessel strike analysis, Northern Gateway would like to work with DFO and other parties to develop guidelines for large vessel operations in the CCAA and OWA that would apply to Northern Gateway as well as other vessel operators in the region.

Q.19. DFO made the following recommendation:

> 3.3.9.5 DFO recommends that the Proponent plan its Project taking into consideration that eulachon, quillback rockfish and yellowmouth rockfish (all designated by COSEWIC as threatened or endangered) which will likely be listed under SARA. It is further recommended that when planning its Project the Proponent consider species that are being considered for listing as special concern under SARA (e.g., darkblotched rockfish and spiny dogfish).

Does Northern Gateway have any comments on this recommendation?

A.19. Yes. Northern Gateway agrees with this recommendation. Northern Gateway will consider these species and undertake detailed surveys of the terminal area as part of the Environmental Effects Monitoring Program for the terminal area. Special status species will be considered in these surveys. In addition, Northern Gateway will work with DFO and other parties to identify opportunities to enhance or restore habitat for these species as part of the marine habitat compensation plan. Northern Gateway will also work with DFO and other parties, including LNG projects and Rio Tinto, to address other threats to these populations.

Q.20. DFO made the following recommendation:

> 3.3.9.6 DFO recommends that the Proponent follow the "Impact assessment protocol for works and developments potentially affecting abalone and their habitat" (see Lessard and Campbell 2007) and identify effective mitigation measures to avoid harm to the northern abalone during construction and operation or provide an alternative assessment.

Does Northern Gateway have any comments on this recommendation?

A.20. Yes. Northern Gateway agrees with this recommendation. Northern Gateway will consider abalone habitat in the Environmental Effects Monitoring Program. Although abalone have not been found in the terminal area, if this species is found to occur in the area around the terminal, Northern Gateway will work with DFO and other parties to identify opportunities to enhance or restore habitat for these species as part of the marine habitat compensation plan. Northern Gateway will also work with DFO and other parties, including LNG projects and Rio Tinto, to address other threats to these populations.

C. Transport Canada

Q.21. Has Northern Gateway reviewed Transport Canada's recommendations?

A.21. Yes.

Q.22. Transport Canada made the following recommendation:

> Because of the scope of the GOSRP, Transport Canada would likely require more than six months to conduct a detailed review of the Proponent's oil spill preparedness and response plans. The Proponent is encouraged to submit plans at the earliest possible date. Under the regulations, the plans must also include response scenarios and details on training exercises. To facilitate the review process, OHF operators usually engage TC in developing such scenarios and exercises. Therefore, Transport Canada encourages the Proponent to engage the department as soon as possible on this matter. Furthermore, to ensure a state of readiness, these scenarios and exercises should be practiced prior to the first shipment.

Does Northern Gateway have any comments on this recommendation?

A.22. Yes. Northern Gateway agrees with this recommendation. Northern Gateway will engage with Transport Canada early in the detailed planning process. The response plans will be exercised prior to the first shipment of oil at the terminal.

Q.23. Transport Canada made the following recommendation:

> Transport Canada believes that the Proponent should ensure an oil spill response capability at the Port of Kitimat equal to or greater than that required for a designated port. Also, a project of this magnitude should base the calculation of response times from Kitimat as if it were a designated port. This would increase current spill response resources in the local area.

Does Northern Gateway have any comments on this recommendation?

A.23. Yes. Northern Gateway agrees with this recommendation. Northern Gateway has already committed to a response capability in excess of a designated port in terms of volume and required response times.

D. Environment Canada

Q.24. Has Northern Gateway reviewed Environment Canada's recommendations?

A.24. Yes. Additionally, Northern Gateway met with Environment Canada on June 20th 2012 to discuss Environment Canada's recommendations.

Q.25. Environment Canada made the following recommendation #2-1 in its evidence:

> 315 Environment Canada recommends that the Proponent make available data describing the physical properties and the chemical distributions (also refer to Recommendation #2-2) of hydrocarbon products to be shipped to spill responders, regulators and researchers for the lifetime of the Project. An evaluation of the behavior and fate modeling requires the interfacial tension, emulsion and simulated distillation data, provided by the Proponent in the original data reports, beyond the usual commercial information provided by petroleum producers. As well as data for fresh hydrocarbon products, data for the evaporated products are also important. Access to the empirical weathering data are also very important for planning and further understanding the behaviors and effects of these products when spilled. Ideally, these data would be stored electronically to ensure immediate availability to responders in the event of a spill. Environment Canada is prepared to offer additional guidance with respect to electronic standards for hydrocarbon product information and availability.

> 316 Environment Canada notes that under Question 98 of the Northern Gateway Response to Federal Government IR No. 1 (Exhibit A2E8J0), the Proponent did commit to providing data on the physical properties of each Project-specific hydrocarbon within detailed Oil Spill Response Plans.

Does Northern Gateway have any comments on this recommendation?

A.25. Yes. Northern Gateway agrees with this recommendation. Northern Gateway recognizes that data describing the physical properties, weathering and chemical distributions of hydrocarbon products are valuable for both spill response planning and preparedness and during the initial response phase until the released product can be characterized. Northern Gateway and Environment Canada agreed during the June 20, 2012 meeting that this recommendation is applicable to the detailed planning phase post Project approval. At the meeting, Environment Canada further clarified this recommendation by expressing that the scope would be to include several representative oils within each category (dilbit, synbit, synthetic oil) similar to crude monitor. In terms of the parameters sampled Environment Canada recommended following the format on the Environment Canada Oil Properties Database. Northern Gateway notes that this initiative would benefit all industry and therefore may be more appropriately applied through a standardized industry procedure. Northern Gateway agrees to engage industry partner's post-approval to examine a potential system to meet recommendation #2-1.

Q.26. Environment Canada made the following recommendation #2-2 in its evidence:

> 317 In order to account for the majority of the PAHs in the hydrocarbon products, as requested in Question 100 in the Northern Gateway Response to Federal Government IR No. 1 (Exhibit A2E8J0), Environment Canada recommends that the Proponent provide data on the alkylated homologous families for the most abundant 2-, 3- and 4-ring PAH series (naphthalenes, fluorenes, phenanthrenes, chrysenes and dibenzothiophenes). In addition, data on the resin and asphaltenes content in the specimen hydrocarbon products should be provided. These data should be provided for both the fresh hydrocarbon products and weathered samples, and made available to ensure immediate availability to responders in the event of a spill as recommended in Recommendation #2-1.

Does Northern Gateway have any comments on this recommendation?

A.26. Yes. Northern Gateway filed information (A2L8X2) on alklyated polycyclic aromatic hydrocarbons ("PAHs") in response to the JRP's Ruling No. 16 regarding Notices of Motions from the Haisla Nation, Coastal First Nations, Gitxaala Nation, Sustainability Coalition, and BC Nature and Nature Canada – Requests for Full and Adequate IR Responses from Northern Gateway.

Attachment JRP Ruling No. 16 Haisla Nation IR 1.43(b) (A2L8X3) includes the results of supplemental chemical analysis for a condensate, synthetic crude, and diluted bitumen sample.

Northern Gateway and Environment Canada agreed during the June 20, 2012 meeting that this recommendation is applicable to the detailed planning phase post Project approval. Similar to Environment Canada's recommendation 2-1, Northern Gateway envisions this as being a centralized, industry-wide, initiative.

Q.27. Environment Canada made the following recommendation #2-3 in its evidence:

> 318 Environment Canada recommends that the Proponent consider an ongoing research effort into the environmental behaviour and fate models for the hydrocarbon products to be shipped. Suggested topics include: product weathering, dispersion and oil-suspended particulate matter interactions, product submergence, and remediation options for removing persistent oil from typical shorelines in the Confined Channel Assessment Area and Open Water Area. The "Orimulsion Shorelines Studies Program" could be used as a model for such work. Such a research effort would be linked to additional spill modelling studies as recommended in Recommendation #2-9 in section 2.2.2 of this submission.

Does Northern Gateway have any comments on this recommendation?

A.27. Yes. In the event the Project is approved, Northern Gateway agrees to participate in a collaborative research effort into the environmental behaviour and fate models for diluted bitumen. Diluted bitumen is currently being transported by pipeline throughout North America and shipped by tankers off the west coast of Canada and commercial vessels carry substantial volumes of heavy fuel oil throughout coastal waters. Northern Gateway would welcome Environment Canada to lead any research and development projects, in association with industry and academia, and subsequently provide relevant scientific advice, industry - wide.

Please refer to Northern Gateway Response to JRP IR No. 10.6.

As noted in *Federal Government Participants' Response to Information Request No. 1.8 from Northern Gateway Pipelines Limited Partnership* Environment Canada has identified potential funding to lead such an initiative.

Q.28. Environment Canada made the following recommendation #2-4 in its evidence:

> 319 Environment Canada recommends that the Proponent commit to ongoing measurement of the oil properties, chemical distributions and selected behaviors relevant to spill response preparedness, as the products shipped change with time. Environment Canada is prepared to aid the Proponent in selecting what should be measured and by which protocols.

Does Northern Gateway have any comments on this recommendation?

A.28. Yes. Northern Gateway agrees with the recommendation. Northern Gateway recognizes that data describing the physical properties, weathering and chemical distributions of hydrocarbon products are valuable for both spill response planning and preparedness and

during the initial response phase until the released product can be characterized. This initiative would benefit all industry and therefore may be more appropriately applied through a regulatory directive or standardized industry procedure.

Northern Gateway and Environment Canada agreed during the June 20, 2012 meeting that this recommendation is applicable to the detailed planning phase post Project approval. At the meeting Environment Canada further clarified this recommendation by expressing that the scope would be to include several representative oils within each category (dilbit, synbit, synthetic oil) similar to crude monitor. In terms of the parameters sampled Environment Canada recommended following the format on the Environment Canada Oil Properties Database.

Q.29. Environment Canada made the following recommendation #2-5 in its evidence:

> 320 For the hydrocarbon products to be shipped, Environment Canada recommends that the Proponent facilitate acquisition of samples (upon request) by regulators and other researchers for the purposes of research into environmental fate and behaviour of the product classes.
>
> 321 Environment Canada notes that the Northern Gateway Response to Federal Government IR No. 2 Question 2.82 indicated that the Proponent is prepared to facilitate acquisition of samples by Environment Canada.

Does Northern Gateway have any comments on this recommendation?

A.29. Yes. Northern Gateway agrees. Northern Gateway and Environment Canada agreed during the June 20, 2012 meeting that this recommendation is applicable to the detailed planning phase post Project approval. As an additional clarification to Northern Gateway's response to Federal Government IR 2.82, Northern Gateway is willing to help facilitate the acquisition of samples, from the product owners (i.e., the producers), upon request for regulators and their contracted researchers for the purposes of research into environmental fate and behaviour of the product classes.

Q.30. Environment Canada made the following recommendation #2-6 in its evidence:

> 322 Environment Canada recommends that the Proponent make clear, using a net environmental benefit approach (e.g. Efroymson et al., 2003), the appropriate options to be considered when developing site-specific spill response plans. Specific response options should be listed as appropriate, while others, which would not result in a net benefit, should not be given further consideration for the site-specific situation.
>
> 323 Environment Canada notes that the use of a net environmental benefit analysis was referenced in the Northern Gateway Response to Federal Government IR No. 1 Question 108 (Exhibit A2E8J0).

Does Northern Gateway have any comments on this recommendation?

A.30. Yes. Northern Gateway agrees. Northern Gateway and Environment Canada agreed during the June 20, 2012 meeting that this recommendation is applicable to the detailed planning phase post Project approval. Net Environmental Benefit Analysis (NEBA) will be considered on an area specific basis during detailed planning. Northern Gateway would like to explore the various approaches to NEBA with Environment Canada and together identify the most suitable approach for use in Project spill response planning. Environment Canada noted at the June 20, 2012 meeting that Efroymson et al., 2003 is the standard methodology that Environment Canada uses to conduct this research in house.

Q.31. Environment Canada made the following recommendation #2-7 in its evidence:

> 324 Where dispersants are contemplated as part of a possible response option, Environment Canada recommends that the Proponent test dispersant effectiveness using the ASTM F2059 test (reference below) for all hydrocarbon products to be shipped. Test variations which include cold water conditions should also be considered.

Does Northern Gateway have any comments on this recommendation?

A.31. Yes. Northern Gateway agrees. SL Ross has undertaken tank-based testing of the effectiveness of dispersants on diluted bitumen and synthetic crude. The dispersant testing report, "Tank Tests to Evaluate the Effectiveness of Corexit 9500 Dispersant on Synthetic Crude Oil and Mackay River Bitumen" was filed by Northern Gateway as Attachment Federal Government IR 2.71c (A2I9G8).

Northern Gateway will use the ASTM F2059 test or another test deemed appropriate through discussions with Environment Canada, for any additional dispersant testing. Similar to recommendation 2-1 there are several options for moving forward with this initiative.

Northern Gateway and Environment Canada agreed during the June 20, 2012 meeting that this recommendation is applicable to the detailed planning phase post Project approval. Environment Canada noted in *Federal Government Participants' Response to Information Request No. 1.7 from Northern Gateway Pipelines Limited Partnership* that regulations governing the use of spill treating agents, such as dispersants, are currently being considered for development.

Q.32. Environment Canada made the following recommendation #2-8 in its evidence:

> 325 Environment Canada recommends that the Proponent provide specific examples of existing oil spill response option protocols in its detailed site-specific spill response plans. These should capture existing best practices for spill response. Environment Canada is willing to aid the Proponent in locating these resources.

Does Northern Gateway have any comments on this recommendation?

A.32. Yes. Northern Gateway agrees. Northern Gateway will include best practice oil spill response protocols in the site-specific marine Geographic Response Plans and terrestrial Watercourse Tactical Plans, which are to be developed during detailed planning. Northern Gateway would like to work with Environment Canada, the DFO, Transport Canada, Canadian Coast Guard (CCG), British Columbia Ministry of Environment (BC MOE) and local governments during the development of the emergency preparedness and response program.

Q.33. Environment Canada made the following recommendation #2-9 in its evidence:

> 326 Environment Canada recommends that the Proponent undertake additional spill modelling and risk assessment studies based on current state-of-the art knowledge and practice. The Department suggests that the Proponent consider convening an expert scientific committee to oversee the definition, scope and delivery of such research studies, including the choice of modelling scenarios, the selection of appropriate models and inputs, and the approach to accounting for variability and model validation. The committee should include various scientific disciplines including oceanography, meteorology, marine biology, oil spill chemistry and behaviour and numerical modelling.
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> 327 Environment Canada further recommends that previous and ongoing spill modelling and risk assessment studies for similar project types be considered in the planning and delivery of additional modelling work related to the proposed Project. Among these studies, the Aleutian Islands Risk Assessment Project (available at: www.aleutiansriskassessment.com) is highly recommended. The Cook Inlet Maritime Risk Assessment Project (available at: www.cookinletriskassessment.com) is also recommended, although studies in this case are less advanced.
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> 328 Such research would be linked to additional spill behaviour and fate studies as recommended in Recommendation #2-3 in section 2.2.1.1 of this submission.

Does Northern Gateway have any comments on this recommendation?

A.33. Yes. Northern Gateway agrees with this recommendation. As discussed above, Northern Gateway agrees that a multi‑stakeholder research initiative would provide important information, particularly in the context of emergency preparedness and response planning for the west coast.

Both of the risk assessment processes referenced by Environment Canada are regional studies and cannot be undertaken or led by only one project proponent. Northern Gateway is one of the many proponents proposing a project to the west coast and there are substantial existing operations in the Pacific North Coast region, including the Port of Prince Rupert and private facilities in Kitimat.

It should also be noted that spill modelling and risk assessment studies undertaken for the Project have involved a variety of experts from the disciplines identified in Environment Canada's Recommendation 2 ‑ 9. The Project's expert team includes, among others, Det Norske Veritas ("DNV") who were highly involved in the Aleutian Islands Risk Assessment Project.

The methodology used for the Aleutian Islands Risk Assessment Project bears many similarities to that undertaken for the Northern Gateway Project. Although stochastic modelling is a particularly useful risk assessment and response planning tool for known single ‑ point spill sources, the value is lessened, where there is potential for an incident to occur anywhere along marine transportation routes. Northern Gateway assigns greater value to the development of Geographic Response Plans, which identify coastal and marine sensitive environmental, socio ‑ economic and cultural resources and provide indicative, site ‑ specific, response options to guide spill responders during a spill incident. Trajectory modelling may be used to assist in the development of Geographic Response Plans.

Northern Gateway has previously made several commitments that would help mitigate the potential consequences of an oil spill, including:

- providing an opportunity for Aboriginal groups to complete baseline harvesting studies;
- an advanced Marine Environmental Effects Monitoring Program;
- ground truthing of sensitivity and operational atlases; and
- working with local communities to complete Geographic Response Plans.

The BC marine industry would be a more appropriate group to be involved in the initiative that is being described by Environment Canada. Northern Gateway could be one participant as the potential operator of an Oil Handling Facility, and is prepared to contribute financial and human resources toward the initiative should the Project be approved. As noted in *Federal Government Participants' Response to Information Request No. 1.8 from Northern Gateway Pipelines Limited Partnership* Environment Canada has identified potential funding to lead such an initiative.

Northern Gateway and Environment Canada agreed during the June 20, 2012 meeting that additional oil spill modeling may be useful for the development of detailed site specific response plans (geographic response plans) during the detailed planning phase post Project approval.

Q.34. Environment Canada made the following recommendation #3-1 in its evidence:

> 329 Environment Canada recommends that, in order to minimize impacts to breeding migratory birds, the Proponent avoid habitat destruction (e.g. vegetation clearing and disturbance-related activities) at a minimum

> between the period of March 15 and August 15 of any year. Depending on the specific location along the pipeline corridor, a narrower window may be applicable; upon request, Environment Canada will provide additional specific advice in relation to this matter. In addition, Environment Canada expects the Proponent to use best management practices to minimize impacts to migratory birds, including inadvertent destruction of nests or killing of birds. Environment Canada recommends that any filling, draining or other destruction of wetlands with wetland dependent species not take place until August 31 at the earliest, to ensure that migratory birds have had sufficient time to fledge and disperse. If the Proponent has a priori knowledge of an active nest, it must be protected with a suitable buffer until the young have fledged.

Does Northern Gateway have any comments on this recommendation?

A.34. Yes. Northern Gateway agrees with this recommendation. Following Project approval, Northern Gateway will complete a pre-construction breeding bird survey, as well as site-specific surveys of bird habitat and use along the pipeline RoW as part of the centerline surveys to finalize the pipeline route. Alignment sheets will be prepared for this final route; the alignment sheets will detail aspects such as appropriate clearing windows, avoidance of wetlands, and protection areas around active nests and broods. These aspects of the alignment sheets will be reviewed with Canadian Wildlife Service (CWS).

Q.35. Environment Canada made the following recommendation #3-2 in its evidence:

> 330 Environment Canada recommends that, in addition to survey commitments identified in Northern Gateway Response to Federal Government IR No. 2 Question 2.60 (Exhibit A219D0), the following surveys be completed by the Proponent prior to the finalization of the pipeline centreline:
>
> • Surveys for swifts (e.g. Black Swift)
>
> • Surveys for swallows (e.g. Barn Swallow)
>
> 331 These surveys should be focused on areas where construction would coincide with high suitability habitat for these species.
>
> 332 In addition, it is recommended that the pre-construction Breeding Bird Survey replicate the 2006 Survey completed by the Proponent. The Breeding Bird Survey should:
>
> • Provide coverage in major habitat types that support relatively high bird densities, high species richness and/or high species diversity. The Breeding Bird Survey should not focus on species at risk only, but also on birds.

• Each station should be sampled twice/year (earlier and later in the breeding season).

333 Furthermore, it is recommended that follow-up monitoring be completed for breeding birds in priority habitats (e.g. wetlands, riparian areas; others as defined by the data).

334 It should be noted that Environment Canada may recommend further surveys for other species not identified to date, based on future species assessments or listings (e.g. Committee on the Status of Endangered Wildlife in Canada (COSEWIC), SARA).

335 Where biodiversity hotspots are identified based on the accumulated survey work and other data sources, additional efforts should be made to avoid (e.g. micro-routing) and minimize (e.g. detailed mitigation measures developed within the Construction Environmental Protection and Management Plan) impacts to these habitats. In such situations, it is recommended that micro-routing or other mitigation proposed be reviewed by Environment Canada.

Does Northern Gateway have any comments on this recommendation?

A.35. Yes. Northern Gateway agrees with this recommendation. Northern Gateway will undertake surveys for swifts and swallows in areas where these species are likely to occur (i.e., high suitability habitat). A pre-construction breeding bird survey will also be completed. Prior to the start of these surveys, Northern Gateway will review the survey design and methods with CWS. It is also Northern Gateway's desire to engage participating Aboriginal groups in the conduct of these surveys.

Information from these surveys, including hotspots, will be used as input to the finalization of the pipeline centerline and the preparation of alignment sheets.

Q.36. Environment Canada made the following recommendation #3-3 in its evidence:

336 Environment Canada recommends that, in order to minimize impacts to migratory avian species at risk, the Proponent avoid habitat destruction (e.g. vegetation clearing, initial grading) at a minimum during the period March 15 to August 15 of any year. Provincially sensitive species and SARA-listed species may require species-specific timing restrictions which also need to be observed. For further information regarding species-specific timing restrictions for SARA-listed species, the Proponent is directed to the Petroleum Industry Activity Guidelines for Wildlife Species at Risk in the Prairie and Northern Region (2009) (see Appendix 1). Please note the changes found in Table 3-1, to the setback distances outlined in the aforementioned document.

337 For Marbled Murrelet it is recommended that the Project avoid clearing within any Wildlife Habitat Areas or Old Growth Management

Areas. Areas of suitable habitat within the Project Development Area should also be avoided through micro-routing and minimization of the Project footprint; in particular, efforts should be made to avoid bisecting large tracts of undisturbed suitable habitat which are important for the continued persistence of this species.

338 For species at risk generally (i.e. avian AND non-avian) where habitat loss and fragmentation are known limiting factors, it is recommended that areas of suitable habitat (as identified through habitat suitability mapping and species at risk surveys) be avoided by the Project through micro-routing and the use of existing disturbed areas to the fullest extent possible. Habitat suitability maps and survey data should also be used to identify areas that support multiple species at risk, and additional efforts should be made to avoid or minimize impacts in those areas.

Does Northern Gateway have any comments on this recommendation?

A.36. Yes. Northern Gateway agrees with this recommendation. Northern Gateway will include the concerns in paragraphs 336 through 338 in the finalization of the centerline for the pipelines. As noted in the response to Recommendation 3-1 and 3-2, Northern Gateway will prepare alignment sheets and associated environmental protection measures, including avoidance, where possible. The alignment sheets will be reviewed with the CWS.

Q.37. Environment Canada made the following recommendation #3-4 in its evidence:

339 Boreal Caribou

• Environment Canada recommends that the Project, where it crosses the Little Smoky local population range, be located in areas of fire disturbance within the last 40 years and/or in unbuffered anthropogenic footprints in order to reduce the risk of the Project destroying habitat that is proposed as critical habitat in the proposed national recovery strategy.

• Environment Canada recommends that measures proposed by the Alberta Sustainable Resource Development (Attachment IR 76b) to Northern Gateway Response to Federal Government IR No. 1 (Exhibit A2E8K0)), including minimizing habitat disturbance (e.g. use of existing footprint/disturbances, minimizing right-of-way width, minimizing temporary workspace), ensuring no net gain of access (implementation of access management plan, reclaim access routes), and carrying out 4:1 ratio of habitat restoration for habitat destroyed, be implemented. These measures are consistent with the broad strategies and general approaches to meet objectives, which are identified in the proposed national recovery strategy and can be expected to reduce the impact of the Project to this local population of caribou. Furthermore, measures which restore habitat and reclaim access routes are considered to be a high priority for recovery of this local population.

340 Southern Mountain Caribou

• Environment Canada recommends that, in order to avoid destruction of habitat identified as critical habitat in a final recovery strategy, a decision on the Project footprint would need to be made in the context of the results of the critical habitat identification within the final recovery strategy for SMC. It is important to highlight the possibility that critical habitat for SMC is expected to be identified to the extent possible in a final recovery strategy within a timeline that would overlap with that of the approval and early construction of the Project (i.e. likely within the next 12-24 months).

• If it is determined that the above timing for decision making is not appropriate, Environment Canada recommends that in addition to managing linear feature density, through the Proponent's 'no net gain in linear feature objective' (as described in Northern Gateway's Response to JRP IR 3 (Exhibit A2C5T3)) that disturbance to caribou habitat be avoided and mitigated. This includes, routing the Project within or as close as possible to existing development footprints so as to minimize habitat clearing; and, implementing a 4:1 ratio of habitat restoration to habitat destroyed within those ranges of caribou habitat that are relatively more disturbed. This should be applied to the area that is within the Narraway local population range and the Bearhole-Redwillow area of the Quintette local population range.

• Environment Canada recommends that micro-routing be done in consultation with provincial experts on SMC.

• Environment Canada recommends that, in addition to ensuring a no net gain in access within SMC habitats, that access management measures be applied within the Project area wherever possible in order to minimize access (and thus opportunities for movement of predators) into SMC habitat.

• Environment Canada recognizes that access control measures aimed at managing human access may not affect access by predators. Environment Canada recommends active management of early seral stage vegetation within the Project area; as well as reclamation of cleared areas to provide grasses and trees (rather than shrub vegetation). These measures are intended to avoid attracting ungulates and to reduce use of corridors by predators. Together with other actions, in particular, reduction of line of sight as referenced in the Application, these measures can help mitigate the potential for increased predation pressure on caribou as a result of Project construction and operation.

• Environment Canada recommends an adaptive management approach for mitigation. The purpose of such an approach would be to ensure that effectiveness of mitigation measures, such as reductions to line of sight,

habitat restoration, decommissioning of access, etc. is monitored and measures are adjusted as needed during the operation of the Project in order to ensure objectives regarding habitat disturbance and access are achieved.

Does Northern Gateway have any comments on this recommendation?

A.37. Yes. Northern Gateway has met with Alberta Sustainable Resource Development ("ASRD") on a number of occasions to discuss and refine the pipeline routing in the range of the Little Smoky caribou population. The current routing represents the outcome from these meetings, as well as a desire to keep the pipeline RoW within or parallel to existing disturbed areas or linear features, where possible. During future centerline surveys and the finalization of the pipeline route, Northern Gateway will further consider how the pipeline routing can take advantage of the features noted by CWS.

As noted in Northern Gateway's response to Federal Government IR 2.63, Northern Gateway will continue to work on the Linear Feature Management and Removal Plan ("LFMRP") within sensitive wildlife areas, including caribou range and grizzly bear range. An outline of the LFMRP is included in the Attachment to the response to Federal Government IR 2.63.

Northern Gateway has committed to a "no net gain in linear disturbance features" in areas of sensitive wildlife habitat. This is in agreement with Enbridge's policies on habitat restoration (i.e., the "tree for tree" and "acre for acre" restoration policy).

Northern Gateway would like to identify the preferred restoration measures in cooperation with the CWS, ASRD and the BC MOE. While the ratio for habitat restoration could be a specific objective in certain areas, Northern Gateway would prefer that restoration objectives be set to meet the specific needs for different sensitive wildlife areas along the RoW, rather than a general area for area ratio.

As habitat recovery for the Southern Mountain Caribou must require a regional effort, Northern Gateway is committed to working with the CWS, the appropriate provincial wildlife agency and other industrial users or proponents to develop and implement a recovery strategy.

Northern Gateway will incorporate concerns for protection of caribou habitat into the micro-routing of the pipeline. Measures to protect such habitat will be included in the alignment sheets for the pipeline. Reclamation, revegetation and maintenance of the permanent RoW for the pipeline will take into account attraction of ungulates to the RoW and use of the RoW by predators. Recommended measures would be reviewed with CWS and the provincial wildlife agencies as part of the LFMRP.

Q.38. Environment Canada made the following recommendation #3-5 in its evidence:

341 Environment Canada advises that for portions of the Project that could impact threatened, endangered and extirpated species at risk, their residences or their critical habitat, on federal lands, a permit under

subsection 73 of SARA would be required to undertake the work. For more information the Proponent is directed to the Species at Risk Act Public Registry at: www.sararegistry.gc.ca/sar/permit/permits_e.cfm.

Does Northern Gateway have any comments on this recommendation?

A.38. Yes. Northern Gateway agrees with this recommendation. Northern Gateway will obtain all required permits for clearing of the RoW in advance of the start of any such clearing. Similarly, all permits for construction of the pipeline will be obtained prior to the start of construction.

Q.39. Environment Canada made the following recommendation #3-6 in its evidence:

342 Environment Canada advises that the Federal Policy on Wetland Conservation's goal of no net loss of wetland functions applies to wetlands that would be impacted by the Project as follows:

- Wetlands on federal lands and in federal waters

In British Columbia

- Provincial red and blue-listed ecological wetland communities; and

- Wetlands within areas defined by the Canadian Intermountain Joint Venture (see Figure 3-1) as priority wetland conservation areas for migratory birds in Alberta

- Wetlands in the White Areas (settled areas) of Alberta (see Figure 3-2).

343 Environment Canada recommends that the hierarchy of avoidance, minimization and compensation be used to achieve no net loss of functions for these wetlands.

Does Northern Gateway have any comments on this recommendation?

A.39. Yes. During detailed routing for the final pipeline routing, wetlands will be avoided whenever possible.

Northern Gateway has already completed a framework document that outlines how wetland function will be assessed, how effects would be measured and how compensation might occur if effects are confirmed. During the detailed design phase for the pipelines, Northern Gateway would prepare a detailed Wetland Functional Assessment plan that would document where wetlands would be affected, how their function will be measured, how compensation would be met and associated monitoring needs.

Q.40. Environment Canada made the following recommendation #3-7 in its evidence:

> 344 Environment Canada recommends that, prior to commencement of Project activities, a detailed assessment of wetland functions be completed for wetlands that would be impacted by the Project as committed to by the Proponent under Northern Gateway Response to Federal Government IR No. 2, Question 54 (Exhibit A2I9C9). This assessment should include surveys to identify the presence and distribution of migratory birds and species at risk in relation to potentially impacted wetlands and associated riparian areas. In addition, this would include an assessment of other potentially impacted functions (hydrology, biochemical cycling, habitat, climate). The assessment in the form of a report should be completed to the satisfaction of Environment Canada and other relevant agencies at least 180 days prior to commencement of construction activities.

Does Northern Gateway have any comments on this recommendation?

A.40. Yes. Northern Gateway agrees with this recommendation. Please see response to Recommendation #3-6.

Q.41. Environment Canada made the following recommendation #3-8 in its evidence:

> 345 Environment Canada recommends that avoidance of wetlands and associated riparian areas be carefully considered in the determination of the final centreline and auxiliary facilities for the pipeline. Furthermore, it is recommended that in cases where it is determined that avoidance cannot be achieved, that the Proponent document why avoidance could not be achieved, and provide the relevant agencies with a report for review and discussion (with the Proponent) such that a final report is completed to the satisfaction of Environment Canada and other relevant agencies prior to the finalization of the pipeline route and at least 180 days prior to commencement of construction activities.
>
> 346 In addition, Environment Canada recommends that documented efforts be made to protect wetlands from the risk of an oil spill; this should include avoidance of areas of high functioning, and ecologically important wetlands in final route selection for the pipeline and implementation of best management practices throughout the life of the Project.

Does Northern Gateway have any comments on this recommendation?

A.41. Yes. Northern Gateway agrees with this recommendation. Please see Northern Gateway's response above to Recommendation #3-6.

Q.42. Environment Canada made the following recommendation #3-9 in its evidence:

> 347 In areas of the Project where the Federal Policy on Wetland Conservation goal of no net loss applies and impacts to wetlands cannot be

avoided, Environment Canada recommends that minimization of impacts on wetlands should be pursued through measures such as winter construction, reduced risk timing periods (relevant management agencies should be consulted for advice on reduced risk timing windows for species under their jurisdiction). Where impacts cannot be mitigated through avoidance and mitigation, impacts should be monitored and compensation should be provided where it is demonstrated that there are ongoing effects (i.e. effects lasting longer than 5 years).

348 With respect to wetland compensation, Environment Canada recommends:

- A ratio of 2:1 of area of wetland restored/created to original wetland area impacted should be used, except in the settled areas of Alberta where a 3:1 ratio should be used.

- The preferred method of compensation is restoration of drained or altered naturally occurring wetlands. Restored wetlands are preferred over enhanced wetlands, both of which are preferred over newly created wetlands. Furthermore, preference is for restoration of the same wetland types as those impacted.

- Lost wetland functions should be compensated on-site if site conditions are suitable for wetland functions. Second preference is in the same watershed from which they were lost. Third preference is in the same ecosystem from which they were lost.

349 In addition, it is recommended that the hierarchy be applied broadly to the Project for wetlands and associated riparian areas that support species listed under the *Species at Risk Act*, and/or supporting important breeding populations of migratory birds.

350 In other areas where the Wetland Policy goal of no net loss does not explicitly apply, it is still recommended that the Proponent take all feasible measures to reduce impacts to wetland functions through the mitigation hierarchy of avoidance and minimization.

Does Northern Gateway have any comments on this recommendation?

A.42. Yes. Northern Gateway agrees. Please see response to Recommendation #3-6.

Q.43. Environment Canada made the following recommendation #3-10 in its evidence:

351 Environment Canada recommends that wetland monitoring be implemented for a period of time post-construction to ensure that no net loss goals are met. Upon completion of the monitoring period, compensation is required for, any residual wetland function effects remaining. The appropriate period of time for monitoring is five years;

however, three years of monitoring would be considered acceptable, provided that compensation is based on residual wetland function effects present at the end of the third year of monitoring.

Does Northern Gateway have any comments on this recommendation?

A.43. Yes. Northern Gateway agrees with this recommendation. Please see Northern Gateway's response above to Recommendation #3-6.

Q.44. Environment Canada made the following recommendation #3-11 in its evidence:

> 352 Environment Canada recommends that further review of short and long-term, lethal and sublethal effects of oil exposure on marine birds, which considers the range of available scientific literature on the subject, be provided by the Proponent (as committed to in the Northern Gateway Response to Federal Government IR No. 2, Question 76 (Exhibit A2I9D0)). The review should focus on literature related to the Exxon Valdez oil spill and not be limited to the key indicator species. This analysis is important for understanding the potential duration and severity of effects of an oil spill on marine birds.

Does Northern Gateway have any comments on this recommendation?

A.44. Yes. A report entitled Effects of the Exxon Valdez Oil Spill on Marine Birds: A Literature Review was prepared by Stantec Consulting on behalf of Northern Gateway. The report provides an assessment of the acute and chronic effects of the Exxon Valdez Oil Spill on marine birds. The report was provided to the CWS of Environment Canada in April, 2012. CWS has recently provided comments to Northern Gateway. Northern Gateway will revise the report to incorporate the comments from CWS and file the revised report with the JRP as committed to in Northern Gateway's Response to Federal Government IR No. 2, Question 76.

Q.45. Environment Canada made the following recommendation #3-12 in its evidence:

> 353 As per the 'Framework for the Marine Environmental Effects Monitoring Program' A2I9G6), the Proponent has identified a commitment to collect three years of additional baseline information in the marine environment prior to commencement of operations. Should a positive Project decision be made, Environment Canada would support this commitment and recommends that the baseline be developed as follows: Generally, the baseline must indicate abundance and distribution of important ecosystem components, as well as of underlying ecological processes that maintain the function and diversity of those ecosystems.
>
> 354 The baseline must be at a relevant spatial scale, in this case including both confined channel and open water areas. With respect to marine birds, Environment Canada advises that an adequate baseline for the Project must include:

• Marine bird abundance and distribution: by season (4 seasons); by habitat (inlets, nearshore, pelagic); for multiple years (at least 3; complete and consecutive).

• Spatial and temporal variation in marine bird prey including density, distribution and productivity of benthic invertebrates and forage fish.

• Contaminants background including hydrocarbons (prey, sediment, water column) and CYP1A in marine birds.

• Studies to link variation in marine bird abundance, distribution and movement patterns to environmental variation.

355 To ensure that the baseline and monitoring work is adequate, it is highly recommended that the details of the Environmental Effects and Monitoring Program, including details on baseline information to be collected, be developed to the satisfaction of Environment Canada (and other agencies/parties, as deemed appropriate). Should the Project proceed, this would be an area of high importance for Environment Canada.

Does Northern Gateway have any comments on this recommendation?

A.45. Yes. Northern Gateway has provided a framework document that describes the Marine Environmental Effect Monitoring Program ("EEMP") (Attachment 1 Federal Government IR 2.66, A2I9G6). Following approval of the project, Northern Gateway will develop a detailed plan for the Marine EEMP. The plan will be reviewed with Environment Canada and participating Aboriginal organizations. Northern Gateway would like to engage participating Aboriginal groups in the conduct of the Marine EEMP.

Q.46. Environment Canada made the following recommendation #4-1

356 Environment Canada recommends that the Proponent provide final estimates of design flood values to Environment Canada in order to review design flood methodology and values.

Does Northern Gateway have any comments on this recommendation?

A.46. Yes. Northern Gateway agrees. Northern Gateway will provide final estimates of design flood values to Environment Canada during the detailed design phase of the Project.

Q.47. Environment Canada made the following recommendation #5-1

357 Environment Canada recommends that the Proponent commit to consultation with Environment Canada, provincial agencies, and other stakeholders as appropriate, regarding ongoing and revised air quality assessments/dispersion modeling (as applicable).

> 358 Environment Canada recommends that the Proponent meet commitments made under Question 82 and 84 of the Northern Gateway Response to Federal Government IR No. 1 (Exhibit A2E8J0), and Question 2.69 of Northern Gateway Response to Federal Government IR No. 2 (Exhibit A2I9D0) of:
>
> • collaborating with stakeholders in the design and implementation of the Air Quality and Emissions Management Plan;
>
> • annual reporting of the Air Quality and Emission Management Plan to federal/provincial governments and other stakeholders as appropriate; and
>
> • adherence to Canada-wide Standard principles, including application of 'best available technology economically achievable' principles.

Does Northern Gateway have any comments on this recommendation?

A.47. Yes. Northern Gateway agrees. Northern Gateway will consult with Environment Canada, applicable provincial agencies, participating Aboriginal groups and participating stakeholders as appropriate, regarding ongoing and revised air quality assessments/dispersion modeling.

Q.48. Environment Canada made the following recommendation #6-1

> 359 Environment Canada recommends that the Proponent meet the commitment of engaging appropriate regulatory agencies, including Environment Canada, in the development of final acid rock management procedures and mitigation measures prior to construction of the Project (as committed under Question 7.29 of the Response to Government of Canada Submission September 2010 (Exhibit A1V7R3) and Question 32 of the Northern Gateway Response to Federal Government IR No. 1 (Exhibit A2E8J0)).

Does Northern Gateway have any comments on this recommendation?

A.48. Yes. Northern Gateway agrees with this recommendation. Northern Gateway will consult with Environment Canada, applicable provincial agencies, participating Aboriginal groups and applicable stakeholders in the development of final acid rock management procedures and mitigation measures prior to construction of the Project.

III. ECONOMIC NEED AND THE PUBLIC INTEREST

Q.49. Has Northern Gateway reviewed the intervenor evidence addressing the need for the Project and the potential impacts on commercial and public interests?

A.49. Yes. In particular, Northern Gateway has reviewed the issues and concerns raised in the following intervenor evidence:

- The evidence of the Alberta Federation of Labour and, in particular, the report of Robyn Allan entitled *An Economic Assessment of Northern Gateway* (A2L7D1);
- The report of Dr. Thomas Gunton and Sean Broadbent entitled *A Public Interest Assessment of the Enbridge Northern Gateway Project* filed on behalf of the Coastal First Nations ("CFN") (A2K0J8);
- The report of Dr. Thomas Gunton and Sean Broadbent entitled *A Review of Potential Impacts to Coastal First Nations from an Oil Tanker Spill Associated with the Northern Gateway Project* filed on behalf of the CFN (A2K0K0);
- The report of Nathan Lemphers entitled *Pipeline to Nowhere* filed on behalf of ForestEthics (A2K2C6);
- The report by J. David Hughes entitled *The Northern Gateway Pipeline: An Affront to the Public Interest and Long-Term Energy Security of Canadians* filed on behalf of ForestEthics (A2K2C9);
- The report by Dr. Robin Gregory, Lee Failing and Chris Joseph entitled *Economic Impacts of the Enbridge Northern Gateway Project on the Gitga'at First Nation* filed on behalf of the Gitga'at First Nation (A2K4W9);
- The report by Dr. Robin Gregory, Lee Failing and Chris Joseph entitled *Making Informed Decisions about the Enbridge Northern Gateway Project: Evaluating the Anticipated Costs, Benefits and Risks of Marine Oil Transportation on the Gitga'at Nation and Canada's Public Interest* filed on behalf of the Gitga'at First Nation (A2K4X5);
- The report by Dr. Matthias Ruth and Rebecca Gasper entitled *Ecological Costs Associated with the Proposed Northern Gateway Pipeline* filed on behalf of the Haisla Nation Council (A2K3F0); and
- Material submitted by individuals providing oral statements to the Panel regarding the need for the Project and public interest issues associated with it.

Q.50. Does Northern Gateway have any reply to this evidence?

A.50. Yes. Northern Gateway commissioned the following evidence in reply:

- A report by Muse Stancil entitled *An Update of Market Prospects and Benefit Analysis for the Northern Gateway Project* provided as **Attachment 1**;

- A report entitled *Public Interest Benefit Evaluation of the Enbridge Northern Gateway Pipeline Project: Update and Reply Evidence* prepared by Wright Mansell Research Ltd. provided as **Attachment 2**;

- Reply evidence of Roland Priddle prepared on behalf of Enbridge Northern Gateway Pipeline in respect of the Enbridge Northern Gateway Project provided as **Attachment 3**; and

- A report entitled *Evaluation of Natural Capital and Ecological Goods and Services at Risk Associated with the Proposed Enbridge Northern Gateway Pipeline* prepared by Anielski Management Inc. provided as **Attachment 4**.

Q.51. What is the purpose of the Muse Stancil update and reply evidence?

A.51. The original Muse Stancil study filed with the Application was based on a 2009 assessment of the Western Canadian Sedimentary Basin ("WCSB") supply from the Canadian Association of Petroleum Producers ("CAPP"). During the information request process, Northern Gateway was asked if it was going to update its Muse Stancil evidence based on more recent developments. Northern Gateway indicated it was prepared to do so. In addition to using an updated supply forecast to calculate the net benefits to the Canadian oil and gas industry, Muse Stancil also updated its market assessment, transportation options available to WCSB production and certain assumptions including currency exchange rates and an in-service date for the Northern Gateway Project.

The conclusion of the Muse Stancil update is that gross benefits for western Canadian producers would be approximately $5 billion in 2019, which is the first full year of operation of the pipeline under its new in-service date. Net benefits, to the entire Canadian oil industry, after making deductions for higher Canadian refinery feedstock costs and accounting for Northern Gateway tolls, are estimated at $38 billion through to 2035.

In addition to updating this report, Muse Stancil replied to intervenor criticisms of its methodology for assessing benefits, market information for WCSB production and its forecast of oil price differentials.

Q.52. What is the purpose of the Wright Mansell update and reply evidence?

A.52. The original Wright Mansell economic impact analysis calculated the economic benefits associated with the Northern Gateway Project beyond the Canadian oil and gas industry, taking into consideration benefits accruing to all Canadians. These benefits were assessed in terms of increases to GDP, government revenues, employment and labour income. One of the primary inputs to the Wright Mansell study was the netback benefits calculated by Muse Stancil. Therefore, Northern Gateway had Wright Mansell update its report filed with the Application in order to reflect the updated evidence of Muse Stancil. Wright Mansell's update estimates widely distributed impacts across the Canadian

economy associated with an additional $312 billion in GDP, $98 billion in increased government revenues and 907 person years of employment, as a result of the construction and thirty years of operation of the Northern Gateway Project.

Like Muse Stancil, Wright Mansell also replies to intervenor criticisms of its impact assessment methodology, as well as its results. Intervenors also argued that Northern Gateway should have prepared and submitted a cost benefit analysis for the Project. In addition to making this criticism, certain intervenors attempted to conduct their own cost benefit analysis for the Northern Gateway Project.

A cost benefit analysis is not required by the National Energy Board Filing Manual, nor was one specifically required for the Panel's assessment of the Northern Gateway Project. Although not required, for certain projects a cost benefit analysis may be a useful tool that can be used as part of project assessment. However, the attempts made by intervenors at cost benefit analysis were anything but useful. Rather than just criticize the intervenor approaches to cost benefit analyses, Northern Gateway commissioned Wright Mansell to conduct a cost benefit analysis of its own for the Northern Gateway Project. The conclusion of this cost benefit analysis is that there is a large and robust net social benefit associated with the Northern Gateway Project from a national Canadian perspective. Using an 8% discount rate, the social net benefit associated with the Northern Gateway Project is $23.5 billion, equating to a social rate of return of almost 33%.

Q.53. What is the purpose of the reply evidence prepared by Anielski Management Inc.?

A.53. In order to conduct a cost benefit analysis for the Northern Gateway Project, it was necessary to quantify the costs of the Project with respect to the loss of ecological goods and services that could result from construction. This reply evidence provides an assessment of these costs for incorporation into the cost benefit analysis.

Q.54. What is the purpose of Mr. Priddle's reply evidence?

A.54. A number of intervenors made various arguments going to the issue of whether the Northern Gateway Project was in the overall pubic interest. These intervenor arguments questioned the need for the Northern Gateway Project, they suggested that WCSB supply should first be used to satisfy eastern Canada refinery demand, to the extent that it is currently served by imports and argued that the Panel should examine other pipeline options before making any decision on the Northern Gateway Project. Intervenors and members of the public making oral statements also argued that the Northern Gateway Project would jeopardize Canadian energy security. Mr. Priddle's reply evidence discusses these public interest issues and how the distribution of regional costs and benefits affect determinations of what constitutes the overall Canadian public interest.

IV. ENGINEERING

A. Avalanche Risk and Groundwater Concerns

Q.55. Has Northern Gateway reviewed the written material of Cheryl Brown?

A.55. Yes.

Q.56. Does Northern Gateway have a reply to Ms. Brown's concern about avalanche risk discussed in the following paragraph?

> The following evidence is from work safe BC regarding working standards within avalanche areas. Sections of the pipeline considered avalanche prone would have access restrictions if there were any avalanche concerns. In the event of a spill during a high avalanche period there would be no ability to respond to a hydrocarbon release and clean up for an indeterminate period of time within these areas. (A38103)

A.56. Yes. As discussed in Northern Gateway's response to JRP IR 4.2, Northern Gateway has undertaken a preliminary avalanche hazard assessment study to identify the location and nature of avalanche hazards within the Coast Mountains area from the valley of the Clore River to the Kitimat River (KP 1070 to 1115, Route P). The *Avalanche Assessment Report* filed as Attachment JRP IR 4.2 (A38103) provides the findings of this preliminary study. The avalanche path assessment included areas traversed by the proposed pipelines, access roads and proposed powerline to the mid tunnel area. The results of the assessment were incorporated in routing studies and location of pipeline facilities, including tunnel portals and valve sites. Additional avalanche hazard assessment studies will be conducted during detailed engineering.

The preliminary avalanche hazard assessment for access roads, staging areas and construction camps was undertaken by a certified avalanche professional following accepted guidelines, (Canadian Avalanche Association, *Guidelines for Snow Avalanche Risk Determination and Mapping in Canada*, 2002). Details of the findings are included in the *Avalanche Assessment Report*. Additional studies will be undertaken during detailed engineering and will be used to develop the details of an avalanche control program to meet safety and access requirements during pipeline and tunnel construction.

The key sections of the pipeline route exposed to avalanche hazards include sections of the Upper Kitimat River, Hoult Creek and the Hope Creek (Clore River Tributary) area between the Clore and Hoult Tunnels. The Project has included road access to each of the tunnel portal areas to ensure alternate means are available to access the tunnel facilities during a range of operating conditions, including avalanche hazards.

Procedures governing emergency access will be developed during detailed engineering for all sections of the proposed pipeline route. These procedures will include protocols for accessing areas that are seasonally exposed to avalanche hazards. The procedures will be developed in accordance with applicable safety standards and regulations. Avalanche

hazard assessment and control services required for routine or emergency access will be under the direction of certified avalanche professionals.

Q.57. Does Northern Gateway have any comments regarding Ms. Brown's concern about groundwater and aquifers discussed in the following paragraph?

> There are 2 aquifers being potentially contaminated by placing the pipeline over the aquifer by not knowing the aquifer flow divide and the variations as a result of high precipitation.
>
> A complete model of the water flows have to be done for the placement of the placement of the pipeline prior to approval to see if the routing is possible. (A2K7J3)

A.57. Yes. As discussed in Northern Gateway's response to Brown IR 2.10, Northern Gateway does not anticipate that any additional design measures will be required for pipelines that are installed over aquifers. This will be confirmed as part of the risk assessment during detailed engineering. During operation of the pipelines, should a spill occur, the Pipeline Oil Spill Response Plan will be activated to isolate, control and clean up the spill.

The current pipeline route has been determined to be the safest route across the Onion Lake Flats area and Northern Gateway does not anticipate making any substantial revisions to this route. The proposed route will be finalized during the detailed route selection process following approval of the Project.

B. Corrosivity of Diluted Bitumen

Q.58. Has Northern Gateway reviewed the material filed by the following intervenors regarding concerns related to the corrosivity of diluted bitumen:

- C.J Peter Associates Engineering;
- Dave Shannon;
- Douglas Channel Watch;
- ForestEthics;
- Josette Wier; and
- Haisla Nation?

A.58. Yes. It has been claimed that diluted bitumen is more corrosive to pipelines than conventional crude. NRCan also wanted more information on this issue.

Q.59. Does Enbridge have operation and inspection history relevant to the relative corrosivity of diluted bitumen and converted crude oil?

A.59. Yes. The Enbridge pipeline system has transported diluted bitumen since Imperial Oil began their pilot project at Cold Lake in the mid 1970's. By 1987, Enbridge was shipping more than 100,000 bpd of Cold Lake diluted bitumen and volumes from various sources have increased substantially since then. This experience is drawn upon to evaluate the claims of the corrosive nature of diluted bitumen.

Q.60. Has Enbridge done an evaluation of pipelines and tanks used for transportation and storage of diluted bitumen to investigate the claim that diluted bitumen is more corrosive to pipelines than conventional crude?

A.60. Yes. Enbridge has evaluated its operational history transporting diluted bitumen to investigate the legitimacy of the intervenor's claims. Specifically, a representative sample of lines and tanks for transportation and storage of diluted bitumen were considered, including the 36" segment of the Line 4 Terrace Expansion, Line 18, Line 19 and tank facilities within Western Canada. The representative pipeline systems have been inspected with modern inspection technologies which resulted in an increased level of confidence in understanding their current condition.

Q.61. What were the results of the pipeline evaluations?

A.61. Based on inspection records with modern inspection technology over the last 10 years for the above mentioned lines, internal metal loss features have not met the Enbridge depth excavation criteria, which is more stringent than the standards set by the Canadian Standards Association in code Z662. Most of the reported internal metal loss features were below the tolerance of 10% of wall thickness variance, which indicates that these features are not necessarily due to internal corrosion and are likely to be pipeline manufacturing anomalies. The 10% variance is the allowable depth tolerance for any feature length in CSA Z662 on pipelines.

Q.62. What are the possible causes of this corrosion?

A.62. The large majority of the internal metal loss indications were below a depth of 10% and were randomly oriented around the circumference of the pipe with no concentration or pattern of internal metal loss indications along the bottom of the pipe. The primary internal corrosion mechanism in oil pipelines is under-deposit corrosion, which occurs along the bottom of pipelines. Since the internal metal loss indications were below a depth of 10% and were randomly oriented around the circumference of the pipe, this indicates that not all the reported internal metal loss indications are due to internal corrosion. It is more likely that the majority of the reported internal metal loss indications represent pipe fabrication anomalies. Regardless of the cause of the internal metal loss indications, monitoring and mitigation processes make a conservative assumption that the internal metal loss indications are caused by internal corrosion. Through periodic monitoring with in-line inspection ("ILI"), should pipe wall thickness loss reach the Enbridge criteria for excavation and further assessment, regardless of the

mechanism, the pipeline will be excavated, inspected on-site, and if necessary repaired by methods as defined by Enbridge procedures and CSA standards.

Q.63. These are point in time results. Does Enbridge estimate corrosion growth rates?

A.63. Yes. Internal corrosion growth rates have been calculated for the representative sample of lines discussed above. The calculated growth rates are based on ILI results. This historic growth rate is calculated by dividing the defect depth by the calculated time of growth multiplied by a safety factor of two. Areas with only one inspection completed assume that all measured features occurred during operation which is very conservative as there are features that occur during manufacturing process and are not growing. A comparison of the growth rates to industry ranges can be made from NACE Standard RP0775-2005. The calculated corrosion growth rate for 29 of the 30 line segments evaluated were within the low to moderate internal corrosion category from NACE Standard RP0775-2005. One segment fell into the high internal corrosion category; however the orientation of the deeper features which resulted in this classification were away from the bottom of the pipe and suspected to be unique manufacturing anomalies. These internal corrosion growth rates are based on conservative assumptions and the internal features are monitored to ensure that their growth will not exceed the Enbridge depth criteria before the next planned inspection or else the feature is excavated and repaired.

Q.64. Have there been any recorded leaks due to internal corrosion on these pipelines?

A.64. According to Enbridge's Leak Reporting System there have been no recorded leaks due to internal corrosion on any of the line segments discussed above (36" segment of Line 4 Terrace Expansion, Line 18 or Line 19).

Q.65. What were the results for the Western tank facilities evaluated?

A.65. In-service inspections of these tank facilities that handled diluted bitumen, in general, have demonstrated none to very minimal corrosion and exhibited no epoxy liner blistering. Of the 33 tanks tested, five exhibited minimal internal corrosion and coating loss within the anticipated spectrum of API 653 and the other 28 exhibited no corrosion or coating loss. One out-of-service inspection was considered. The out-of service inspection results indicate that for the tank shell there was no internal corrosion and coating was acceptable with only a few areas of minor loss. The bottom of the tank experienced coating disbondment and internal corrosion on small sections of eight of the 98 plates that form the bottom of the tank. This was assessed to be a result of air bubbles formed during the coating application process.

Q.66. How does Enbridge manage pipeline safety?

A.66. Enbridge's overarching objective and highest priority is to ensure the safety and reliability of Enbridge's delivery systems for our customers, the public, our employees and our contractors. One of the ways to achieve this objective is the development of the Integrity Management System ("IMS") by the Pipeline Integrity Department which contains a suite of documents, plans, programs, and initiatives to manage pipelines that are subject to normal age and service related deterioration.

Q.67. Based on Enbridge's evaluation does transporting diluted bitumen increase the risk of corrosion on pipelines and tanks compared to conventionally produced crude oil?

A.67. Based on Enbridge's history with the transportation and storage of diluted bitumen, there is no evidence that diluted bitumen increases the risk of corrosion on pipelines and tank facilities compared to conventionally produced crude. Enbridge's experience is consistent with the results of independent assessments that have been made regarding the corrosivity of diluted bitumen.

C. Improvements Since the Marshall Incident

Q.68. Has Northern Gateway reviewed the material filed by the following intervenors regarding Enbridge's improvements since Marshall?

- Haisla Nation;
- Josette Wier;
- C.J. Peter Associates Eng;
- Coastal First Nations;
- Dave Shannon;
- ForestEthics;
- Metlakatla First Nation; and
- Chief Marvin Yellowbird?

A.68. Yes.

Q.69. Has Enbridge made any improvements since the Marshall incident?

A.69. Yes. As stated in Northern Gateway's response to Haisla Nation IR 2.29 (A2I8V1) Enbridge has made a number of improvements since the Marshall incident. In conjunction with the steps listed in Northern Gateway's response to Haisla Nation IR 2.29, Enbridge has made the following improvements to ensure the safety and reliability of its delivery systems:

- Enbridge has intensified its commitment to its core values – integrity, safety and respect – and continues to work on incorporating these values throughout our operations.

- Enbridge has made significant efforts to improve in a number of areas: pipeline and facility integrity, leak detection, pipeline control (including control centre operations ("CCO")), public awareness, emergency response and safety culture.

Pipeline and Facility Integrity

- Enbridge has heightened the importance of its pipeline and facility integrity program.

- Enbridge has re-organized the functional areas that are responsible for pipeline and facility integrity and substantially increased pipeline integrity management spending to over $450 million in each of 2011 and 2012. Over 200 inline inspections and nearly 3000 pipeline excavations have been completed during that time to ensure the safety and integrity of the pipeline.

- Enbridge has strengthened its focus on the tools, technologies and strategies needed to ensure that pipeline networks have the strength and operating fitness to perform safely, reliably and in an environmentally responsible manner.

- Enbridge has conducted hundreds of internal inspections with tools specifically designed to detect features similar to those observed at the site of the Marshall incident.

- It has extensively reviewed its records and has undertaken thousands of investigative digs to confirm the reliability of its pipelines.

- Enbridge has revised and improved numerous procedures within its Integrity Management program.

Leak Detection

- Enbridge implemented additional Leak Detection Analysis procedures. These procedures include improvements to the leak detection escalation process, shift change transitions, alternate leak detection procedures, and analysis and communication procedure. Enbridge formalized best practices for its standard operating procedures.

- Enbridge formalized a Quality Management System ("QMS") that will ensure the effective execution of critical work activities that meet pre-defined quality objectives.

- Enbridge established a Pipeline Control Systems and Leak Detection department, doubling the number of employees and contractors dedicated to leak detection and pipeline control.

- Enbridge enhanced the following aspects of the Leak Detection Analyst Training Program: on-the-job training, training program layout, readiness assessment, and communications with CCO personnel.

- Enbridge completed assessments and planning of instrumentation additions to and upgrades required to improve the performance of the leak detection system. Enbridge implemented a Leak Detection Instrumentation Improvement Program to add and upgrade instrumentation across its system based on the assessments. It reviewed and restructured our maintenance management program. This work has enhanced

Enbridge's existing program by formalizing the inventory and management of critical leak detection equipment.

- Enbridge made changes to its Pipeline Control Systems. It has initiatives underway to improve controller decision support systems. This work includes developing tools to further support the analysis of column separation and potential leaks, and implementing expert systems to support alarm analysis. Enbridge is making ongoing improvements to its historical data storage and retrieval at most of its terminal and pump stations, resulting in the archiving of critical data at a resolution frequency of approximately one second. Enbridge is evaluating its current communication mechanisms, including its remote terminal unit ("RTU") infrastructure.

Pipeline Control (including CCO)

- Enbridge developed and implemented corporate and CCO-specific "Golden Rules" (safe operating, when in doubt – shutdown, emergency procedures).

- It has revised and enhanced all of its procedures pertaining to decision making, handling pipeline start-ups and shutdowns, leak detection system alarms, communication protocols, and suspected column separations.

- Enbridge has revised a number of documents associated with its newly revised processes and procedures including pipeline manoeuvres, start-up and shutdown documents, operating standards manoeuvres, operating standards and procedures, QMS, CCO on-call handbook and CCO fatigue risk management handbook.

- Enbridge has augmented its CCO staff, technical support, engineering and operator positions and enhanced its organizational structure to better support operators and to manage span of control and workloads.

- It has enhanced its training programs in a number of areas including hydraulics, column separation analysis, incident investigation for all managers, technical services, engineers, shift leads and training staff, introduction to Lifesaving Rules training, enhanced emergency response training, fatigue management training, enhanced mentor selection process and training and material balance system training and formalized communication protocols.

- Enbridge moved into its new CCO in Edmonton in November 2011. The new CCO also includes design features that address worker fatigue, a growing concern for companies with shift work employees. It has sit/stand consoles, improved lighting, noise reduction and facilities to address fatigue management to create an environment that meets all of the regulatory requirements related to control room management.

- Enbridge now ensures that everyone in the CCO understands that, if they are ever in doubt, they must shut the line down and leave it down until the situation is fully understood. Enbridge's clear message is that it operates its pipelines safely. And if, for any reason, Enbridge cannot operate them safety, it shuts them down and will not

restart them until it knows exactly what is going on. Enbridge will not sacrifice safety for throughput or expediency or the ability to return a line to service.

Public Awareness

- Enbridge is developing an online and in-person training tool that will enable it to give Enbridge-specific information to emergency responders in its host communities.

- Enbridge has formalized the Canadian Public Awareness Committee. The committee includes regional and corporate representatives from departments involved with its Public Awareness Program.

- Enbridge has improved and expanded its landowner database, in which it stores (and continuously updates) property and landowner/tenant information.

- Enbridge has established Community Relations positions in each region to build relationships with community members, emergency responders and local government.

- It has developed an Agricultural Screening Tool to help landowners determine if they can safely cross pipelines with farm equipment.

Emergency Response

- Enbridge expects to spend about $50 million between 2012 and 2013 to improve its equipment and capabilities, develop better tools to deal with particular waterborne spills and improve training programs.

- In 2011, Enbridge created, and began specialized training for a cross-business unit response team, to respond to large-scale events anywhere in North America that would require more resources than a single region or business unit could provide. The response team will be conducting major training exercises involving all business units, Emergency Response ("ER") contractors and consultants, and federal, state/provincial and local emergency response agencies.

- Enbridge is conducting an ER preparedness assessment to identify additional strategic equipment purchases (e.g. sorbent boom, containment boom, fire boom, skimmers. boats, bladders, etc.) to enhance capabilities to more rapidly respond and contain a significant release anywhere in the Enbridge system.

- ER personnel are being added to each region to improve ER preparedness planning and coordination.

Safety Culture

- Enbridge is reinforcing a high level of safety and operational integrity across the company by investing in six program areas: integrity management, third-party damage avoidance and detection, leak detection capability and control systems,

incident response capacity, worker and contractor occupational safety and public safety and environmental protection.

- In January 2012, Enbridge implemented the following six "Lifesaving Rules" and associated training for all Enbridge employees and contractors:
    - Hazard Management: Always ensure an analysis of potential hazards has been completed and proper authorization received prior to starting the work.
    - Driving Safety: Only drive a vehicle or operate equipment when not under the effect of alcohol or any substances that cause impairment.
    - Confined Space Entry: Always follow procedures for Confined Space Entry.
    - Ground Disturbance: Always follow procedures for locating, positively identifying and excavating buried facilities.
    - Isolation of Energized Systems: Always follow procedures for Lockout/Tag-out.
    - Reporting of Safety-Related Incidents: Always report significant safety related incidents.
- Enbridge has introduced new Safety Culture training sessions for all employees.
- Enbridge has renewed its focus on risk assessment and research and development.

D. Geotechnical Concerns

Q.70. Has Northern Gateway reviewed the material filed by the following intervenors regarding geohazards along the pipeline route?

- Haisla Nation (Ellen Rathje: *Geohazards Issues for the Enbridge Northern Gateway Project*) (A2K3E8);
- Northwest Institute (James Schwab: *Hillslope and Fluvial Processes Along the Proposed Pipeline Corridor, Burns Lake to Kitimat, West Central British Columbia*) (A2K5S0); and
- Douglas Channel (Murray Minchin: *Photographic Evidence Regarding Proposed Liquid Petroleum Pipelines from Nimbus Mountain to the Kitimat River Estuary*) (A2K7I7)?

A.70. Yes.

Q.71. What mitigation measures has Northern Gateway employed to address geohazard concerns, such as landslides raised by intervenors?

A.71. Northern Gateway has addressed landslide issues in the route selection process by avoiding identified landslides which could pose concerns for pipeline construction and design. Much of the intervenor evidence is concerned with comparing pipeline location to surface infrastructure, including roads, power lines, etc. Landslide mitigation is primarily addressed by the fact that the pipeline is buried below the landslide activity. In areas prone to landslides, the design features considered are to avoid the landslide area if possible and to focus on depth of cover of the pipeline.

Northern Gateway prepared a report entitled "Quantitative Geohazard Assessment Proposed Northern Gateway Pipelines" dated April 23, 2012 (A2T0E5 and A2T0E6). This Geohazard Assessment Report deals strictly with events causing a potential for loss of containment.

E. Geohazards Issues in the Rathje Report

Q.72. Has Northern Gateway reviewed the report by Ellen M. Rathje entitled, *Geohazards Issues for the Enbridge Northern Gateway Project* filed as part of the Haisla Nation's written evidence (A2K3E8)?

A.72. Yes.

Q.73. Ms. Rathje references four general standards and guidelines she believes should apply to Northern Gateway: *CSA Z662-07*, Clause 4; *CSA Z662-07*, Clause 11; *PRCI-L51927 Guidelines for the Seismic Design and Assessment of Natural Gas and Liquid Hydrocarbon Pipelines*; and *ISO 23469 Bases for design of structures – Seismic actions for designing geotechnical works*. Do these guidelines and standards apply to the Project?

A.73. Ms. Rathje may not be familiar with the regulatory requirements in Canada and in particular with the requirements of the OPR, 1999, which apply to the design, construction, operation and abandonment of pipelines under the National Energy Board jurisdiction. Northern Gateway, as stated in Application Volume 3, Section 1.4 Regulations, Codes and Standards. The OPR, 1999 state:

> **4.** (1) When a company designs, constructs, operates or abandons a pipeline, or contracts for the provision of those services, the company shall ensure that the pipeline is designed, constructed, operated or abandoned in accordance with the applicable provisions of:
>
> a. these Regulations;
>
> b. CSA Z276, if the pipeline transports liquefied natural gas;
>
> c. CSA Z341 for underground storage of hydrocarbons; and

d. CSA Z662, if the pipeline transports liquid or gaseous hydrocarbons.

Therefore, for the Northern Gateway Project, CSA Z662 is the governing standard.

While Ms. Rathje references the 2007 version of CSA Z662, Northern Gateway has, in Application Volume 3 and in Response to JRP IR 3.14, confirmed that the Project design will comply with the requirements of CSA Z662-11 which updates the CSA Z662-07 version. Clause 4 of CSA Z662-11 relates to the requirements for design of steel pipeline systems, but does not specifically address additional loadings including occasional extreme loads such as inertial earthquake, slope movements, fault movements, seismic-related earth movements, and others. Clause 11 of CSA Z662-07 is specific to offshore pipelines and does not apply to onshore pipelines.

PRCI-L51927 contains guidelines that, possibly along with other publications, will be considered in addressing seismic design issues, including additional screening of the pipeline route for potential liquefaction and earthquake-induced slope instability, if required, for detailed design. Given the generally low seismic potential along the pipeline route, screening level assessment of geohazards is considered sufficient for the purposes of identifying locations where more detailed seismic design may be warranted, such as the terminal site. In this area, other seismic design criteria related to tank design as outlined in API 650 and ASCE 7 will be used. ISO 23469 may provide additional guidance in establishing an acceptable pipeline design as part of detailed engineering.

Q.74. Does Northern Gateway have any comments on the following paragraphs from the introduction of Ms. Rathje's Report?

> Critical information required for seismic design is the design ground motion. The ground motion is typically specified in terms of an acceleration-response spectrum, and this ground motion is used to evaluate the direct effects of shaking on the pipeline (i.e., induced stresses and strains) and the indirect effects of shaking (i.e., the potential for shaking to induce geohazards such as liquefaction or slope failures that damage the pipeline). Often, these indirect effects are more damaging that the direct effects of shaking.
>
> Design ground motions at a site are generally specified via a probabilistic seismic hazard analysis (PSHA), which considers all potential earthquake sources in the area, the rate of occurrence of earthquakes of different sizes on these sources, and the range of ground motions possible given each earthquake size and its distance from the site. The PSHA provides a hazard curve, which plots the return periods of different levels of ground motion. The key issue for design is the return period that will be used to specify the design ground motion. While the standards and guidelines identified above provide important information regarding the seismic design of pipelines systems, they do not recommend a return period for design.

The Enbridge Application does not specify the return period of the ground motion level that will be used for seismic design. The return period for the design ground motions must be specified such that the seismic loading for the pipeline and terminal facility can be determined. Current building codes in Canada and the U.S. are based on ground motions with a return period of 2,475 years, which represents a motion with a 2% probability of exceedance in 50 years. The geotechnical report provided in Volume 3, Appendix E-1 provides some initial estimates of seismic ground motion levels across the pipeline route based on a return period of 2,475 years, but it is clear from this Appendix that Enbridge has not decided upon an appropriate return period.

A.74. Yes. Ms. Rathje indicates that a probabilistic seismic hazard analysis ("PSHA") of the pipeline route is required in order to undertake seismic design of the pipeline. The probabilistic assessment completed by Atkinson (Atkinson, G.M. 2009. *Preliminary Seismic Evaluation of Enbridge Northern Gateway Pipelines Project*) and submitted to the JRP as Attachment Haisla Nation IR 1.36j) (A2E8Z4) provides ground motion parameters at locations along the pipeline route. These values are sufficient for a screening level assessment of seismic wave propagation, liquefaction and earthquake-induced slope instability hazards along the pipeline route in conjunction with available route characterization data.

For facility design, seismic load parameters corresponding to a 2 percent probability of exceedance in 50 years will be used, consistent with the provisions of the ASCE 7 standard.

A buried pipeline subjected to the passage of seismic ground waves will incur longitudinal and bending strains as it conforms to the associated ground strains. Seismic ground motions are required for seismic wave propagation analyses; however, in most cases, this is of little importance for a welded steel pipeline constructed to current standards, because induced strains are relatively small, and welded pipelines in good condition typically do not incur damage.

Given the low seismic potential along the pipeline route, the likelihood of liquefaction is considered very low to negligible. Seismic triggering of slope instability is also considered significantly less likely than other triggering mechanisms such as prolonged intense rainfall or snow melt. Preliminary evaluations of these mechanisms for slope instability have been considered in the semi-quantitative risk assessment conducted for the pipeline route (AMEC 2012). Further evaluation of these mechanisms will be completed in detailed engineering, including potential for ground instability failures induced by seismic ground motion, corresponding to a 1000 year occurrence interval.

F. Limitations of Code Based Seismic Design Concerns in the Malhotra Report

Q.75. Has Northern Gateway reviewed Limitations of Code Based Seismic Design by Mr. Malhotra, filed by Haisla Nation as part of their written evidence (A2K3E6)?

A.75. Yes.

Q.76. Does Northern Gateway have any comments on the following paragraphs from Mr. Malhotra's Report?

> While conformance with international standards is important, it is not sufficient for projects with very high consequence of failure. This report clarifies that the code-based seismic design of tanks and pipelines does not eliminate the risk; it only reduces the risk to a certain unknown level. Codes have a life-safety objective to safeguard against major failures and loss of life, not to limit damage, maintain function, or provide for easy repair (Structural Engineers Association of California). The minimum code requirements may have to be significantly exceeded in order to reduce the risk to the environment to a 'tolerable' level.

A.76. Yes. API 650 is a consensus document that has evolved over decades, incorporating the results of research and development along the way. It is routinely used for the design of liquid hydrocarbon and chemical storage tanks worldwide. The latest 11th Edition - Addendum 3, published in August 2011, has some commentary explanations on Appendix E, "Seismic Design of Storage Tanks", and Section EC.1 provided clarification in addressing certain scientific uncertainties. Understanding there will always be some level of risk on all bulk liquid hydrocarbon and chemical storage tanks; API classifies bulk storage tanks into various Seismic Use Group ("SUG") and lists "the storage tanks in a terminal or industrial area isolated from public access that has secondary spill prevention and control" be in group SUG 1. Since the proposed tank farms will be in remote areas and have secondary spill containment and control, Northern Gateway should not be required to exceed the seismic provisions of API 650.

Q.77. Does Northern Gateway have any comments on the following paragraphs from Mr. Malhotra's Report?

> **Ground motions due to future earthquakes.** There is no upper limit on the ground shaking that can occur at a site. Higher levels of shaking are less likely than lower levels of shaking, but any level of shaking is possible at the proposed Kitimat terminal and the Kitimat valley pipeline corridor.

A.77. Yes. This statement is true with respect to the theoretical probability distribution that is not limited on the upper end. However, the probability of a high magnitude event is extremely low. From a practical point of view, the geological conditions set an upper limit on the maximum magnitude event that can be generated. The design seismic parameters for Northern Gateway will be established consistent with best international practice and national codes.

Q.78. Does Northern Gateway have any comments on the following paragraphs from Mr. Malhotra's Report?

> **Design ground motions in loading standards.** The design accelerations in loading standards such as ASCE 7 [2] can be exceeded during future earthquakes. The probability of exceeding design accelerations at the Kitimat terminal is about 2% during the 30-year life of the project. The probability of exceeding design accelerations anywhere along the Kitimat valley pipeline corridor can be as high as 20% in 30 years. The site-specific hazard analysis conducted by Enbridge [4] is not suitable for generating the design accelerations for pipelines.

A.78. Yes. As with the previous statement, this is theoretically true to the extent that the probability distribution is not limited on the top end. Design accelerations for the Kitimat Terminal have been established by the Atkinson (2009) PSHA for 2% probability of exceedance in 50 yrs. For pipelines, it is true that, ideally, the PSHA would have provided seismic ground motion parameters as intervals of about 10 to 20-km, rather than limited to the eight sites considered. However, the Kitimat Terminal site is covered by the first, most westward point, and seismicity decreases significantly heading east. The PSHA is suitable for the front-end engineering design ("FEED") or pre-FEED stage. It may need to be extended for detailed design.

Seismic ground motions are required for seismic wave propagation analyses and will be developed and used in detailed design. However, this is of little importance for a welded steel pipeline constructed to current standards. Seismic accelerations can trigger landslides, so extension of the PSHA would be prudent, albeit ground motions are expected to be low along most of the route. Similarly, ground motions are needed for liquefaction assessment; however, liquefaction is not an issue for proximate M6 events and less, which applies to much of the route.

Q.79. Does Northern Gateway have any comments on the following paragraphs from Mr. Malhotra's Report?

> **Code-based design of tanks.** Tank standards such as API 650 [3] reduce the design accelerations obtained from ASCE 7 [2] by as much as 75%. The tank shell, base anchors, and foundation are designed for the reduced accelerations. Tanks designed to meet the minimum code requirements are expected to be damaged by the design accelerations obtained from ASCE 7 [2], but the damage is not computed by the code procedures. The probability of a leak in a code-designed tank can be significantly greater than 2% in 30 years. Enbridge has not attempted to estimate the probability of a leak in tanks proposed for the Kitimat terminal.

A.79. Yes. Design in accordance with API 650 will be consistent with best international practice. Seismic loading per API 650 incorporates a force reduction factor, R_{wi}, and a force reduction coefficient, R_{wc}, for the impulsive (inertial weight) and convective (sloshing) components of seismic load. These factors are taken as 3.5 (self-anchored

tanks) and 2, respectively, and are used to reduce the seismic loads to account for the absorption of energy through limited inelastic behaviour and the nonlinear action of the contained fluid. This approach facilitates analysis and design for equivalent elastic, linear conditions, but with the understanding that the tank shell could be plastically deformed at high stress locations. The absorption of energy through inelastic behaviour is a fundamental principle of seismic design. The design will be in accordance with API 650; there is no requirement or need to estimate the probability of a leak.

Q.80. Does Northern Gateway have any comments on the following paragraphs from Mr. Malhotra's Report?

> **Risk-based design of tanks.** The risk to a tank can be defined by the probability of a leak. The risk to a code-designed tank can be calculated by using an advanced analysis which computes the damage to a tank for different levels of ground shaking that are possible at the Kitimat terminal. The tank shells, base anchors, and foundations can be built stronger to minimize the risk to less than a 1% chance of a leak throughout the life of the project. Enbridge should perform a risk-based design of tanks in addition to meeting the minimum code requirements.

A.80. Yes. The linear analysis methods of API 650 would identify high stress locations that could be candidates for selective reinforcement. This must be done carefully and in balance with neighbouring plate. For example, strengthening the lower course of wall plate might simply shift failure to the bottom plate.

It is expected that the tanks will be self-anchored, as a compliant base should be more suitable for large tanks.

Q.81. Does Northern Gateway have any comments on the following paragraphs from Mr. Malhotra's Report?

> **Risk-based design of pipelines.** The risk to a pipeline needs to be computed differently than the risk to a tank because pipelines can be damaged by earthquakes anywhere along their length. The probability of a leak anywhere along a pipeline can be 10 times greater than the probability of a leak at a single location. Therefore, the design criterion for pipelines should be significantly higher than the design criterion for tanks. The risk should be reduced to less than a 1% chance of a leak anywhere along the pipelines during their expected life. Enbridge should perform a risk-based design of pipelines in addition to meeting the minimum code requirements.

A.81. Yes. Seismic design threats to pipelines generally result from ground movement hazards such as landslides, which are dominant causes of failure in mountainous areas. Seismic wave propagation is essentially no threat to the pipeline. The proposed risk assessment would be of very limited value.

Q.82. Does Northern Gateway have any comments on the following paragraphs from Mr. Malhotra's Report?

> In this study [Atkinson report], a fault is considered active if it has produced at least one earthquake in the past 10,000 years. If the last earthquake on the fault occurred 15,000 years ago, the fault is considered 'inactive'.

A.82. Yes. The Atkinson report does not actually say this. The 10,000 year time period that Mr. Malhotra references is the approximate age of post-glacial sediments in Canada (earlier sediments have been "scraped away" by the glaciers).

The widely accepted definition of an active fault for the purpose of pipeline design is a fault with geologic or geomorphic (or both) evidence of displacement or deformation during the Holocene epoch (approximately the last 11,000 years), or a fault associated with significant historical seismicity. Fault identification with reference to Holocene activity is in recognition that the typical (or range of) recurrence intervals for large, ground-rupturing earthquakes on an individual fault may be thousands of years and that the instrumental or well recorded "felt" historical seismicity record (or both) is typically only a few hundred years or less in most areas of the world, including British Columbia. Thus a fault that produced offsets in post-glacial sediments (10,000 years in age) would be considered active.

Q.83. Does Northern Gateway have any comments on the following paragraphs from Mr. Malhotra's Report?

> For example, an earthquake of magnitude up to M 7.5 could occur in Kitimat, according to Atkinson [4], producing very high accelerations at the site of tanks.

And

> Future earthquakes of magnitude up to M 7.5 can occur anywhere along the length of the proposed pipelines.

And

> According to the seismic hazard study by Atkinson [4], an earthquake of magnitude up to M 7.5 can occur anywhere in the Kitimat region where the tanks and pipelines are located. If a large earthquake occurs close to the project, the costs from the environmental cleanup alone can run into billions of dollar.

And

> Figure 2.

A.83. Yes. The statements in the Atkinson report regarding the possibility of occurrence of large-magnitude earthquakes require the probabilistic context to be correctly interpreted. The maximum magnitude used for the area in the seismic hazard analysis was M=7.5, as noted by Mr. Malhotra. This is the largest event considered possible in the study region; it is a standard value that applies to all of western North America, with the exception of active plate boundary faults (e.g. such as the San Andreas fault) that may produce even larger events. The occurrence of an event of M7.5 near the pipeline route, while considered possible, is very unlikely.

Mr. Malhotra raises the specific scenario of an event of M7.5 occurring within 50 km of the pipeline, and states that the probability of this scenario is significant. We can calculate the probability of this scenario based on the magnitude recurrence parameters for the source zones along the pipeline route, as provided in the Atkinson report. This is an appropriate way to address the question of "aggregate hazard" due to the extended length of the pipeline that is raised by Mr. Malhotra, and to gain insight into the frequency of occurrence of large events that might impact the pipeline (i.e. within a probabilistic context). The rates of occurrence of M7.5 events along each of the source zone segments of the pipeline within the source zones NAB, ROC, NBC, CST, for an area within 50 km of the pipeline, on a per annum basis, are 9.2E-5, 2.4E-5, 9.6E-6 and 7.2E-5, respectively (this follows from the magnitude recurrence information provided in the Atkinson report). This gives a total (summed) aggregate occurrence rate for M7.5 events, anywhere within 50 km of the pipeline, of approximately 0.0002 per annum, or a return period of 5000 years for such a scenario. Thus the likelihood of a M7.5 event occurring within 50 km of the pipeline route is very small (1 in 5000 per year).

The probability of such an event occurring within 25 km of the pipeline is half of the rate for a 50 km distance, or 0.0001 per annum (a return period of ~10,000 years). In his Figure 2, Mr. Malhotra shows the probability distribution of peak ground acceleration ("PGA") that could occur for an event of M7.5 at a distance of 25 km, which indicates that the median PGA at the pipeline for such a scenario would be approximately 0.13g. This amplitude has a mean return period of 2500 years, as stated in the Atkinson report, and noted by Mr. Malhotra on p.7. However, it is important to note that the Atkinson analysis is more comprehensive than the scenario presented by Mr. Malhotra, in that it considers not just the occurrence of an event of M7.5 within 25 km of the pipeline, but the probabilities of occurrence of all possible earthquake magnitudes, at all possible distances, to derive the total probabilities of ground motion exceedance. That is why the return period for PGA=0.13g is 2500 years, while the return period for the scenario event of M7.5 within 25 km that is raised by Malhotra (one of the possible scenarios that could cause PGA=0.13g) is much longer, about 10,000 years as noted above. It is precisely because we consider all possible events at all possible distances that the amplitude of the expected ground motion continues to grow as the probability is lowered. This is true globally for all potential projects, at all potential sites, and Kitimat is no exception. That is why ground motions are treated probabilistically, thereby allowing engineers to use a ground-motion level that has an acceptably low probability of exceedance (as specified by regulatory guidance) to achieve a design with sufficient seismic resistance to accommodate a wide range of potential scenarios.

A tank spilling oil into a containment area is not likely to cost billions of dollars. For tanks, secondary containment is important if a tank leak were to occur. Mr. Malhotra may not be aware of the secondary containment designed for tanks. It is not mentioned in his report.

To mitigate potential tank spills, Northern Gateway has already conceptually incorporated a secondary spill containment system for the proposed tank farm as per the criteria in the latest NFPA 30, Canadian Council of Ministers of the Environment ("CCME") guidelines and the local environmental regulatory agencies. The secondary spill containment system will be sized per current regulatory requirements and will have a synthetic liner with a maximum permeability coefficient of $1x10^{-6}$ cm/sec and a leak detection system.

Q.84. Does Northern Gateway have any comments on the following paragraphs from Mr. Malhotra's Report?

> The aggregate seismic hazard analysis should provide the MRPs of exceeding different levels of ground acceleration anywhere along the length of pipelines.

And

> The site-specific hazard analysis performed by Atkinson [4] is not sufficient for distributed structures such as pipelines because pipelines can be damaged by ground motions anywhere along their length. The mean return period (MRP) of exceeding a specific value of ground acceleration anywhere along the pipelines can be much shorter, as little as one-tenth the MRP of exceeding the same value of ground acceleration at any specific site. Enbridge should perform the aggregate seismic hazard analysis of the region to establish the MRPs of exceeding different levels of ground shaking anywhere along the length of the proposed pipelines.

A.84. Yes. The PSHA could be extended to provide seismic acceleration parameters at equally spaced locations along the route – perhaps 10 to 20 km, depending on seismic intensity and variation. This could be useful for evaluation of seismically induced landslide hazard evaluation, but probably little else due to the relatively low seismic hazard.

Q.85. Does Northern Gateway have any comments on the following paragraph from the Mr. Malhotra's Report?

> ASCE 7 [2] seismic design loads are derived from the 2475-year mean return period (MRP) ground motions, also known as the maximum considered earthquake (MCE) ground motions. According to Equation 2, the MCE ground motions have 1.2% chance of being exceeded in 30 years. But, the structures are not really designed for the MCE ground motions; they are only designed for two-thirds of the MCE ground motions. According to the hazard curve shown in Figure 3, the MCE ground acceleration in Kitimat is 0.13 g. Two-thirds of the MCE ground

acceleration is 0.08 g. According to Figure 4, the MRP of 0.08 g acceleration is only 1400 years. Therefore, the mean return period (MRP) of design acceleration for proposed tanks in Kitimat terminal would be 1400 years (Figure 4) if the design is based on ASCE 7 [2].

A.85. Yes. It is true that ASCE seismic design loads are derived from the 2475-year MRP event. The purpose of the 2475-year event was to provide uniform treatment of the seismic hazard among regions where large events have relative short cycles (California) versus other regions that can experience large events less frequently (Central U.S.). The two-thirds factor then reduces the recurrence to about 1000 to 1500 years. It is misleading to say that the design would be for "only two-thirds" of the MCE, because this was the intent of ASCE 7 all along. API 650 follows the same approach.

Q.86. Does Northern Gateway have any comments on the following paragraphs from Mr. Malhotra's Report?

It is worth noting that structures with high consequence of failure are designed for much longer MRP ground motions than those in ASCE 7 [2]. Dams are designed for 10,000-year MRP ground motions [7], and nuclear power plants are designed for 100,000-year MRP ground motions [8]. The Yucca Mountain nuclear waste repository in Nevada was being designed for 1,000,000-year MRP ground motions

And

Structures with very high consequence of failure such as dams and nuclear power plants are designed for much longer MRP ground motions than those in ASCE 7 [2] (Table 1). Considering that the damage to pipelines can have significant adverse effect on the environment, the design ground motions for pipelines should be significantly higher than those based on ASCE 7 [2].

A.86. Yes. This project is to build a pipeline system, not a dam, a nuclear power plant, or a nuclear waste repository. The consequences of damage due to seismic hazards are altogether different.

Q.87. Does Northern Gateway have any comments on the following paragraph from Mr. Malhotra's Report?

If the tanks in Kitimat terminal are designed according to ASCE 7 [2] as proposed by Enbridge, there is 2% chance that the design acceleration will be exceeded during the 30-year life of tanks. If the pipelines are designed according to ASCE 7 [2], there could be 10 time greater chance of exceeding the design accelerations anywhere along the pipelines in 30 years. If the design loads for tanks and pipelines are based on ASCE 7 [2], the pipelines will be at much greater risk than tanks, because design loads for pipelines could have 20% chance of being exceeded in 30 years.

A.87. Yes. Northern Gateway believes this statement does not provide any value. Kitimat is one site and the pipeline extends 1177 km. This is similar to saying the chance of a design earthquake anywhere in California is 10 times higher than in Los Angeles alone.

Q.88. Does Northern Gateway have any comments on the following paragraphs from Mr. Malhotra's Report?

> It is assumed that the damage will not be life-threatening to humans, but it could cause a leak in the tanks and therefore result in a significant harm to the environment (due to the size and number of tanks that will be simultaneously affected by an earthquake).
>
> The perception of seismic risk reduces dramatically after code-based reduction factors (2/3rd factor is ASCE 7 [2] and load reduction factor of R = 4 in API 650 [3]) are applied to the ground motions obtained from the seismic hazard analysis [4]. Therefore, code-based seismic design does not eliminate the risk from future earthquakes, but it reduces the perception of the risk. The damages shown in Figures 5-8 are possible in code-designed tanks, but the probabilities of such damages are not revealed by the code-based design procedures.

A.88. Yes. Although an earthquake is a common-cause event affecting all tanks simultaneously, the tanks will be designed not to fail, although plastic deformation could occur. Should a single tank fail, it is not a given that all tanks would fail. Most tanks would not be full, in which case, actual seismic loads would be less than design. Mr. Malhotra implies that the design accelerations should be 2500-yr recurrence, when the intent of the code is to derive the design accelerations from 2500-yr recurrences.

To minimize potential spills from any of the proposed storage tanks, Northern Gateway will design piping systems attached to storage tanks to have sufficient mechanical flexibility to accommodate tank wall and foundation displacements without damage causing release of liquid hydrocarbons. Proper attention to piping system flexibility would minimize leak potentials resulted from seismic events such as shown in Figure 6a and Figure 6b in Mr. Malhotra's report.

Q.89. Does Northern Gateway have any comments on the following figure from Mr. Malhotra's Report?

> Figure 8. Fire caused by damage to roofs in tanks during the 1999 Izmit, Turkey Earthquake.

A.89. Yes. This photo might have been taken at a much later time (more than seven hours from the initial tank fire) involving both naptha and crude oil tanks. The photo revealed two separate fires, separated by several storage tanks. According to the subsequent fire investigations, the initial fire started in four adjoining naptha tanks and was later extinguished and controlled by the fire crew in approximately 7 hours. The subsequent fire (approximately 11 hours after the initial fire) was caused by a spill of naptha from a

damaged flange in one of the original naptha tanks, which then caused the fire in the neighbouring crude oil and naptha tanks. [1]

The proposed Northern Gateway tank farms will consist of three condensate tanks and 11 oil tanks. Since the chemical characteristics of condensate are quite similar to naptha, it will have similar flammability potentials. To mitigate potential fires in any of the bulk liquid storage tanks, Northern Gateway will install a foam/water fire protection system for all bulk liquid hydrocarbon storage tanks. Design of the foam/water fire protection system will be per NFPA 30 (Flammable and Combustible Liquids Code) and NFPA 11 (Standard for Low-, Medium-, and High-Expansion Foam). The fire protection system will consist of fixed foam chambers around the top perimeter of all storage tanks, foam generation/proportioning system, foam concentrate storage tank, a network of firewater supply piping system and hydrants strategically located around the tank farm, and a fire water reservoir complete with electrical fire water and diesel back-up pumping systems.

Q.90. Does Northern Gateway have any comments on the following paragraph from Mr. Malhotra's Report?

> Seismic design according to API 650 [3] does not eliminate the risk from future earthquakes; it only reduces the risk to a certain unknown level. Code-designed tanks can leak or even suffer catastrophic failures during future earthquakes.

A.90. Yes. There is no reason to conclude that an API 650 code-based design is not fit-for-purpose. The intent of design specifications is to provide a uniform and fully vetted design approach for practitioners. API 650 is used as a basis by the world's leading tank designers/fabricators. It incorporates the essential elements of tank seismic design in a procedure that is readily usable.

Q.91. Does Northern Gateway have any comments on the following paragraph from Mr. Malhotra's Report?

> Code-based design lacks transparency. It does not reveal the probability of a leak or the probability of a catastrophic failure in the tank due to future earthquakes. Without knowing the risk, it is difficult to say whether the risk is 'tolerable' or it should be further reduced.

A.91. Yes. The perceived lack of transparency that is stated is inherent to all building codes and industry standards. They are based on design for load conditions with a stipulated probability of exceedance, either specified by the code or developed via site-specific assessment. During preliminary engineering, Northern Gateway completed a considerable amount of work focused on identifying, evaluating and preparing

[1] S. Girgin, The natech events during the 17 August 1999 Kocaeli earthquake: aftermath and lesson learned – Natural Hazards and Earth System Science http://www.nat-hazards-earth-syst-sci.net/11/1129/2011/nhess-11-1129-2011.pdf

engineering solutions using a risk-based approach for the Project. This included geotechnical engineering and field work, for the pipelines, facilities and tunnels, as described in the Application, Volume 3, Section 3 and in Joint Review Panel Session Results and Decision, Section C.2.4. Further work on the Kitimat Terminal engineering is described in the Application, Volume 3, Section 9 and in Joint Review Panel Session Results and Decision Section C.6.2. A semi quantitative risk assessment on the Northern Gateway pipeline was submitted to the JRP as part of the response to JRP IR 8.1.

Northern Gateway will design, construct and operate the Project consistent with, or exceeding the NEB Regulations, CSA Z662 and the Enbridge Engineering Standards. A risk-based approach is imbedded in Enbridge's Engineering Standards. Accordingly, Northern Gateway's use of a risk-based approach for designing the Project occurs throughout the application and use of the Enbridge Engineering Standards, which in turn incorporate Canadian regulatory and industry standards. The Enbridge Engineering Standards have been developed over Enbridge's operating history using risk-based approaches, which are supplemented with CSA and general pipeline industry experience.

Northern Gateway's operations will use a risk-based approach for integrity management, which includes risk identification and assessment of project operations. This risk-based integrity management system will use documented policies, procedures and practices to confirm operational reliability of the system components, including pipelines, pump stations, tank terminal and marine terminal piping and tanks. Integrity management programs will confirm compliance with internal procedures, practices and standards as well as with regulations.

As described in the response to the Haisla Nation Information Request 2.1f, all seismic design requirements, including those that may exceed the minimum code requirements, will be finalized during detailed engineering. The design requirements will include the use of "importance" factors in the design of critical equipment and systems to ensure their functionality during and after a potential upset event. Part of the design process will include assessments on the criticality of various facility components and the inclusion of design considerations to ensure their on-going reliability. Seismic hazard considerations will form part of standard facility design and operability reviews (Hazard and Operability Analysis ("HAZOP") and Hazard Identification ("HAZID") evaluations).

Q.92. Does Northern Gateway have any comments on the following paragraph from Mr. Malhotra's Report?

> Enbridge should go beyond the minimum code requirements to bring transparency into the design of tanks. Enbridge should adopt a design procedure that will explicitly calculate the probabilities of leak and catastrophic failure in the tanks.

A.92. Yes. Considering the universal acceptance of API 650 as the recognized international tank design standard, there is no reason to develop an alternative tank design procedure. Such an assessment would not only involve sophisticated analysis, but also weld quality, weld alignment, flaws, etc. This type of endeavour is better suited for a research

organization or the API 650 technical committee, should the concept have merit. Furthermore, for the low seismic hazard at Kitimat, seismic loading may not even control design of the tanks.

Q.93. Does Northern Gateway have any comments on the following paragraph from Mr. Malhotra's Report?

> Risk-based design does not make use of arbitrary reduction factors found in codes (i.e., 2/3rd factor in ASCE 7 [2] and R factor in API 650 [3]). Nonlinear responses such as base sliding, base uplifting, and plastic yielding in tank are explicitly computed in a risk-based seismic design. The design criterion for the tank is selected such that the risk is below the 'tolerable' level.

A.93. Yes. A risk-based design of the type described would require an extensive nonlinear analysis task – essentially a research project. It is not needed or warranted, nor will it add value for the low level of seismic threat. The ASCE 7 two-thirds factor is not arbitrary.

Q.94. Does Northern Gateway have any comments on the following paragraphs from Mr. Malhotra's Report?

> 1. The risk to a tank can be defined by the probability of a leak.
>
> 2. The risk to a code-designed tank can be calculated by using an advanced analysis.
>
> 3. The risk cannot be eliminated but it can be reduced to less than a 1% chance of a leak throughout the expected life of the project by selecting the appropriate design criterion.
>
> 4. Enbridge should perform a risk-based design of tanks. It should clearly state the risk being targeted by the project design team and show that the risk is below the 'tolerable' level.

A.94. Yes. Risk can be calculated; however the reduction of risk to 1% is not meaningful, if the accuracy could be off by an order of magnitude. There is no reason for Northern Gateway to embark on a risk analysis. API 650 code procedures and other environmental regulatory guidelines and fire protection requirements are adequate for the purpose.

G. Geotechnical Review of Douglas Channel Watch Photographic Material

Q.95. Have you reviewed the photographic material filed by Douglas Channel Watch in their written material and Murray Minchin's oral material from January 11, 2012 regarding the report?

A.95. Yes.

Q.96. Has Northern Gateway reviewed the material filed by the Council of Haida Nation and Dave Shannon that refers the photographic evidence by Douglas Channel Watch:

A.96. Yes.

Q.97. Does Northern Gateway have a reply to this material?

A.97. Yes. Northern Gateway has prepared a report entitled *Geotechnical Response to Photographic Evidence Regarding Proposed Liquid Petroleum Pipelines from Nimbus Mountain to the Kitimat River Estuary Submitted by Murray Minchin of Douglas Channel Watch*. A copy of this report is included as **Attachment 5**.

H. Geotechnical Review of Schwab 2011 Report

Q.98. Has Northern Gateway reviewed the report entitled *Hillslope and Fluvial Processes Along the Proposed Pipeline Corridor, Burns Lake to Kitimat, West Central British Columbia* filed as the written evidence of James W. Schwab P.Geo., Eng (the "Schwab Report")[2] by the Northwest Institute for Bioregional Research?

A.98. Yes.

Q.99. Has Northern Gateway reviewed the material filed by the following intervenors that refer to the Schwab Report:

- Brown, Cheryl;
- Council of the Haida Nation;
- Doug Donaldson;
- Northwest Institute;
- Haisla Nation;
- The Friends of Morice-Bulkley;
- Douglas Channel Watch;
- ForestEthics;
- Raincoast Conservation Foundation;
- Gary Coons; and
- Office of the Wet'suwet'en?

[2] A2K5S0.

A.99. Yes.

Q.100. Does Northern Gateway have a reply to the following sentences and paragraph from the introduction of the Schwab Report?

> **The northwest trending rugged topography poses serious challenges for linear development. Only certain valleys and passes are suitable for east–west oriented infrastructure.** Together with steep, unstable rock masses and weak soils, the terrain in west central B.C. places constraints on development.
>
> The intent of the paper is to help formulate discussion, encourage more in-depth study, direct more detailed on-the-ground investigation, and stimulate investigation into possible safer alternative routes to the unstable terrain found in west central B.C. This paper is by no means a complete discussion of bedrock geology and surficial geology in the region nor does it answer geotechnical engineering concerns at specific site locations. There also is no attempt to discuss environmental consequences and risk, although the environmental consequences of an oil pipeline break do differ considerably from a break sustained by a natural gas pipeline.

A.100. Yes. This section introduces the reader to the complex nature of the geological conditions in the region and past work with respect to the perceived challenges faced by the Project routing. Bolding the statement presented by past research (carried out by one of the peer reviewers of this paper) suggests this is a key theme of the paper. There is no disagreement that only certain valleys or routes are suitable; however, a suitable route has been chosen by Northern Gateway and the unstated implication that the route chosen is not suitable is not correct.

The second statement appears to ignore the fact that Northern Gateway has already filed information related to alternative means to construct the Project as required by the process, the results of investigations including direct on-the-ground and extensive aerial and other investigations, and has committed to extensive additional site-specific studies at the detailed engineering stage of the Project.

The overview level of work in the paper did not include geotechnical work at site specific locations. Location specific geotechnical assessments, consistent with the information filed by Northern Gateway, provide the baseline information required to provide any judgements on the viability of a route through the region. A complete discussion of the geological conditions is required by the JRP process to allow a proper objective assessment to be made, and is available in the Project documents filed with the JRP. The work of this paper, as stated by the author, is not complete from a geological perspective and thus cannot be used as a baseline for assessing the viability of the route.

Q.101. Does Northern Gateway have a reply to the following paragraph from section 2 of the Schwab Report regarding hillslope and fluvial processes?

> Landslides and erosion are commonplace in the mountainous terrain of west central B.C. (Geertsema et al. 2006a). The landslides include shallow debris slides and flows, massive rapid moving rock slides, slow moving earth flows and rapid moving flow slides (refer to Cruden and Varnes 1996; Hungr 2005; and Geertsema et al. 2010 for landslide terminology and descriptions). Climate, topography, bedrock geology and surficial geology influence the type, frequency and occurrence of various hillslope processes within a physiographic unit. Hence, hillslope processes between Burns Lake and Kitimat are discussed within the context of recognized physiographic units within a described location, for example, Nechako Plateau—Burns Lake to the Morice River.

A.101. Yes. Landslides and erosion are not uncommon and have been identified in all the physiographic regions crossed by the corridor. The presence of geohazards, such as landslides and erosion, among others, and the relative location of the proposed corridor has been the subject of significant geotechnical study to date.

The following references describe the general geotechnical conditions throughout the Project corridor, including the areas within the scope of this paper. In addition the references provide a listing of all the geohazards reviewed, and include mitigation strategies for each. Further work on geohazards is covered under separate filings.

> Volume 3 - Engineering, Construction, and Operations – Section 3 Geotechnical Conditions

> Volume 3 - Engineering, Construction, and Operations, Appendix E-1 - Overall Geotechnical Report on the Pipeline Route Rev. R for the Enbridge Northern Gateway Project Bruderheim AB to Kitimat, BC., including Section 2 – Setting, Section 3 – Geotechnical Considerations, Section 4 – Terrain Hazards and Risk Analysis and associated tables and figures including Summary Table B-1

> Geohazard Assessment Report, Attachment 4 to Semi-Quantitative Risk Assessment filed as Northern Gateway's Response to JRP IR 8.1b) (A2T0E5 and A2T0E6).

Q.102. Does Northern Gateway have a reply to the following sentences from section 2.1.1 of the Schwab Report regarding Burns Lake to the Morice River?

> A natural erosional event in the early 1980s transported in the order of 250 000 m^3 of sand and gravel from a glacial fluvial terrace into and down Tchesinkut Creek (Figure 2).

> Landslides have occurred along the northwest-southeast trending ridges that extend from Houston toward Francois Lake and presently active

landslide movement is occurring along the ridge above Parrott Creek. The landslides at Buck Creek and Dungate Creek (Figure 3) are located about 25 km north of the pipeline corridor. These landslides occurred catastrophically prior to settlement in the Bulkley Valley at Houston. These events, although situated north of the pipeline corridor, demonstrate the instability of the volcanic bedrock.

Bedrock spread, a form of landslide movement, is active along the ridge above Parrot Creek within the general corridor for the pipelines (Figure 4). Geertsema et al. (2009) mentions these landslides but they remain unstudied.

A.102. Yes. The Tchesinkut Creek event is located 10 km south of the route and is regionally representative of the potential for failures of steep sedimented slopes and debris flows in confined channels. While we are not aware of the details of the failure, it may have been a groundwater piping failure. No evidence of similar debris flow events has been found in areas that would directly affect the route corridor.

It is unclear what is intended from the statement that suggests the slides stated to be 25 km north of the route "demonstrate the instability of the bedrock". While bedrock underlies the entire area, it would not be appropriate to suggest that it is all unstable. Based on measurements, the Buck Creek and Dungate Creek slides are between 11.5 and 15.5 km north of the route, not 25 km as reported.

The Buck, Dungate and Parrott Creek slides noted by the author were in areas of steep near surface rock outcroppings and at high elevation ridges in the region. While the route is located through this general region, it avoids areas of such high relief. The failures noted are in the high bedrock ridges that bracket the overall rolling east-west valley system through this segment. The pipeline crosses through the lowlands between the adjacent higher elevation bedrock controlled ridges. The Parrott slides are about 14 km south of the Project corridor.

As noted above, the Northern Gateway route is between 11.5 and 15.5 km south of the Dungate and Buck slides, and 14 km north of the Parrott slides. Note that if the route was hypothetically plotted 25 km south of the Dungate/Buck slides, as the author noted in the paper, this hypothetical route would be very near to the Parrott slides, not 14 km to the north as it actually is. The mapping shown on Figure 1 on this paper is at a very large scale; perhaps the concern the author has regarding the proximity to the Parrott slides is a result of a mapping error.

In any case, the pipeline route has been chosen to avoid deep-seated slides wherever possible and the particular slides have been noted and avoided. Ongoing work is being done to check that no undetected deep-seated slides are present.

Q.103. Does Northern Gateway have a reply to the following paragraph from section 2.1.2 of the Schwab Report regarding Morice River?

> South of Houston along the Morice Forest Service Road (FSR), large slump earth flows were reactivated during a road up-grade in the mid 1970s and a massive wildfire in 1983; the largest is 1.5 km wide. The Forest Service in Smithers has detailed terrain maps of all the historic and active landslides between kilometre 6 and 27 on the Morice FSR (junction of the Morice FSR, Morice West FSR and Morice Owen FSR). Attempts to stabilize the road (Figure 7) have cost millions of dollars with the most recent stabilization work undertaken in February 2011 (per comm. B.C. Forest Service Engineering). The Morice West FSR also required stabilization at kilometre 33, with road realignment in 2004 and a rock buttress subsequently added to stabilize the road in 2008.

A.103. Yes. The construction difficulties with the Morice Forest Service Road are well known by the Project team and were identified by the Project early on, precipitating a re-route of an early alignment that crossed the Morice River downstream of the Owen Creek confluence to avoid the earthflow in the proximity of the previous crossing and approach route. This re-route also avoided terrain adjacent to the Houston-Tommy Creek area that is about 10 km north of the present route.

Note that Northern Gateway work has also identified glaciolacustrine sediments in the Owen Creek and potentially Lamprey Creek area. The presence of shallow sliding and channel level bedrock outcrops was observed in Project reconnaissance at Lamprey Creek. As this area is studied further, some route adjustments may be made in the area. The route will also be revised west of Owen Creek to avoid a deep-seated slide in this area.

Q.104. Does Northern Gateway have a reply to the following paragraphs from section 2.2 of the Schwab Report regarding the Hazelton Mountains?

> [Section 2.2.1 Gosnell Creek] Erosion on these fans has posed considerable road maintenance challenges over the past 15 years. Two large alluvial-colluvial fans situated in the pass between the Gosnell and Clore watersheds are presently undisturbed. Maintenance for a pipeline across these fans in the Gosnell watershed will be challenging due to shifting channels and erosion. Crystal Creek and upper Gosnell Creek flow north out of the Morice Range. These streams carry large quantities of sediment and show considerable lateral bank instability at the proposed pipeline crossing locations; thus, these locations may also prove challenging for construction and maintenance.

> [Section 2.2.2 Upper Clore] The proposed pipeline corridor dissects the active floodplain located immediately upstream from the Clore Canyon. These glaciofluvial and glaciolacustrine sediments within the Clore basin

have not undergone anthropogenic disturbances; hence, the effect of proposed development is unknown.

[Section 2.2.3 Sackungen] The reddish coloured well-bedded pyroclastic and flow rocks are of particular interest—large landslides have occurred in this volcanic bedrock within the Hazelton Mountains in recent years and have directly impacted the natural gas pipeline, roads and highways (Geertsema et al. 2009). … Detailed geotechnical investigation is required to determine the stability of the bedrock and hillslope wherever these volcanic rocks and sackungen occur in areas proposed for development. Avoidance of these unstable volcanic rocks is generally the preferred engineering option.

A.104. Yes. In his discussion of alluvial fans and debris flows, the author references the occurrence and resulting effects on the terrain without discussing how the pipeline design considers such events. The fact that the author suggests that maintenance will be a challenge through these areas indicates a lack of understanding of pipeline design and the mitigation measures available. The ground conditions are described in Northern Gateway filed documents and are consistent with the findings of outlined in the Schwab report. The geohazards are further characterized by Northern Gateway in additional filed documents, which also include the general nature of the geotechnical considerations and mitigation solutions. Schwab provides only a general identification of the geohazards.

The comments related to the upper Clore Canyon are inconsistent with other themes in the paper, namely, that regional occurrences of events should be used to predict the response along the Project corridor. In this case, the author suggests that since construction has not occurred in the area, the potential response of glaciofluvial and glaciolacustrine sediments is unknown. The range of response of such materials is well understood through standard geotechnical engineering practice, and the response can be reasonably predicted. Site specific work, including ground reconnaissance and bedrock mapping, has been carried out along this proposed route segment and is appropriate for the purposes of assessing the route.

The author references large rockslides and unstable bedrock in the Hazelton Mountains, a need to carry out detailed investigations to examine the stability of the rock, and indicates that avoidance is the preferred option. Two of the large rock slides referenced are in the Zymoetz (Copper) River-Limonite Creek corridor followed by the Pacific Northern Gas ("PNG") Pipeline and these slides, and other unstable areas, were principal reasons for not following the existing PNG alignment.

Sackung on the east end of North Hope Peak is not consistent with our findings. This area has been checked as a result of the references in the Schwab report and the feature appears to be a bedrock joint (very long continuous rock joints are present in this area). Sackung and other slides do occur along both sides of the Clore canyon at various locations and are avoided by the routing including the tunnels.

Areas of unstable bedrock are avoided by the Clore and Hoult Tunnels which demonstrate how issues were identified and addressed, detailed studies were carried out and designs were developed to address the issues. The author fails to note that designs and routing to mitigate the very concerns he raises are proposed by Northern Gateway.

Q.105. Does Northern Gateway have a reply to the following paragraphs from section 2.3 of the Schwab Report regarding the Kitimat Range?

> [Section 2.3.1 Hoult Creek] The steep gully channels and fans show evidence of frequent debris flows and snow avalanches—these hillslope processes pose ongoing concerns for pipeline development.
>
> [Section 2.3.2 Upper Kitimat River Valley] Lateral movement [of the river] over time is from valley wall to valley wall through the middle reaches of the upper Kitimat River. Catastrophic movement of the channel has eroded the Kitimat Mainline forest access road on a regular basis. A pipeline could suffer the same fate.
>
> Control works constructed above the Hunter Creek Bridge attempt to stabilize stream movement and protect the bridge. However, the current channel is unstable and changes will recur with an influx of a large amount of sediment to the fan apex.
>
> Fluvial-colluvial fans are situated at the base of most gully-stream channels that extend from the alpine to the valley flat along the north side of the upper Kitimat Valley. The channels and fans show varying levels of debris flow activity (B.C. Ministry of Forests 2001; Bovis and Jakob 1982; Wilford et al. 2005c), with many experiencing torrents during extreme events in the fall of 1978 and 1992. Debris flows have also occurred down some channels all the way to the Kitimat River. These debris flows tend to occur episodically during strong summer convective storms and fall frontal rainstorms (Jakob et al. 2006) but in many respects are "normal" occurrences for many debris flow channels (Wilford et al. 2009). Hence, they pose considerable problems for developed infrastructure such as pipelines and roads.
>
> The pipeline corridor, as proposed, crosses Chist Creek about 3 km upstream from the Kitimat River confluence, downstream from the Chist Creek bridge crossing. The corridor then climbs the glaciofluvial terrace onto the Onion Lake flats. Glaciomarine sediments are visible beneath the glaciofluvial sediments and are exposed at about 180 masl, downstream from the bridge crossing.

A.105. Yes. The author's comments throughout this segment of the report are concerned with lateral erosion, debris flows and avalanches that could affect the proposed pipelines. While he presents generalized identifications of geohazards, he does not present how the specific geohazards may influence the pipelines, other than to suggest that the geohazards he has identified pose "concerns", or "considerable problems" with respect to [inferred]

pipeline integrity. This demonstrates the author's lack of consideration for typical design solutions that include mitigating measures in the design evaluation considered for such a route. The comparison to forest road susceptibility for the same events is not appropriate as the susceptibility of infrastructure such as logging roads and bridges differs significantly from an appropriately installed pipeline designed to avoid the hazard area.

Hunter Creek is proposed to be crossed using horizontal directional drilling ("HDD") methods, and the limits of the crossing would install the pipelines well below and outside the zone of influence of any debris flow activity. Preliminary mitigation methods for the geohazards along Hoult Creek and the upper Kitimat River valley are outlined in the Overall Geotechnical Report (Application Volume 3, Appendix E-1) and further details are provided in the Geohazard Report (A2T0E5 and A2T0E6).

Investigations to date have not identified any deposits of marine clays that would likely influence the stability of the slopes at Chist Creek. Investigations to date have included three geotechnical drill holes for the purposes of evaluating the Chist Creek crossing.

Q.106. Does Northern Gateway have a reply to the following paragraph from section 2.4 of the Schwab Report regarding the Kitimat Trough?

> [Section 2.4.3 Submarine flow slide] These recent large landslides serve to show the sensitivity of the glaciomarine sediments in the Kitimat Trough and the marine sediments on the fan-delta at the fiord-head of Kitimat Arm. Natural and human caused factors trigger these landslides, as previously discussed. Pipeline construction will encounter glaciomarine sediments in the vicinity of Cecil Creek, Deception Creek, Wedeene River, Little Wedeene River, along the west side of Kitimat Arm and along the east side of Chist Creek. The pipeline corridor crosses features indicative of prehistoric flow slides near Cecil Creek through to the Little Wedeene River. The presence of glaciomarine sediments and prehistoric flow slides suggest that there is a high probability for future large landslides; hence, landslides will likely break or disrupt pipeline service. Therefore, pipelines or other infrastructure placed on or crossing glaciomarine sediments must avoid areas that lie within potential flow slide depletion zones.

A.106. Yes. The author presents a lengthy review of the identified presence and character of glaciomarine sediments in the Kitimat Trough segment of the route consistent with the information already filed by Northern Gateway. Geotechnical engineering studies have been conducted with respect to the presence and extent of marine clays in the region and in several instances Northern Gateway has adjusted the route as a result of the potential for ground movements related to marine clays. Regional drilling programs were carried out to review the nature of the clays, and site-specific drilling was also carried out at the Marine Terminal. A significant study with respect to submarine landslide potential associated with these deposits was also completed and provides specific findings that go well beyond the scope of the Schwab Report (See Attachment JRP IR 4.1).

The engineering and route development studies carried out by Northern Gateway have included evaluation and consideration of the potential for sliding in glaciomarine clays and the presently proposed route is planned to avoid the areas in the potential flow slide depletion zones. A report summarizing the results of work to date on glaciomarine clay distribution and implications has been filed (See Attachment Haisla Nation IR 2.17f)). This route development work is consistent with the key recommendation of the author noted above.

It is inaccurate to suggest that future "landslides will likely break or disrupt pipeline service". Schwab introduces a recommendation that "pipelines or other infrastructure placed on or crossing glaciomarine sediments must avoid areas that lie within potential flow slide depletion zones". If avoidance or other appropriate mitigation methods are used, the pipelines will not be subject to failure.

Q.107. Does Northern Gateway have a reply to the following paragraph from section 3 of the Schwab Report regarding Regional Landslides?

> [Section 3.0 Regional Landslides] Landslides and erosion have historically occurred at different rates within the physiographic units situated between Burns Lake and Kitimat. Landslide rates reflect the bedrock geology, surficial geology, and past and present day climate. An understanding of the past is commonly the basis for predicting the future. Inherent structural weaknesses in bedrock or surficial material combined with slope geometry render a slope unstable. Hence, the location of historic landslides can help predict the probable locations for future catastrophic landslides within a geographic area—sites of similar bedrock geology, surficial geology and geological processes (refer to Geertsema et al. (2010) for an in-depth discussion on the cause and triggers of landslides).

A.107. Yes. The discussion in this section of the paper constitutes little more than a basic overview of the practice of geological hazard identification and some aspects related to the practice of geotechnical engineering. The items and considerations listed are not unique to this region, nor are they unique considerations with respect to the geotechnical engineering for any pipeline Project.

Geertsma et el (2010) is not considered a baseline document for the discussion of the causes and triggers of landslides.

Q.108. Does Northern Gateway have a reply to the following paragraphs from Sections 4 and 5 of the Schwab Report regarding Landslides and Linear Infrastructure/ Climate?

> Landslides damage linear infrastructure such as pipelines, roads, railroads, and power transmission lines (Geertsema et al. 2009). Damage frequently occurs in the landslide runout zone after landslide debris has traveled, in some cases, many kilometres from the initial slide. This is evident in recent large complex landslides that transformed from bedrock slide to avalanche to debris flow (Schwab et al. 2003).

Pipelines or other infrastructure, if crossing glaciomarine sediments, must avoid areas within potential depletion zones.

The above discussion tends to look at large events, big storms and catastrophic large landslides, however it should not be ignored that many small landslides and erosion events occur across the landscape at a much higher frequency. Although small, these events can also disrupt linear infrastructure, such as pipelines, and given their higher frequency, they are more likely to rupture pipelines on an ongoing basis.

A.108. Yes. These sections, similar to section 3, summarize the fact that landslides can be damaging to linear infrastructure, although they ignore the IF statement. Landslides are only potentially damaging if they are actually present on the route and if adequate mitigation measures are not used. A recent example was the landslide activity in the Pine Pass in July 2011 as a result of an intense high precipitation event. The storm triggered significant sliding, lateral erosion, flooding and debris flows throughout the valley, and damage to infrastructure was extreme. Notably, Highway 97, and CN Rail, along with streets and property in the town of Chetwynd were significantly impacted. The extensive pipeline network in the region was exposed by erosion in some areas and other areas of lateral erosion will require mitigation but only exposures occurred and no loss of containment events occurred. There are numerous areas where some degree of mitigation will be required; however, there was no failure of the pipeline system such as ruptures or leaks.

Notably in this section the author talks about routing as a mitigation technique. Enbridge is in agreement with this statement; however, there are also other appropriate mitigation techniques that will be considered depending on the circumstances.

There is considerable emphasis in the Schwab Report on large runout slides in rock (such as the Howson slides that cut the PNG pipeline), large runout failures in sand and gravel (a few examples of blow-off groundwater piping failures) and large failures in glaciomarine clay. As discussed previously, large runout slides such as the Howson slide were a major consideration in overall routing and the valleys in which these failures occur were avoided. Similarly, glaciomarine clay has been a major consideration in routing.

Q.109. Does Northern Gateway have a reply to the following paragraph from the conclusion in Section 6 of the Schwab Report?

Recognition and avoidance of unstable terrain is the most efficient and cost effective method for management in landslide prone terrain. This requires detailed terrain stability mapping and geotechnical investigation to identify unstable slopes, runout zones, and depletion zones. However, avoidance of unstable terrain is a difficult management strategy to adopt over many sections of the proposed pipeline corridor. Therefore, the unstable mountainous terrain across west central B.C. is not a safe location

for pipelines. Eventually a landslide will sever a pipeline. Although difficult, an alternative, safer route through B.C. needs investigation.

A.109. Yes. "Recognition and avoidance of unstable terrain is the most efficient and cost effective method for management in landslide prone terrain" is a statement consistent with the Project documents, specifically as noted in Volume 3, Section 2.3.1 and avoidance has been practiced wherever it is feasible and practical. This is supported by many examples in the Project engineering documents. The March 2011 submission to the JRP also provides a consistent view, and includes several examples of how such a process was used in the corridor described in this paper. The implication that avoidance is always "the most efficient and cost effective method" is not correct. Other mitigation methods may be appropriate depending on the circumstances. The route was reviewed by a multi-disciplinary team that included geotechnical engineering input supported by detailed site specific studies of many aspects as noted throughout this review.

The author suggests that "avoidance of unstable terrain is a difficult management strategy to adopt over many sections of the proposed pipeline corridor". This statement is not true – slides have been avoided in many sections of the proposed pipeline corridor in the paper. The statement "these landslides serve to illustrate the terrain instability along the pipeline corridor—from mountaintop to valley bottom" makes a sweeping generalization that the presence of slides in certain locations means that slides are present everywhere. This is not correct. It is inappropriate to assume that slides in particular areas render large geographic areas unstable and unsuitable for consideration. The work by Northern Gateway has shown that the route is viable and has been carried out using accepted geotechnical engineering practices to an extent that far exceeds the scope of the analysis provided in this paper.

As has been noted throughout this review, this author is not in a suitable position with respect to his personal experience or industry knowledge to suggest that "the mountainous terrain across west central BC is not a safe location for pipelines" or that, "Eventually a landslide will sever a pipeline". The Schwab Report provides an overview listing of selected geohazards (most of which are not on the pipeline route) and subjective opinions on pipeline integrity that specifically excludes any discussion regarding hazard mitigation. The possibility of mitigating measures, site-specific analysis, or in-depth engineering analysis to solve the issues presented has not been considered in this paper.

I. Kitimat Valley

Q.110. The Haisla Nation, the Kitselas Nation and other intervenors have expressed concern regarding the potential effects of a pipeline spill into the Kitimat Valley drainage. Has Northern Gateway reviewed that evidence?

A.110. Yes.

Q.111. Does Northern Gateway have any reply?

A.111. Yes. Northern Gateway acknowledges the importance of the Kitimat Valley to First Nations as well as to the broader Kitimat community. To address these concerns, Northern Gateway commissioned two reports regarding the Kitimat Valley. The first report is entitled *Kitimat Valley Design, Operations and Construction Study Report*. This study was developed, in part, through an onsite review of the Upper Kitimat Valley with the aid of representatives from the Kitselas First Nation. A copy of this study is provided as **Attachment 6**. The second report is entitled *Preliminary Kitimat River Drainage Area Emergency Preparedness Report*. This study was developed, in part, through an onsite review of the Kitimat Valley with the aid of representatives from the Haisla Nation and the Kitselas First Nation. A copy of this study is provided as **Attachment 7**. Draft versions of both of these reports have been provided to the Haisla Nation and the Kitselas First Nation for comment. Northern Gateway will consider any comments received from the Haisla Nation and the Kitselas First Nation about the reports and incorporate those comments during detailed engineering and design. Northern Gateway will continue to offer opportunities to meet with the Haisla Nation and the Kitselas First Nation to discuss these reports.

J. Additional Engineering, Design and Operation Measures

Q.112. Do you have anything further to add?

A.112. Yes. As part of Northern Gateway's ongoing Project review and consultation through meetings with northern and Aboriginal communities and input from Community Advisory Board, Northern Gateway has endeavoured to make it clear that it intends to take all practicable measures to design and construct a safe, reliable pipeline system. To that end, Northern Gateway has identified a variety of design features that will enhance the safety and reliability of the pipelines over and above standard industry practice. These additional factors include the following:

1. Pipeline Wall Thickness

- Northern Gateway will increase the wall thickness of the oil pipeline which will increase the strength of the pipe.

2. Watercourse Crossings

- Further, additional increases in pipe wall thickness will be used for major tributaries to the Fraser, Skeena and Kitimat Rivers.

3. Block Valves

- Remotely operated isolation valves have been located to protect environmentally sensitive locations. Additional isolation valves will be placed on each side of major tributaries to the Fraser, Skeena and Kitimat Rivers to provide enhanced

protection of high value salmon habitat. For BC this will result in an increase in the number of isolation valves by more than 50%.

4. Integrity Management

- In addition to specific plans for high consequence areas such as the Kitimat Valley which involve numerous in-line inspection surveys within the first two years of operation, Northern Gateway will increase the frequency of its in-line inspections across the entire pipeline system by a minimum of 50% over and above current standards.

5. Leak Detection

- Northern Gateway will commit to installing dual leak detection systems.

6. Pump Stations

- Northern Gateway plans to staff all of its pump stations on a 24/7 basis for on-site monitoring and security of equipment, rapid response and ultimately to further ensure the safety of the public and protection of the environment.
- Consistent with its overall commitment, Northern Gateway intends to recruit and train people from local communities and Aboriginal groups as a priority to fill the positions needed for a 24/7 operation.

V. ENVIRONMENT

A. Recovery of Biophysical and Human Environment from Oil Spills

Q.113. Have you reviewed the material filed by the following intervenors regarding concerns of recovery of biophysical and human environment from oil spills:

- Haisla Nation;
- Gitga'at First Nation; and
- Living Oceans Society?

A.113. Yes.

Q.114. Does Northern Gateway have a reply to this material?

A.114. Yes. In reply to this material Northern Gateway has prepared a report entitled *Recovery of Biophysical and Human Environment from Oil Spills.* A copy of this report is included as **Attachment 8**.

B. Reply to Summit Report

Q.115. Has Northern Gateway reviewed the report entitled *Northern Gateway Pipeline – Review of Vegetation, Wildlife, Aquatics on behalf of HLFN and EPMS* prepared by Summit Environmental Consultants filed as written evidence by Horse Lake First Nation (A2K1A4) and East Prairie Metis Settlement (A2K0Z9)?

A.115. Yes.

Q.116. Does Northern Gateway have reply to this material?

A.116. Yes. Northern Gateway has prepared a report in reply the Summit report. A copy is provided as **Attachment 9**.

C. Reply to Management and Solutions in Environmental Science ("MSES") Report

Q.117. Has Northern Gateway reviewed the report entitled *High Level Review of the Enbridge Northern Gateway Pipeline Environmental Impact Assessment – Whitecourt to Fox Creek Alberta* prepared by Management and Solutions in Environmental Science filed as written evidence by Swan River First Nation (A21S2)?

A.117. Yes.

Q.118. Does Northern Gateway have reply to this material?

A.118. Yes. Northern Gateway has prepared a report in reply the MSES report. A copy is provided as **Attachment 10**.

Q.119. Do you have anything further to add regarding environmental and human health effects?

A.119. Yes. Intervenors have expressed concern regarding protection of the environment in the Kitimat area, and cumulative effects of industrial development. While no specific issue has been taken with the human health risk assessment conducted by Northern Gateway, reviews of the assessment of potential health effects of the Project associated with air emissions has indicated to Northern Gateway a need to clarify certain findings regarding the quality of the existing human environment in the Kitimat area. Although it was made clear that the Project emissions are minor, for certain parameters the human health assessment indicated that existing conditions may exceed human health thresholds without providing complete context. The discussion below has been prepared to provide that context, and in so doing to provide assurance that existing conditions in the area should not be cause for concern.

<u>Project Versus Baseline Risks</u>

The results of the human health risk assessment appear to show that the development of the Project will actually improve the environment and reduce the risks. The risk

estimates for the Application Case were less than the risk estimates for the Baseline Case. The Baseline Case quantifies the human health risk for the existing conditions. The Application Case, as presented in the Application, only quantifies exposures due to the emissions from the Project alone[3]. Therefore, it is necessary to sum the risk estimates from the Baseline scenario with the Application Case (i.e., Table E-5 plus Table E-7 and Table E-6 plus Table E-8) to obtain the overall risks. For example, the Total Hazard Quotient ("HQ") for arsenic at Roy Wilcox Elementary School has a Baseline Total HQ of 0.050 (Table E-5) and a Project Total HQ of 0.000045 (Table E-7). Therefore, the Total HQ for the Project and Baseline effects would be 0.050045; with rounding to two significant digits, the Total HQ would be 0.050. Similarly, for the carcinogenic evaluation of arsenic, the Total Incremental Lifetime Cancer Risk ("ILCR") for the Baseline is 9.7 x 10-6 (Table E-6) and 6.4 x 10-9 (Table E-8) for the Application Case at the same location. Therefore, the Total ILCR for the Project and Baseline remains at 9.7 x 10-6 after rounding for two significant digits. As demonstrated by the arsenic example, the Project would not substantively change the baseline risk estimates. Therefore, the development and operation of the Northern Gateway Project would not result in a material increase in the total human health risk for people in the area.

Total Polycyclic Aromatic Hydrocarbons ("PAH")

In the Application, the baseline ILCR for total PAHs was 1.1 x 10-5 for all receptor locations, which was higher than Health Canada's guideline. The risks were primarily due to the soil ingestion and soil dermal contact exposure pathways. All other exposure pathways had risk estimates that were orders of magnitude lower than the guideline. Risks estimates were calculated using the 95th percentile concentration of the total PAHs in soil samples collected from a site near the proposed Kitimat Terminal and analyzed in the laboratory. The 95th percentile concentration was used to represent the soil exposure risks for all of the receptor locations.

However, an uncertainty exists because these PAH risks may be reflective of past and current operations of the Rio Tinto Alcan Söderberg smelter at Kitimat, BC, as well as possibly other sources. These operations have resulted in the release of PAHs into the surrounding environment. Under terms of an agreement between Rio Tinto Alcan and Environment Canada, emissions from the Kitimat facility are to be reduced to 0.8 and 0.75 kg of PAH atmospheric emissions per tonne of aluminum produced by the plant by 2008 and 2012, respectively.[4] The average PAH emission for 2011 was 0.63 kg per tonne of aluminum with geometric mean PAH concentrations ranging from 11 to 114 ng/m3 in the ambient air in the region.[5] Although these reductions are for current operations, emissions in the past from this facility are assumed to be higher than the levels reported following the implementation of additional emission controls. Studies have demonstrated

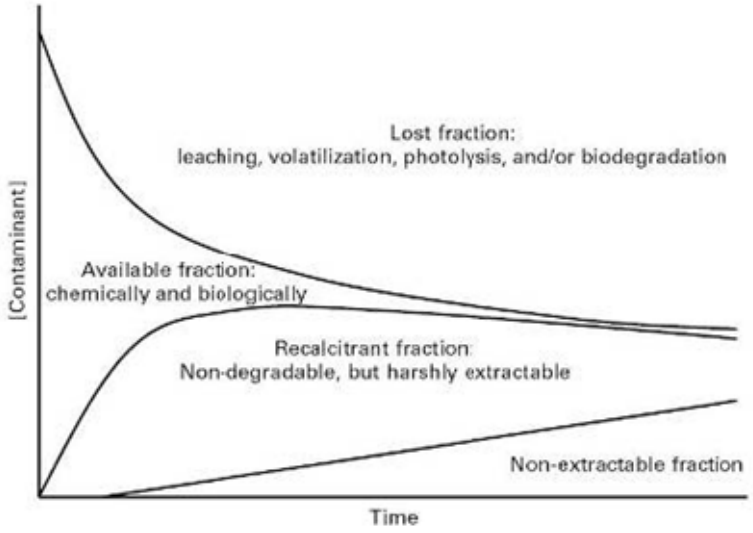
[3] The Application Case, as presented in the Application, should actually be "Project Alone" Case and not "Application Case" as defined under cumulative effects.

[4] Environment Canada. 2008. Environmental Performance Agreement Concerning Atmospheric Emissions of Polycyclic Aromatic Hydrocarbons. Available at: http:www.ec.gc.ca/epe-epa/default.asp?land=En&n=B6464981-1.

[5] Rio Tinto Alcan. 2011. Annual environmental report. B.C. operations. 2011. Available at: http://www.riotintoalcaninbc.com/media/reports/AER%202100.pdf.

that PAHs are present in high concentrations in the biota and marine sediments around Kitimat Arm, the distribution of which is attributable to the Alcan smelter as the historical source.[6]

In addition, the assessment in the Application assumed that the bioavailability of all the PAHs in the soil was 100% and 13% for the oral and dermal exposure routes, respectively. However, the interactions of the PAHs with the organic components of the soil matrix can regulate their behaviour in the environment. This can lead to increased sequestration within the soil rendering them unavailable to other organisms and thus, reduce their toxic effect. Ounnas et al. (2009) have shown that the soil matrix significantly reduces the bioavailability of PAHs with organic carbon content being the primary factor responsible for bioavailability.[7] As shown in the following figure, Stokes et al. (2005) demonstrates that with time, the bioavailable fraction of PAHs decreases while the recalcitrant and non-extractable fractions increase.[8]



CCME (2010) mentions that high molecular weight PAHs will remain tightly sorbed to soils, and especially the five- to six-ringed PAHs may exhibit a very limited bioavailability to terrestrial organisms based on soil contact."[9] Table 1 presents some studies that evaluated the oral bioavailability of PAHs in soils. These studies show that the oral bioavailability of PAHs can be considerably less than the assumed 100% used in

[6] Eickoff, C.V., He, S.X., Gobas, F.A.P.C. and Law, F.C.P. 2003. Determination of polycyclic aromatic hydrocarbons in Dungeness Crabs (*Cancer magister* near an aluminum smelter in Kitimat Arm, British Columbia, Canada. Environ. Toxicol. Chem. 22:50-58; Simpson, C.D., Harrington, C.F., Cullen, W.R., Bright, D.A., and Reimer, K.J. 1998. Polycyclic aromatic hydrocarbon contamination in marine sediments near Kitimat, British Columbia. Environ. Sci. Technol. 32:3266-3272.

[7] Ounnas, F., Jurjanz, S., Dziurla, M.A., Guiavarc'h, Y. Feidt, C. and Rychen, G. 2009. Relative bioavailability of soil-bound polycyclic aromatic hydrocarbons in goats. Chemosphere 77:115-122.

[8] Stokes, J.D., Paton, G.I., and Semple, K.T. 2006. Behavior and assessment of bioavailability of organic contaminants in soil: relevance for risk assessment and remediation. Soil Use Management 21: 475-486.

[9] Canadian Council of Ministers of the Environment (CCME). 2010. Canadian soil quality guidelines for the protection of environmental and human health: Carcinogenic and Other PAHs. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

the Human Health and Risk Assessment ("HHRA") for the Application. The lower bioavailability of the PAHs in the soil would reduce the exposures for people in the area.

Table 1. Summary of oral bioavailability studies for PAHs

Authors	PAH Source	Test Species	No. of Soils	Soil Concentration	Relative Bioavailability
Goon et al. 1991[10] and Magee et al. 1996[11]	Soil sources unknown	Male Sprague – Dawley rats	Sandy loam (0.04% TOC) Clayey soil (1.4% TOC)	100 mg/kg ^{14}C-labelled B(a)P, weathered for 1, 7, 30, 180, and 365 days	37-49% 22-36% (decreasing with time)
Weyand et al. 1996[12]	Manufactured gas plant site	Female B6C3F1 mice	2 1	1 and 35 mg/kg pyrene 377 mg/kg total PAHs	11 and 36% 17%
Koganti et al. 1998[13]	Manufactured gas plant site	Female B6C3F1 mice	3 3	0.2-627 mg/kg pyren 8-3120 mg/kg total PAHs	8-100% 8-76%
Magee et al. 1999[14]	Superfund site	Female B6C3F1 mice	3	66-388 mg/kg total PAHs	1-36%
Bordelon et al. 2000[15]	Manufactured gas plant site	Fischer 344 rat	1	3500 mg/kg total PAHs	35-40%

[10] Goon, D., Hatoum, N.S., Klan, M.J., Jernigan, J.D., and Farmer, R.G. 1991. Oral biavailability of "aged" soil-adsorbed benzo(a)pyrene (BaP) in rats. Toxicologist 11:1356.

[11] Magee, B. , Anderson, P., and Burmaster, D. 1996. Absorption adjustment factor (AAF) distributions for polycyclic aromatic hydrocarbons (PAHs). Human Ecol. Risk Assess. 2:841-873.

[12] Weyand, E.H., Rozett, K., Koganti, A., and Singh, R. 1996. Effect of soil on the genotoxicity of manufactured gas plant residue. Fund. Appl. Toxicol 30:Part 2.

[13] Konganti, A., Spina, D.A., Rozett, K., Ma, B.I., and Weyand, E.H. 1998. Studies on the applicability of biomarkers in estimating the systemic bioavailability of polynuclear aromatic hydrocarbons from manufactured gas plant tar-contaminated soils. Environ. Sci. Technol. 32:3104-3112.

[14] Magee, B.H., Dolan, D.G., Paley, D.A., and Weyand, E.H. 1999. Benzo(a)pyrene bioavailability from residential soils. Toxicologist 48 (I-S) abstract 54.

[15] Bordelon, N.R., Donnelly, K.C., King, L.C., Wolf, D.C., Reeves, W.R., and George, S.E. 2000. Bioavailability of the genotoxic components in coal tar contaminated soils in Fischer 344 rats. Toxicol Sci. 56:37-48.

Authors	PAH Source	Test Species	No. of Soils	Soil Concentration	Relative Bioavailability
Gron et al. 2007[16]	Mine waste or household/construction waste	Minipig	4	6-270 mg/kg B(a)P 0.77-43 mg/kg dibenz(a,h)anthracene	36-55% 27-30%

Therefore, assuming 100% oral bioavailability for all PAHs in the exposure assessment of the HHRA would overestimate the oral risks.

As well, assuming 13% bioavailability for the dermal exposures without accounting for the individual dermal bioavailabilties of each PAH would also lead to an overestimation of the risk. The dermal bioavailability was derived by the U.S. EPA which observed a range of bioavailabilities for B(a)P from 1 to 13%. The upper bound bioavailability was based on a percutaneous absorption study in rhesus monkeys where the percentage of topically applied B(a)P absorbed over 24 hours averaged 13.2%.[17] However, there are several aspects of the study which lead to an overestimation of the dermal bioavailability:

- The soil was sieved to remove clay and silt particles which have the capacity to bind PAHs;
- Sieving the soil will also remove natural organic matter which may also have absorb the PAHs; and
- Lack of weathering time for the B(a)P in the sieved soil which may reduce the dermal absorption.

Therefore, the 13% dermal bioavailability used in the assessment overestimated the actual bioavailability that might be encountered by human receptors at Kitimat.

Further evidence of the reduced bioavailability of the PAHs was presented by Johnson et al. (2009) who observed that the smelter-derived PAHs from the Alcan facility in the sediments of the Kitimat area were less bioavailable to fish in the channel compared to PAHs derived from other sources (e.g., fuel, wood burning).[18] Since the PAHs were from the same source, it is expected that these PAHs sequestered in the soils around Kitimat would behave in a like manner as those in the sediments.

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[16] Gron, C., OOmen, A., Weyand, E. and Wittsiepe, J. 2007.Bioaccessibility of PAH from Danish soils. J. Environ. Sci. Health Part A 42:1233-1239.

[17] Wester, R.C., Maibach, H.I., Bucks, D.A., Sedik, L., Melendres, J., Liao, C., and Dizio, S. 1990. Percutaneous absorption of [^{14}C]DDT and [^{14}C]benzo(a)pyrene in soil. Fund. Appl. Toxicol. 15:510-516.

[18] Johnson, L.L., G.M. Ylitalo, M.S. Myers, B.F. Anulacion, J. Buzitis, W.L. Reichert, and T.K. Collier. 2009. Polycyclic aromatic hydrocarbons and fish health indicators in the marine ecosystem in Kitimat, British Columbia. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-98, 123 p.

Therefore, although the Baseline risk estimates for total PAHs exceeds the Health Canada guideline, given the conservative nature of the assessment (i.e., assuming high bioavailabilities), the assessment overestimates the existing risks to people in the area. Also, because this exceedance is only marginally higher than the criterion, the risks that may be encountered are highly likely to remain below the guideline when more realistic estimates of bioavailabilities are considered.

Nickel and Vanadium

In the Application, the Baseline HQ values for nickel and vanadium were 0.0074 and 0.028, respectively (Table E-5, Appendix E, Technical Data Report - Human Health Risk Assessment). However, for the Application Case, the HQ values had increased to 0.34 for nickel and 0.46 for vanadium (Table E-7, Appendix E, Technical Data Report - Human Health Risk Assessment). Summation of the HQ values would result in total HQ values of 0.35 for nickel and 0.49 for vanadium, both of which exceed Health Canada's guideline of 0.2. A review of the individual HQ values for each exposure pathway demonstrated that the inhalation exposure pathway was the main contributor to the risks as it was orders of magnitude higher than the other exposure pathways (Table E-7, Appendix E, Technical Data Report - Human Health Risk Assessment).

In addition, the exceedances were observed only at the Kitimat Terminal location. All other locations (i.e., Roy Wilcox Elementary School, Mount Elizabeth Secondary School, Stepping Stones Preschool, Nechako Elementary School, Kitimat General Hospital, Kitimat Elementary School, Kildala Elementary School, Kiwanis Senior Citizens Housing, Alcan Kitimat Works, Eurocan Kitimat Plant, Haisla School, Haisla Support and Recovery, and Kitimat LNG Terminal) had total HQ values orders of magnitude lower than the guideline. However, there are several assumptions that need to be considered in the assessment of these health risks.

- The exceedances in the risks are only observed at the Kitimat Terminal and not in any of the other receptor locations. Public access to the Kitimat Terminal will be restricted as it will be an operating industrial facility. Only employees and other authorized personnel with adequate PPE and training will be permitted at the site. Although these administrative controls will be implemented for other reasons (e.g., security, worker safety), they will also manage the exposures and the associated risks to the general public.

- The air dispersion modelling used to predict the ground level concentrations of the chemical and potential concerns ("COPC") was based on emissions from the burning of a typical bunker fuel by the ships at the terminal. These fuels typically contain higher concentrations of sulphur (i.e., up to 35,000 mg/kg of sulphur) and metals. However, Environment Canada's Regulations Amending the Sulphur in Diesel Fuel Regulations reduced the sulphur content in diesel fuels for marine vessels to 500 mg/kg on 1 October 2007 and will reduce it further to 15 mg/kg on 1 June 2014. In addition, in conjunction with the United States, a 200 nautical mile exclusion zone around the Northern America coastline will be established as an Emission Control Area (ECA). Within the ECA, stricter standards on emissions from large ships

including oil tankers, cargo ships and cruise ships will be imposed when they are operating in this zone. Implementation of the ECA will commence on 1 August 2012 and is expected to reduce emissions of sulphur oxides by 96%. Use of low sulphur fuel will reduce metallic ash particles in the exhaust.[19] Therefore, the human health risks associated with the vessel emissions will be reduced substantially as the low sulphur fuel requirements are implemented.

Based on the above, the human health risks to the general public predicted in the Application are considered to be over-estimated and the actual risks following development of the Project will be substantially lower, including risks to human health within the Kitimat Terminal area.

Northern Gateway has committed to several monitoring programs that will be of direct relevance to human health risk assessment:

- An Air Quality Monitoring Program will be initiated in the Kitimat Area six months prior to the start of operations. Air quality will be sampled at monthly intervals at one site within the Kitimat terminal area and at two reference sites. The monitoring program will continue for a minimum of one year after the start of operations.

- Representative samples of low sulphur fuel oil used by vessels calling on the Kitimat Terminal will be collected for at least one year following the start of operations to determine the total sulphur and asphaltene content and compare these to the Environment Canada regulations and the ECA standards.

- A Marine Environmental Effects Monitoring Program will be conducted in the vicinity of the marine terminal. Sampling will focus on the marine riparian zone down to the upper sub-tidal zone. The quality of sediment and representative benthic organisms will be assessed. Sampling will occur for three years prior to operations and continue for at least three years after the start of operations. Sampling can include parameters of interest to the Human Health Risk Assessment.

Results of the monitoring programs will be shared with federal and provincial regulators. The proposed monitoring will enable Northern Gateway and government regulators to determine if emissions are less than or similar to those predicted in the Application and the HHRA. Should exceedances be detected, Northern Gateway will work with federal agencies, the province and other industrial proponents to address these concerns.

[19] U.S. Environmental Protection Agency (US EPA). 2009. Regulatory Impact Analysis: Control of Emissions of Air Pollution from Category 3 Marine Diesel Engines. December, 2009. Assessment and Standards Division. Office of Transportation and Air Quality. EPA-420-R-09-019.

VI. MARINE

A. Corrosion, Inspection and Maintenance of Oil Tankers

Q.120. Has Northern Gateway reviewed material filed by Living Oceans Society and other intervenors regarding concerns about corrosion, inspection and maintenance of oil tankers?

A.120. Yes.

Q.121. Does Northern Gateway have a reply to this material?

A.121. Yes. Northern Gateway requested Herbert Engineering Corp. ("Herbert Engineering") to prepare a report in reply to these and other such concerns expressed by intervenors. A copy of the Herbert Engineering report, which is entitled *Corrosion, Inspection and Maintenance of Oil Tankers*, is provided as **Attachment 11**.

B. Design and Construction of Oil Tankers

Q.122. Has Northern Gateway reviewed material filed by Coastal First Nations, Forest Ethics, Gitxaala Nation, Living Oceans Society and Raincoast Conservation Foundation and other interveners regarding concerns about the design and construction of oil tankers?

A.122. Yes.

Q.123. Does Northern Gateway have a reply to this material?

A.123. Yes. Northern Gateway requested Herbert Engineering to prepare a report in reply to these and other such concerns expressed by intervenors. A copy of the Herbert Engineering report, which is entitled *Design and Construction of Oil Tankers*, is provided as **Attachment 12**.

C. Pilotage

Q.124. Has Northern Gateway reviewed Coastal First Nations written material, Appendix II – Marine Navigation (A2K0J9), regarding pilotage issues?

A.124. Yes.

Q.125. Does Northern Gateway have a reply to this material?

A.125. Yes. Northern Gateway requested Captain Al Flotre to review and reply to the views and concerns expressed in the Coastal First Nations material as well as those expressed in: the opinion of Captain John Lawrence Bergin prepared at the request of Janes Freedman Kyle Law Corporation; and, the letter from Mr. David Newman dated January 5, 2012 filed by Douglas Channel Watch. A copy of Captain Flotre's reply evidence is provided as **Attachment 13**.

D. Wake Study

Q.126. In Federal Government Information Request 1.31 to Northern Gateway, NRCan expressed the view that the wake heights presented in the Tanker Wake Study were too low, perhaps even by an order of magnitude, and that wake statistics (height, period) should be contrasted with the natural wave climate. Does Northern Gateway have a reply to this material?

A.126. Yes. Northern Gateway requested FORCE Technology and the Danish Hydraulic Institute ("DHI") to re-evaluate ship wake generated by tanker traffic in transit to, or from, Kitimat Terminal A copy of the report prepared by FORCE Technology and DHI, which is entitled *Wake Waves at Kitkiata Inlet and Principe Channel*, is provided as **Attachment 1**4.

E. Acoustic Supplement

Q.127. Has Northern Gateway reviewed the material filed by the Gitga'at First Nation and Rainforest Conservation Foundation regarding concerns about acoustic modeling and the methodology regarding the assessment of the impact of noise on killer whales?

A.127. Yes.

Q.128. The Gitga'at First Nation and Rainforest Conservation Foundation have raised a concern that acoustic modeling was based on literature values for vessel sound source levels and may not have used appropriate surrogate vessel sound source levels. They are also concerned that modelling did not account for the effect of sound-quieting technologies. Does Northern Gateway have a reply to this concern?

A.128. Yes, Northern Gateway has prepared a report entitled *Acoustic Supplement*. A copy of the report is provided as **Attachment 15**. This report includes two new reports based on a field study that Northern Gateway conducted in Valdez, Alaska, to improve the accuracy of the acoustic modeling parameters. The first report presents the methodology behind this acoustic field study. The second report uses the new source levels to re-model and to correct a projection error in the acoustic figures presented in the Application.

Q.129. The Rainforest Conservation Foundation has a raised a concern that the application does not provide the methodology behind the killer whale species-specific threshold that was developed. The Rainforest Conservation Foundation is of the view that this is required to assess the appropriateness of its use. Does Northern Gateway have a reply to this concern?

A.129. Yes. Included in the Acoustic Supplement report is a section explaining the weighting methodology used in developing the killer whale-specific threshold. The final section of the Acoustic Supplement report presents a summary of all acoustic technical data reports associated with the Application (those previously filed and those submitted in the report) and a brief assessment of how the results of the Alaska field study, an erratum pertaining

to related mapping results presented in the Application, and the weighting methodology might alter the assessment and associated conclusions, as presented in the Application.

VII. CONSULTATION – PUBLIC

Q.130. Does Northern Gateway have an update for the JRP on its public consultation program?

A.130. Yes. Northern Gateway has provided a Public Consultation Reply and Update as **Attachment 16** that covers the period between April 1, 2011 and June 30, 2012. Northern Gateway has committed to provide the JRP with periodic updates on its consultation and engagement with the public. Although the reply and update only covers engagement activities up to June 30, 2012, Northern Gateway's public consultation program will remain ongoing throughout all phases of the Project.

VIII. CONSULTATION – ABORIGINAL

Q.131. Does Northern Gateway have an update for the JRP on its Aboriginal engagement program?

A.131. Yes. Northern Gateway has provided an Aboriginal Engagement Reply and Update as **Attachment 17** that covers the period between April 1, 2011 and June 30, 2012 and supplements the information previously provided by Northern Gateway in Volume 5A of the Application, the Update to Volume 5A of the Application, which was filed with the JRP on June 8, 2011 and Northern Gateway's response to JRP IR 10, which was filed June 7, 2012. The primary purpose of the update is to provide a detailed engagement update for each of the Aboriginal groups with whom Northern Gateway is engaged. Northern Gateway has committed to provide the JRP with periodic updates on its consultation and engagement with Aboriginal groups. Although the update only covers engagement activities up to June 30, 2012, Northern Gateway's Aboriginal engagement program will remain ongoing throughout all phases of the Project.