October 6, 2011

Attention: Ms. Anne-Marie Erickson  
Secretary to the Joint Review Panel  
Enbridge Northern Gateway Project

National Energy Board  
444 Seventh Avenue SW  
Calgary, AB  T2P 0X8

Dear Ms. Erickson,

Re: Northern Gateway Pipelines Application to the National Energy Board  
Enbridge Northern Gateway Project  
OH-4-2011  
NEB File No: OF-Fac-Oil-N304-2010-01 01  
Northern Gateway Responses to Round 1 Haisla Nation Information Request No. 1


These documents are being filed electronically with the Board and will be served upon all OH-4-2011 Parties.

Yours truly,

[Signature]

Ken MacDonald  
Vice President, Law and Regulatory  
Northern Gateway Pipelines Limited Partnership

Enclosures
cc: CEAA  
Attention: Carolyn Dunn
GENERAL

Public Interest

1.1 Approved Production

   ii) Exhibit B1-2 Volume 1 - Application dated May 2010, Section 3, p. 3-1 (A1S95X)
   iii) Exhibit B1-4 Volume 2 - Application dated May 2010, Section 1.6, p. 1-13 (A1S9X7)

Preamble: The purpose of the Project is identified as "to provide access for Canadian oil to large and growing international markets, comprising existing and future refiners in Asia and the United States West Coast" and to "new international markets". Further, the application states that "New markets and expanded transportation capacity are essential to the development of [approved but not developed] oil sands production, which has already been determined to be in the public interest".

Request: a) Has the National Energy Board assessed that this development of oil sands production is in the public interest?

b) If not, which governmental entity does NGP say has assessed that this oil sands production is in the public interest?

c) What legislation was this public interest assessment based on?

d) What was the extent of public participation in this assessment?

e) What was the extent of First Nation participation in this assessment?

Response: a) No.

b) The Energy Resources Conservation Board ("ERCB") is the primary regulator of oil sands production in Alberta and makes determinations regarding the Alberta public interest in oil sands development. Since
the coming into force of the *Canadian Environmental Assessment Act* ("*CEA Act*") in 1995, there have been a number of comprehensive studies and joint review panels under the *CEA Act* to assess both project and cumulative effects associated with oil sands development. Subject to the imposition of numerous conditions contained in the reports of joint review panels and comprehensive studies, the Government of Canada has responded to these environmental assessments by allowing federal regulatory authorities and responsible authorities to proceed with the issuance of federal approvals for oil sands projects. Through environmental assessments undertaken pursuant to both provincial and federal legislation the ERCB and in a number of cases, the Government of Canada, have determined that the oil sands production approved to date is in the public interest.

c) Alberta public interest determinations are made pursuant to the *Oil Sands Conservation Act* and the *Energy Resources Conservation Act*. Both of these statutes are administered by the ERCB. Federally, the primary statute is the *CEA Act*, which requires a response by the Government of Canada to joint panel review reports.

d) There has been public participation in the regulatory review of oil sands projects. Decision Reports of the ERCB and joint review panel reports document a high level of public participation.

e) Oil sands development occurs on Crown lands over which there are established treaty rights the exercise of which could potentially be affected by oil sands development. Affected Aboriginal groups have participated in virtually every case involving the proposed development of significant oil sands resources. Again, the decision records of the ERCB and joint review panel reports document participation by Aboriginal groups in the assessment of oil sands projects.
1.2 Need

   ii) Exhibit B1-2 Volume 1- Application dated May 2010, Section 3, p. 3-1 (A1S95X)
   iii) Exhibit B1-4 Volume 2 - Application dated May 2010, Section 1.6, p. 1-13 (A1S9X7)

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Request: a) What is the basis for concluding that new markets and expanded transportation are essential to the development of [approved but not developed] oil sands production?
   b) What international markets currently exist that Canadian oil cannot access through existing pipelines?
   c) Please provide details demonstrating the actual need for the new proposed pipeline.

Response: a) Market diversification is a key objective for any economic enterprise, and applies to the Canadian crude oil industry as well. Diversification into new higher value and growing markets is an additional benefit that will help mitigate the risk around multi-billion dollar investments relying solely on the U.S. export crude oil market.
   b) Any international markets that are currently inaccessible to a material volume of western Canadian oil.
   c) The Muse Stancil report forecasts $28 Billion of incremental value to the Canadian oil industry in the first 10 years alone, and the Wright Mansell report suggests 557,987 person years of employment, a gain of $270 billion in Canadian GDP, and $81.2 billion of incremental government revenue. These reports are in the Application (Volume 2).
1.3 Project Alternatives

Reference: i) Exhibit B1-2 Volume 1 - Application dated May 2010, Section 4.2, p. 4-1, and figure 4-1 (A1S95X)

Preamble: The purpose of the Project is defined as access for Canadian oil to west coast tidewater. The alternatives to the project are all based on an oil pipeline to the coast. A number of existing pipelines currently carry oil from the Canada's interior to the west coast.

Request: a) What alternatives to transportation by pipeline were considered? Was rail considered? Was trucking considered? Please provide copies of any studies showing the potential impacts, including environmental and socio-economic impacts of these alternatives.

b) Was the use of existing pipelines considered as an alternative to the Project? If no, why?

d) Were existing oil pipeline routes considered as an alternative to the project? If not, why?

Response: a) Alternative means of transportation, including rail and trucking, have been considered by Northern Gateway and were concluded to be not as economic and not as safe for the volumes proposed by Northern Gateway for transport.

In a recent US Department of State study, it was determined that trucking large volumes of oil would result in significant impacts to existing transportation systems, substantially higher greenhouse gas emissions, and a higher risk of accidents than transport by pipeline.

For rail, it was determined there would be greater safety concerns and greater impacts during operations than by pipeline. This would include higher greenhouse gas emissions and greater effects on many communities than transport by pipeline.

b) There is only one existing oil pipeline to the Canadian west coast, which terminates at the Westridge marine terminal. It is Northern Gateway’s understanding that this pipeline does not have the capacity to transport the volumes proposed by Northern Gateway to offshore markets. Current physical constraints preclude the use of tankers up to VLCC size. The existing pipeline system is also not capable of transporting imported condensate.

d) Please refer to the Application (Volume 1, Section 4) which discusses alternative oil pipelines routes to the project including terminal locations.
and pipeline start and ending locations. Based on the selected location for the eastern pipeline terminus and the marine terminal, there are no existing oil pipeline routes to follow from the Edmonton, Alberta area to Kitimat, BC.
1.4 Alternative Means of Carrying out the Project - Transportation Method

Reference:  i) Exhibit B1-2 Volume 1 - Application dated May 2010, Section 4.3, p. 4-4 (A1S95X)

Preamble: The Application identifies the alternative means of the Project as alternatives for the siting of terminals and pipeline routes within the constraints of a terminal near Edmonton and a terminal near Kitimat.

Request:  a) What alternative means of a pipeline to the west coast using different starting and end points were considered?
           b) Please provide any relevant reports or documentation.

Response: a) The Application (Volume 1, Section 4.1) provides the reasons that the Edmonton area was selected as the eastern pipeline terminus location. Section 4.2 provides the reasons that the Kitimat area was selected as the marine terminal location. Section 4.2.2 specifically describes the pipeline alternatives to both Kitimat and Prince Rupert that were evaluated and used to finalize the selection of the Kitimat area for the marine terminal. No additional alternative means of a pipeline to the west coast needed evaluation in order to select the eastern pipeline terminus and the marine terminal locations.

b) Please see Northern Gateway’s response to Haisla Nation IR 1.4a).
1.5 Alternative Means of Carrying out the Project - Terminal Location

Reference: i) Exhibit B1-2 Volume 1 - Application dated May 2010, Section 4.2, p. 4-4 (A1S95X)
   

Preamble: The Application identifies a number of alternatives locations for the marine terminal, and relies on a 1978 Fisheries and Environment Canada working group assessment of environmental risk for potential ports (Potential Pacific Oil Ports: A Comparative Risk Analysis, document attached).

The 1978 Report states that "the comparisons are relative. Least risk does not imply no risk. Thus, a port/route identified as being 'least risky' in this analysis could, on comprehensive and detailed study, be found completely unacceptable from a Canadian point of view due to specific liabilities, inadequate benefits or the negative impacts of non-marine factors" (pp. 4-5).

The 1978 Report characterizes the potential values that could be impacted by oil pollution as economic values and social values. The economic values are characterized as commercial fishing, including the cost of cleaning boats and equipment and impacts to shore-based economic activities. The social values are characterized as amenities that define lifestyle for residents, and psychological effects of knowing that resource values are being impacted. The Report, however, makes no reference to traditional use values of Aboriginal Groups.

The 1978 Report acknowledges a lack of information with respect to the physical marine environment of the north coast: "For the north coast of British Columbia, oceanographic information is scarce and comes mainly from rather general, exploratory cruises carried out in the 1950s and 1960s. Long-term current measurements are lacking, so water circulation has to be inferred …" (p. 13).

Request: a) Did NGP rely on the 1978 Report to select Kitimat and Prince Rupert as potential west coast port sites for further evaluation?

b) Have factors commonly used to assess risk of an oil spill changed since 1978?

c) Has additional knowledge about the [navigation] in Kitimat Arm and Douglas Channel been generated since 1978?

d) Has additional knowledge about the nature of the marine ecosystem and important marine species in Kitimat Arm and Douglas Channel been
generated since 1978?

e) Has additional knowledge about environmental impacts of marine oil spills been generated since 1978?

f) What studies or analysis did NGP perform to update the 1978 Report? Please provide copies of all such studies or analysis.

g) Did NGP consider whether or how factors used to assess risk or the state of knowledge relied on in the 1978 Report have changed since 1978?

h) How was knowledge or information that has become available since 1978 used in determining potential marine terminal sites?

i) Were the potential impacts from non-marine components of the project, such as the marine tanker terminal and the pipeline through the Kitimat River valley, considered in limiting potential marine Terminal sites to Kitimat and Prince Rupert? If no, why not?

j) Were traditional use values of Aboriginal Groups considered by NGP in limiting potential marine terminal sites to Kitimat and Prince Rupert? If no, why not?

k) What steps, if any, did NGP take to supplement the oceanographic information for the north coast? Please provide copies of all studies or reports generated in this regard.

l) Was any supplementary information relating to current measurements or other aspects of the physical marine environment of the north coast considered in limiting potential marine terminal sites to Kitimat and Prince Rupert? If not, why?

Response:

a) Northern Gateway considered the referenced 1978 Report as part of the evaluation process, however, Northern Gateway also relied extensively on information gathered and developed for the Project. In addition to the potential environmental considerations discussed in the 1978 Report, Northern Gateway also considered critical factors such as: engineering design including pipeline routing, terminal and berths location, current industrial use of the port area, marine navigability, and overall project economics in selecting the preferred terminal location.

b) While the Potential Pacific Oil Ports report was used in the site selection process, other factors and analyses were considered in reviewing different port locations and identifying the preferred alternative (see Northern Gateway’s response to Federal Government IR 1.5).

The Potential Pacific Oil Ports: A Comparative Risk Analysis was completed to compare terminal and shipping options on the North Coast. While oil spill risk assessment methodologies have advanced over the last 30 years, the range of factors that would be considered in a
comparison of oil spill risk and other factors of importance to possible port locations have not changed appreciably. The types of factors considered in the 1978 analysis would still be valid in a current assessment.

What has changed is the information available to inform the assessment of specific factors, including oil spill risk. In particular, the understanding of oceanographic conditions, vessel and terminal operations, vessel specifications and safety (e.g., double hulls), hydrocarbon fate and behaviour, slick trajectories, spill response measures and success, environmental protection measures and shoreline clean-up methods have improved substantially.

The benefits of improved information sources and benefits from improved operations, vessel specifications and spill response, for the most part, are not site-specific and would apply equally to the assessment of all terminal operations and associated vessel operations, regardless of location. Hence, Northern Gateway would not expect the results of the terminal analysis to change in terms of the preferred locations.

c) Yes, additional knowledge about navigation and shipping in Kitimat Arm and Douglas Channel has been generated since 1978. Nautical charts, navigational aids, requirements for pilots, etc., have been improved (please see Northern Gateway’s response to Coastal FN IR 1.15a). However, as the navigational benefits would apply equally to all terminal operations and associated vessel operations, Northern Gateway would not expect the results of the terminal analysis to change appreciably. Furthermore, while the report was used in the site selection process, other factors and information sources were considered (see Northern Gateway’s response to Federal Government IR 1.5).

d) Baseline information on the marine environment in Kitimat Arm and Douglas Channel has improved since 1978. Information is summarized for each group of marine biota in the baseline sections for each group in the Application (Volume 6B and Volume 8B). Additional information, including results of marine surveys conducted by Northern Gateway, is provided in the technical data reports provided in support of the Application.

e) Information on the effects of marine oil spills has improved since 1978. Of note, over 20 years of research on the Exxon Valdez Oil Spill and effects on various marine biota has improved our understanding of the effects and recovery of various species of marine biota.

f) As discussed in the Application (Volume 3, Section 2.2.2), the selection
of the Kitimat Terminal site was based on a number of criteria which are listed in this section of the ESA. The 1978 Port Analysis report was one of several information sources used to examine alternative sites for the Tank Terminal and the Marine Terminal (see also Northern Gateway’s response to Federal Government IR 1.5).

g) As noted, the Potential Pacific Oil Ports report was one of several factors and analyses considered in reviewing different port locations and identifying the preferred alternative (see Northern Gateway’s response to Federal Government IR 1.5). Please also see Northern Gateway’s responses Haisla Nation IR 1.5b) through 1.5e).

h) Please see Northern Gateway’s response to Haisla Nation IR 1.5f).

i) As discussed in the Application (Volume 3, Section 2), the selection of the terminal location took into account the feasibility and safety of the pipeline route, as well as the feasibility and safety of the terminal site. Additional information on the selection of the preferred general pipeline route is provided in Gateway Pipeline Inc. (2005).

Reference:


j) Please see the Northern Gateway’s response to Haisla Nation IR 1.5a). Traditional use values were not specifically identified during the initial determination that the Kitimat area and the Prince Rupert area would be the focus of further evaluation. These ports are home to substantial and expanding industrial activities including marine infrastructure based on their location at tidewater. Land use planning and associated zoning have identified suitable sites for industrial use.

k) Northern Gateway has completed a number of surveys and reports of relevance to oceanographic conditions and the marine environment. These include:

Reference:


prepared for Enbridge Northern Gateway Project by ASL Environmental Sciences, Sidney, British Columbia


All of these reports are publicly available to the Haisla Nation on both the NEB website and the Northern Gateway website.

In addition to these technical reports, additional information on oceanographic conditions, navigation, and other topics for the Confined Channel Assessment Area and the Open Water Area are provided in the
TERMPOL documents which are also publicly available to the Haisla Nation on both the NEB website and the Northern Gateway website.

1) Please see Northern Gateway’s response to Haisla Nation IR 1.5a).
Information Required to Assess Project

1.6 Assessment of Project

Reference:  
- i) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 1.1, p. 1-1 (A1S9X8)
- ii) Terms of Reference, Joint Review Panel Agreement (A1R4D5)
- iii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 4.1, p. 4-1 (A1S9X8)

Preamble:  
NGP's Application sets out to describe "the conceptual design of the pipelines and related facilities that comprise the Project together with the associated construction and the operation activities." Throughout the Application, references to "detailed engineering" are made in lieu of providing any engineering detail. The proponent proposes to carry petrochemicals though a mostly pristine, remote, mountainous, environmentally sensitive coastal region. The risks of this Project cannot be evaluated at this point due to the lack of detail in all aspects of engineering design. This in turn makes it impossible to assess the potential for effects of the project. Based on the information provided in the Application, NGP expects to have the Project approved solely on a conceptual basis.

The Joint Panel Review Agreement with the NEB (reference ii) provides Terms of Reference which include Factors to be Considered During the Joint Review. Among these are:

i. "The environmental effects of the project, including the environmental effects of malfunctions or accidents that may occur in connection with the project and any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out."

ii. "Measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project."

iii. "Alternative means of carrying out the project, that are technically and economically feasible and the environmental effects of any such alternative means."

Due to the process which is laid out by the Terms of Reference and followed by all concerned parties, it is the responsibility of NGP to provide additional information so that the Joint Review Panel is able to assess the Project in a technically and scientifically sound manner in order to speak responsibly for the Canadian Public.

To enable a scientifically and technically sound assessment of the Project
engineering specifics and plans must be provided for essentially every aspect of the pipelines, pump stations and terminals.

Furthermore, no mention is made in the Application of how NGP's proposed pipeline right of way will interact with the Pacific Trails Pipeline, which has received final approval from the BC Environmental Assessment Office and for which pre-construction activities are currently underway. Information is required on what the cumulative effects of the proposed Project will be as well as what mitigative measures will be enacted to ensure that these effects are avoided or minimized.

**Request:**

a) Please provide the engineering specifics and other detailed information on each of the following:

   i. A risk assessment of the pipeline and terminal portion of the project and the level of risk being targeted (including a comparison of international standards for evaluating risk).
   
   ii. The pipeline design and engineering specifics that will address geotechnical hazards including landslides and acid rock drainage.
   
   iii. The pipeline and storage tank design and engineering specifics that will address seismic risk.
   
   iv. Reference to the specific design codes and standards being followed and the specific subsections therein related to ii and iii.
   
   v. The pipeline materials.
   
   vi. The precise location and type of appurtenances including valves, gaskets and all other fittings.
   
   vii. Detailed characterization of bitumen, diluted bitumen, synthetic oil, and condensate.
   
   viii. All reports and studies on the corrosive nature of diluted bitumen including information on sulphur, sulphur-reducing bacteria, stress corrosion cracking, hydrogen-induced stress corrosion cracking, and corrosion failure that NGP has proposed, undertaken, commissioned or is aware of.
   
   ix. Details on pipeline welding procedures and mitigative measures which will be followed in the field to ensure QA/QC.
   
   x. Details on pipeline inspection procedures and equipment and related schedules for inspection that will be employed.
   
   xi. Details on pipeline monitoring procedures and logistics and schedule.
   
   xii. Details on the engineering and design specifications for the Kitimat Terminal external floating roof tanks.
xiii. Details, including all reports and regulator correspondence, on Enbridge's history of leaks, ruptures, accidents, and regulatory infringements over the past ten years on all its pipelines and other facilities.

b) Please provide the detailed studies prepared, undertaken or commissioned by NGP which look at the cumulative effects of the proposed Project and the Pacific Trails Pipeline.

c) Please provide the detailed mitigative measures planned by NGP concerning the cumulative effects of the proposed Project and Pacific Trails Pipeline. Please provide separate reports on the cumulative impacts of the NGP Project in the context of the Pacific Trails Pipeline project that address each of the following issues:

i. Pre-construction and construction activities
ii. Operation and Maintenance
iii. Emergency procedures
iv. Decommissioning
v. Abandonment

Response: a) i. In the Response to JRP Request for Additional Information (March 2011), the risk-based approach to engineering design and operations was discussed, including:

- Previously filed information regarding: pipeline routing and route evolution; geotechnical engineering and field work, for the pipelines, facilities and tunnels; watercourse crossing evaluations; engineering and field work; evaluation of valve site locations; and Kitimat Terminal engineering.

- Northern Gateway’s commitment to design, construct and operate the Project consistent with, or exceeding the NEB Regulations, CSA Z662-11 and the Enbridge Engineering Standards. A risk-based approach is incorporated within Enbridge’s Engineering Standards. Accordingly, Northern Gateway’s use of a risk-based approach for designing the Project occurs through the application and use of the Enbridge Engineering Standards, which in turn incorporate Canadian regulatory and industry standards.

- Northern Gateway’s route selection process including extensive geotechnical assessments. The geotechnical assessment process has used a risk-based approach to critically examine the geographical, geological and geotechnical features along the route to identify locations, areas or features that should be
avoided with the pipeline route.

- Northern Gateway’s operations using 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.

Northern Gateway’s risk assessment work for the pipelines and Kitimat Terminal is ongoing. For more details please see Northern Gateway’s response to JRP IR 4.

ii. Geotechnical design and mitigation measures that will address geotechnical hazards are outlined in the Application (Volume 3, Appendix E-1).

Additional information on avoidance of geohazards is provided in the Response to Request for Additional Information (Section C.3.6.1 and Appendix C Figures (March 2011)).

Acid Rock Drainage is discussed in two reports in the Application (Volume 3, Appendix E-1-1 and Appendix E-1-2). Please also see Northern Gateway’s response to Coastal FN IR 1.38.

iii. The specifics to address seismic design requirements will be developed during detailed engineering. As stated in Northern Gateway’s response to Eco Justice IR 1.23, no significant consequences arising from seismic shaking have been identified along the pipeline route or at the Kitimat Terminal.

iv. As discussed in the Application (Volume 3, Appendix E-1-2), ARD management along the RoW will follow the guiding principles established by Price and Errington (1998) in the Publication ‘Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia’.

The pipeline and terminal designs will include the requirements of CSA Z662-11 for seismic related earth movements. The tank design methodology to be used for seismic related earth movements is outlined in API Standard 650 – Welded Tanks for Oil Storage. The National Building Code will also apply to the applicable aspects of tank design.
v. Pipeline materials will be in accordance with Enbridge engineering standards which are supplemental to established industry standards such as CSA, API and ASME. These standards are reviewed and updated on a continuing basis considering current industry requirements and Enbridge’s operational experience. The current standards or previous versions have been successfully applied to recent Enbridge projects.

vi. Please refer to the Application Update (Volume 3, Appendix F, Table F-1 (December 2010)), for a preliminary list of pipeline valve locations. Please refer to the Application (Volume 3, Appendix H), and the Application Update (Volume 3, Appendix H (December 2010)) for preliminary locations of pump station valves and fittings. The locations of all pipeline and pump station valves, fittings and appurtenances will be finalized during detailed engineering.

vii. As per the Canadian Association of Petroleum Producers the characterization is as follows:

- **Bitumen** – Petroleum in semi-solid or solid forms.
- **Condensate** – Hydrocarbons, usually produced with natural gas, which are liquid at normal pressure and temperature.
- **Synthetic Oil** – A mixture of hydrocarbons, similar to crude oil, derived by upgrading bitumen from oil sands.

Based on the above information the characterization of:

- **Diluted Bitumen** – A mixture of hydrocarbons derived from Bitumen and Condensate or Synthetic Oil.

Please see Northern Gateway’s response to Haisla Nation IR 1.23a) for further product information.

viii. Similar to the Enbridge mainline system, Northern Gateway will monitor incoming commodity batches to ensure that they meet the tariff requirements for the oil pipeline. All commodities will be tested on a receipt basis for adherence to the density and sediment and water tariff, and viscosity tariff where applicable. Every commodity nominated for transport on the oil pipeline will require prior approval through the Enbridge New Service Request Process, currently implemented on the Enbridge Mainline System. Approved commodities will fall within established parameters, allowing Northern Gateway to effectively track all transported commodities on its oil pipeline. The actual blending of the commodity will occur upstream of Northern Gateway and will be the responsibility of the
producer/shipper.

The content, including sulphur, of the oil proposed to be shipped in the Northern Gateway pipeline is similar to the composition in the existing Enbridge diluted bitumen pipelines. The majority of sulphur present in diluted bitumen is tied up in a class of hydrocarbons known as asphaltenes. These materials do not pose a direct internal corrosion threat to the pipeline.

ix. It is anticipated that the oil pipeline welding will predominantly be performed using a mechanized gas metal arc welding (“GMAW”) process. Terrain such as steep slopes and equipment limitations will also be factors in the welding process selected. It will be necessary to utilize manual shielded metal arc welding (“SMAW”) for welds such as major crossing strings, tie-ins and repair welding. Shop fabricated assemblies may be welded utilizing SMAW, flux cored arc welding (“FCAW”) or submerged arc welding (“SAW”) processes. In all cases, welding procedures will be qualified in accordance with the requirements of CSA Z662-11 or ASME Section IX, as permitted by CSA Z662-11, and Enbridge design standards and construction specifications, which are supplemental to the industry standards.

To ensure field QA/QC, Enbridge design standards, pipeline welding specification and pipeline non-destructive testing specification will be adhered to. A field joining program will be developed during detailed engineering to clearly define the project specific requirements for welding, non-destructive testing (“NDT”) and welding inspection activities as outlined by regulatory and Enbridge requirements and expectations.

x. Enbridge transports a variety of liquid and natural gas products through a network of transmission pipelines spanning North America. Enbridge’s Pipeline Integrity Department supports the Company’s goal of maintaining a safe and reliable pipeline system with a focus on preventing leaks or ruptures caused by duty-related deterioration such as corrosion, cracks, mechanical damage and strain.

All Enbridge pipelines fall within the framework of an overall Integrity Management System (“IMS”) as required by CSA Z662. The core goal of the Integrity Management System is to prevent leaks or ruptures caused by corrosion, cracking, mechanical damage and strain of the transmission pipeline system. The details of the IMS for the Northern Gateway pipelines will be determined during detailed engineering. These details will include consideration for
corrosion, cracks and mechanical damage including:

- Base line in-line inspection ("ILI") surveys
- ILI Inspection frequency
- Geotechnical slope instability
- Cathodic Protection
- Internal Corrosion

xi. The Northern Gateway pipelines will be monitored 24 hours per day, 7 days per week from the Enbridge Edmonton Control Centre. This will include monitoring of flows and pressures at numerous locations along the pipelines by the line operators as well as by the leak detection system. The pump stations will be visited and inspected at least every two or three days as technicians perform routine maintenance on the equipment, as well as perform security and integrity checks on the facilities. The pipeline RoW will be visually inspected by means of aerial patrol on a regular basis. The pipe in the tunnel sections will be visually inspected on a regular basis by means of motorized vehicle (i.e. truck or all-terrain vehicle).

xii) External floating roof tanks to be installed at the Kitimat Terminal will be designed in accordance with API Standard 650 – Welded Tanks for Oil Storage. The National Building Code will also apply to the applicable aspects of tank design. The tank design will also comply with the Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum Products and Allied Petroleum Products (CCME PN 1326). Compliance with CCME PN 1326 ensures that the design of the storage tanks will meet relevant federal, provincial and industry standards regarding engineering, design, construction and operation particularly with regards to environmental considerations.

xiii) Northern Gateway notes that the Haisla Nation has asked several questions on Enbridge’s spill history in a series of information requests beginning at Haisla Nation IR 1.7. Therefore, please see Northern Gateway’s response to Haisla Nation IR 1.7c). Additional information may also be found in responses to Haisla Nation IR 1.9 and Coastal FN IR 1.17k).

b) The methodology used by Northern Gateway to assess Cumulative Environmental Effects is outlined in Application (Volume 6C, Section 3.2.3.2). Specifically, the project inclusion list “includes all past, present and reasonably foreseeable projects (those that are likely to occur), activities and actions with residual environmental effects that could overlap spatially and temporally with the residual environmental
project effect being considered. “The Pacific Trails Pipeline Project was included in the project inclusion list considered in this analysis. Details regarding the results of this cumulative effects assessment can be found in Application (Volume 6C).

c) Northern Gateway does not have specific mitigation measures planned in areas where it is in close proximity to the Pacific Trails Pipeline. Northern Gateway is unaware of any mitigation planned by Pacific Trails Pipeline where it is in close proximity to Northern Gateway. Such site-specific mitigation will be developed during detailed engineering and summarized on environmental alignment sheets issued prior to construction.
Enbridge's Spill History, Environment Record and Response to Incidents

1.7 Enbridge Spill History


Preamble: The Application states that "Enbridge has an excellent pipeline safety record, notwithstanding the two events during the summer of 2010 on Lines 6A and 6B in the United States. In 2010, in Canada and the United States, Enbridge recorded 78 reportable spills along its liquid pipelines system."

Request: a) Is there a volume threshold for a "reportable spill" in Canada?

b) Is there a volume threshold for a "reportable spill" in the United States?

c) Please provide a log of all the spills, reportable and non-reportable, on pipelines constructed by Enbridge, identifying the pipeline construction date, the reason for the spill, the pipeline material, whether or not the pipeline is lined, the type of material being transported, the time and date of the spill, the time that elapsed between the spill and spill detection, the time that elapsed between spill detection and spill shutdown, the volume spilled, and the volume recovered.

Response: a) Yes. All spills in Canada on federally regulated pipelines are reportable. Spills > 1.5 m$^3$ are immediately reported to the TSB. Spills < 1.5 m$^3$ are reported, but in a quarterly report.

b) Yes, 5 gallons.

c) Please see Attachment Haisla Nation IR 1.7c). The attached table provides Enbridge’s record of reportable US and Canadian mainline spills that have occurred over the past ten years. Enbridge’s record of mainline spills provides a more direct comparison to the proposed operations of Northern Gateway due to the size, scale and scope of operations, as opposed to that of gathering or feeder systems.

The past ten years is the most relevant information, as historically, regulatory reporting thresholds have become more stringent (for example PHSMSA has reduced its reporting threshold from 50 barrels to 5 gallons in January of 2002) and there have been significant rulemaking changes dealing with pipeline integrity and operations during this period which have been implemented to reduce the risk of spills. As well, enforcement actions related to spills have become more prevalent in the recent past. Finally, the past ten years is what
regulators use to trend operator performance and spill data. As noted on the NEB website: “Information regarding incidents greater than 10 years old may not be consistent with current investigative practices and is presented for historical perspective only. Such information should be used with caution.”

As such, Northern Gateway has limited its response to mainline spills over the past ten years and believes that this information provides the necessary information to assess Enbridge’s pipeline safety record in relation to the proposed Northern Gateway Project. Northern Gateway has also limited its response to reportable spills, in accordance with the criteria set out in Northern Gateway’s response to J. Wier IR 2.25a).

For additional details related to pump station spills, please see Northern Gateway’s response to Fort St. James Sustainability Group IR 1.4.

Precise timing of the commencement of a leak cannot be ascertained and tracked for all spills. Accordingly, Enbridge statistics focus on the cause and volume released. In the event of a confirmed or suspected leak or rupture, the Enbridge Control Centre will immediately initiate shut down of the pipeline.

Lastly, none of the noted pipelines were internally lined.
1.8 **Commitment to “extended responsibility”**

**Reference:**


ii) Exhibit B27-8 - NGP Response to JRP IR No. 1, Attachment JRP IR 1.2 Commitments Table (A2A4Q0)

**Preamble:**

Enbridge's General Oil Spill Response Plan states that Enbridge spill response plan includes "a corporate commitment to 'extended responsibility' for emergency response along the marine transportation routes. Northern Gateway would take responsibility for maintaining an enhanced spill response capability in the event of third-party tanker spills, beyond what is required under Canadian regulations. The tanker owner would remain the responsible party if a spill were to occur."

The response to JRP IR 1.2, the Commitments Table, includes the following commitments with respect to marine spills:

[Table not reproduced here].

**Request:**

a) Is this the extent of Enbridge's commitment to 'extended responsibility' for emergency response along the marine transportation routes?

b) Does the current marine shipping and oil spill legislation and insurance fund regime cover losses of a cultural nature?

c) If not, will NGP's 'extended responsibility' extend to cover losses of a cultural nature resulting from an oil spill as a result of marine transportation?

d) Is there a potential for a spill to result from the proposed project and associated transportation that will result in damage or loss that exceeds the financial limit for liability that exists under the current marine shipping and oil spill legislation and insurance fund regime?

d) If yes, will NGP's 'extended responsibility' extend to cover potential losses in excess of the financial limit for liability that exists under the current marine shipping and oil spill legislation and insurance fund regime?

**Response:**

a) Please refer to Northern Gateway’s response to Coastal FN IR 1.1a).

b) Yes.

c) Not applicable
d) There has never been a spill of such a magnitude in Canada and the likelihood of there ever being such a spill that exceeded the compensation limits has been greatly reduced by Canada’s ratification of the IOSP Supplementary Fund. Northern Gateway understands that since establishment of this fund, there has never been a spill in the world that has exceeded the limits of compensation under it. However, in the past when the international funds were significantly less than they are today, there were rare occasions when compensation available was not sufficient. In such cases, it has generally been the practice of the State involved to defer its claim to ensure that costs and compensation are covered for private parties.

e) No.
1.9 Ruptures and Leaks

Reference:

i) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 12, p. 12-1 (A1S9X8)

ii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 12.1, p. 12-1 (A1S9X8)

iii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 1.6.1, p. 1-3 (A1S9X8)

iv) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble:

In reference i), the Application states that integrity management entails risk identification and assessment and then briefly discusses how NGP aims to achieve this. In reference ii), the pipeline integrity program is defined as having a primary goal of preventing leaks and ruptures. Quality management, discussed in reference iii), entails the Project following Enbridge's "Quality Assurance and Quality Control (QA/QC) program". However, Enbridge has a history in numerous spills and leaks, as documented in its yearly Enbridge Corporate Social Responsibility Reports (documents attached) and it is important that full disclosure by Enbridge be obtained for each of these occurrences.

A look into Enbridge's operational history over the past decade reveals a high number of incidents, including leaks, ruptures and violations along its hazardous liquid pipelines in both Canada and the United States. Records of these spills are available in Enbridge's yearly "Corporate Social Responsibility" reports and elsewhere. Enbridge pipeline spills that have been documented during the past ten years have often caused environmental damage and occur for any number of reasons, including: human error, pump failure, gasket failure, pipeline failure, seam failure, over-pressure on pipes, corrosion, or rocks.

The list below contains a selection of Enbridge's spill history between 2001 and 2010, with data compiled from its own reports (attached). Enbridge must provide information on each of these incidents in terms of: regulatory response, lawsuits which arose, state of current litigation, spill lead-up, discovery, response and clean-up and changes Enbridge made as a result of each spill.

Request:

a) Please provide all information about the monitoring procedures, monitoring frequency and environmental protection procedures employed for each of the above noted projects.

b) Please provide detailed engineering and design specifications and QA/QC procedures used for materials and during construction and operation in each of the above noted projects.

c) Referring to the table of selected spills above, please provide
information on each of the incidents according to:

i. Nature of product discharged by Enbridge into the environment
ii. Regulatory consequences
   i. Lawsuits and current state of litigation
   iv. Factors leading up to the spill
   ii. Method of spill discovery
   iii. Response and clean-up efforts
   iv. Changes made to policy or procedure in terms of design,
       maintenance and / or inspection methods

Please provide copies of all available documentation relating to all matters referred to in c) i to c) vi above.

d) Enbridge in its 2010 report stated that "crude oil was spilled in Michigan, Line 6B spill". Does Enbridge concede that in fact the product that has spilled into the environment in this case was diluted bitumen? Was Enbridge unaware of the nature of the product it was spilling into the river? How does Enbridge explain this fundamental error in its 2010 report?

e) Declarations based on Enbridge's 2010 "Corporate Social Responsibility Report" indicate that between 2005 and 2009 0.000965% of diluted volume was spilled. Does NGP agree that, given the volume expected along NGP's diluted bitumen and condensate pipeline, a yearly spill volume of 402,000 litres be expected based on Enbridge's past performance? Please confirm the accuracy of this calculation.

f) The US Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) provides detailed information on its website. Between 2006 and March 2011 there were fourteen significant incidents and ten federal enforcement actions involving Enbridge pipelines carrying hazardous liquids. By PHMSA definition, a "significant" incident entails one of the following conditions:

   i. Spill of 7,950 litres
   ii. A fatality or injury requiring hospitalization or
      A total cost of $95,000

Of the fourteen incidents mentioned above, one involved injury or death; all other twelve spills involved spills of greater than 7,950 litres in volume. The total number of reported spills by Enbridge during this period was over 300. Please confirm the accuracy of these statistics.

g) The fourteen significant incident spills mentioned above occurred along
6,070 km of hazardous liquid pipeline. This means approximately 2.3 significant incidents occur per 1,000 km of pipeline in just over five years. Please confirm the accuracy of these statistics.

h) When the numbers in the previous questions are applied to the proposed NGP Project, which would cover 2,354 km of hazardous liquid pipeline (two pipelines of 1,177 km each), one could reasonably expect 5.4 significant incidents to occur in a five year period. This translates to one significant spill (over 7,950 litres) per year from the proposed NGP Project. Please confirm the accuracy of these statistics.

i) The Keystone Pipeline, operational for only one year, has experienced a number of spills. Please provide all details available to NGP on each of these spills (including the nature of product spilled, cause of spill, resulting law suits and regulatory actions and destruction to environment).

j) Do you agree that from the experience of the Keystone Pipeline that the fact that a pipeline is new is no guarantee that there will be no spills?

Response: a-c) Please see Attachment Haisla Nation IR 1.9(a-c) - Ruptures and Leaks - Table of Selected Enbridge Liquid Pipeline Spills over the past Decade.

In Haisla Nation IR 1.9a) the Haisla Nation requested information on monitoring procedures and frequency and environmental protection procedures employed. In each case, Enbridge’s emergency response plan was implemented based on the site-specific circumstances of the incident to minimize environmental impacts. In the event of a pipeline incident (spill), Enbridge implements a comprehensive monitoring program that is commensurate to the site-specific conditions. The program employs industry best practices for environmental monitoring.

The objectives of the program are to characterize the extent of contamination arising from the incident, to monitor containment effectiveness and clean-up progress, and to guide the development of further response and remediation plans. The scope of the monitoring program is scalable to the risk, and is determined based on considerations of the local environmental setting, the presence of potential receptors, the status of the spill (contained, uncontained) and the magnitude of the incident.

The program identifies the specific contaminants of concern, and is designed to assess how these contaminants have dispersed in the environment. It typically includes monitoring of all relevant environmental media, which may include air, surface water,
groundwater, soils and sediments. In circumstances where the spill is in a highly sensitive environmental setting, the monitoring program may also include monitoring of fish and wildlife, marine mammals, vegetation, and other potential biological receptors.

Results from the monitoring program are reviewed relevant to applicable Federal and Provincial environmental quality guidelines.

The monitoring program would be implemented immediately following an incident. The duration of the program would be site- and circumstance-specific, and developed in consultation with the appropriate regulatory, Aboriginal and other stakeholder groups.

In Haisla Nation IR 1.9b) the Haisla Nation requests engineering and design specifications and QA/QC procedures during construction and operation of the “above noted projects”. The information would date back to the 1960’s and Northern Gateway is not prepared to compile and provide it.

In Haisla Nation IR 1.9c) the Haisla Nation requests details of regulatory consequences and lawsuits, including current state of litigation, for each spill. Please see Northern Gateway’s response to Coastal FN IR 1.17k.

Northern Gateway has not provided copies of all available documentation related to all matters referred to in Haisla Nation IR 1.9c)(i to iv). The information provided in its responses and the information available publicly provides an appropriate level of detail to assess Enbridge’s spill history in the context of the Project. Northern Gateway is not prepared to compile and provide the documentation requested.

Enbridge’s pipeline integrity management and maintenance program encompasses tools and technologies needed to ensure that pipeline networks have the strength and operating fitness to perform reliably and safely. Enbridge also continues to invest in inspection digs that gather data that help to more completely understand the condition of the pipe and make any needed repairs.

Enbridge has also increased its focus on reducing leaks that can occur at facilities, including pump stations and terminals. Over the last five years, Enbridge has added new integrity measures such as a leak reduction team and a program to reduce leaks in small diameter pipes. No matter what the size or location of the spill, Enbridge takes every incident seriously.
Northern Gateway will design an emergency program that focuses on prevention, preparedness and response. With respect to spill response, Northern Gateway is planning to have a project-specific response capacity. This will include terrestrial and aquatic response capabilities along the pipeline route and a marine capability along the shipping route which will meet or exceed legislated Canadian requirements. For further details, please see the Application (Volume 7B, Volume 7C, and Volume 8C), as well as the General Oil Spill Response Plan.

d) Based upon a review of transportation records and analysis of sampling taken by Enbridge after Line 6B was restarted following the July 2010 incident, the release appears to have occurred at or about the time that the latter end of a batch of Western Canadian Select (WCS) was passing through Marshall, Michigan and a batch of Cold Lake Blend (CL) crude had begun. The composition of the oil released was approximately 77.5 % CL and 22.5 % WCS. Typical industry terminology for this material would be “crude oil”.

As the nature and cause of the release is still under investigation by the NTSB, this determination is based on a number of assumptions regarding the nature and timing of the release. Any change in these assumptions could affect Enbridge’s understanding of the product released in the incident.

e) Not agreed.

f) Enbridge has confirmed that ten enforcement actions are listed on PHMSA’s website. Fourteen incidents met the criteria of “significant.” One of the 14 incidents involved injury or death. Of the 14 total spills, they met some combination of the criteria listed as noted below:

- 1 meets volume, cost and fatality criteria
- 8 meet volume and cost criteria
- 5 meet cost criteria only (volume is less than 50 bbls)

Enbridge’s review of PHMSA’s website identified a total of 84 reportable spills within that timeframe inclusive of all Enbridge business units as well as both mainline and facility leaks.

g) The arithmetic is correct.

One can derive from this a rate of Enbridge releases of 4.6 per 10,000 km-yrs. It should be noted, however, that most of these releases are contained within operating facilities or the RoW and have no offsite impact.
h) Based on NEB data, for 2,354 km of typical pipeline, over a 5-year duration one could predict 4.81 minor leaks, or roughly one leak per year, almost always from aboveground facilities and contained within the fenced area.

The proposed Northern Gateway pipelines will have a significantly lower likelihood of both leaks and ruptures than historical statistics indicate due to technological improvements in pipeline metallurgy, coatings and inspection.

i) Northern Gateway understands that the referenced leaks were of a minor nature and fully contained within facility sites. Northern Gateway anticipates that the causes of the leaks will be understood well in advance of detailed engineering and construction of the Project. Any applicable lessons to be learned will be applied accordingly, including the assessment of risks associated with pipeline commissioning and start-up.

j) It is Enbridge practice to not only comply completely with all applicable regulatory requirements, but also to apply “continuous improvement” to the technology and available processes for designing, constructing, and operating pipelines in Canada. Because of that strategy throughout the industry, performance of more modern pipelines has improved dramatically with no rupture releases coming from NEB-regulated pipelines constructed within the last 25 years. Enbridge will continue to learn from past releases and strive to have zero future releases.
1.10 Kalamazoo, Michigan Line 6B Spill - July, 2010

Reference:  

i) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 12, p. 12-1 (A1S9X8)  
ii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 12.1, p. 12-1 (A1S9X8)  
iii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 1.6.1, p. 1-3 (A1S9X8)  
iv) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble: The rupture of Enbridge's pipeline on July 26, 2010 which spilled 3,785,000 litres of diluted bitumen into the Kalamazoo River system in Michigan is of great concern for a number of reasons:  

1. The product is the same as NGP's proposed pipeline.  
2. Prior to rupture, the pipeline showed numerous signs of internal corrosion which speaks of the corrosive nature of the product.  
3. Enbridge had delayed in fixing the numerous locations where corrosion had been found, indicating a lack of sound and responsible judgment.  
4. When the rupture occurred, the operators and SCADA mistook it for column separation instead of a leak. As such, response was delayed by almost 12 hours.  
5. After the spill, Enbridge president and CEO Patrick Daniel denied that the product was diluted bitumen as opposed to conventional crude; this speaks once again to judgment but also to an apparent desire not to disclose the product.  

Each of the five issues above must be addressed by Enbridge in a forthcoming and detailed manner.

Request: a) The US Department of Transportation Pipeline and Hazardous Materials Safety Association's (PHMSA) September 16 document provides the following information about Enbridge's Kalamazoo spill:  

i. On June 4, 2008, Enbridge received the final report on the 2007 MFL inspections results from the tool vendor. The final report indicated a total of 140 anomalies requiring action within 180 days, of which 26 were repaired and 114 remain. Is this statement accurate? Please provide and fully explain Enbridge's failure to repair all anomalies promptly.  

ii. The 2009 in-line inspection using ultrasonic technology identified 250 anomalies, 35 of which were immediately repaired, and 215
remain. Is this statement accurate? Please provide and fully explain Enbridge's failure to repair all anomalies promptly.

b) The PHMSA's January 21, 2010 Warning Letter to Enbridge, revealed that inspectors had discovered the following:

i. Internal corrosion monitoring was discontinued on the five hydrogen permeation monitors (Beta Foils) installed on Line 6B. Please confirm the accuracy of this finding. Why was monitoring discontinued?

ii. Two manually-interrogated monitors were discontinued in May 2006. Please confirm the accuracy of this finding. Why was monitoring discontinued?

iii. One remotely-interrogated monitor was discontinued in January 2006 and the other two remotely-interrogated monitors were discontinued in October 2007. Please confirm the accuracy of this finding. Why was monitoring discontinued?

iv. Enbridge representatives stated the monitoring was discontinued due to "communications/instrumentation problems". Please provide a full and accurate explanation of what the reasons were for Enbridge's failures to ensure adequate monitoring.

c) Please provide a copy of the PHMSA's warning letter of January 21, 2010.

d) In a Detroit Free Press article published a week after the spill (document attached), it was revealed that warnings to Enbridge had been issued by both the Obama administration and the Department of Transportation (PHMSA):

- The Obama administration had repeatedly warned Enbridge Energy Partners about safety issues along its Lakehead pipeline system. Is this report accurate? Please provide copies of all warning letters and all other related documentation in Enbridge's possession and control.

- Enbridge company officials were called to Washington earlier in the year [2010] for a meeting on what it deemed "a series of major failures." Some of the concerns specifically involved Line 6B. Is this report accurate? Please fully describe and provide all documentation relating to any such meeting.

- The U.S. Department of Transportation -- which oversees oil pipelines through its Pipeline and Hazardous Materials Safety Administration, or PHMSA -- raised additional concerns about Enbridge's record. Is this report accurate? Please provide all
documentation relating to concerns raised by the United States Department of Transport.

- senior Transportation Department official said the administration "repeatedly warned Enbridge in no uncertain terms that it needed to get its act together with regard to the safety of its Lakehead pipeline system." Is this report accurate? Please provide details and copies of all documentation relating to these warnings.

- The official said PHMSA officials met with Enbridge senior leadership in February to tell them to "overhaul their entire approach to safety." Is this report accurate? Please provide all documents relating to this meeting.

e) Please provide detailed information concerning the findings of numerous anomalies along Line 6B.

f) Please explain why Enbridge failed to make the required repairs in a timely way.

g) Enbridge CEO and president Patrick Daniel delivered a speech in May, 2011 to Enbridge shareholders (document attached) which contained the following with regard to the Kalamazoo spill:

"From the outset we have worked closely with residents in the Marshall and Battle Creek area to address their individual needs. To date, we have met the cleanup deadlines and milestones set by the Environmental Protection Agency."

Enbridge CEO Patrick Daniel

Does NGP now admit that documentation from US government bodies and media sources reveals that Enbridge both has failed to meet EPA milestones and has failed to meet individual needs of Marshall residents?

h) When Mr. Daniel made the statement quoted above, was he aware that it was not accurate?

i) If Mr. Daniel was unaware of the inaccuracies in his statement, why had he not been properly briefed?

j) When did Mr. Daniel become aware that his statement was inaccurate?

k) When did Mr. Daniel provide a public correction of this inaccurate statement?

l) With regard to EPA compliance, documents to Enbridge from the EPA since the spill include (documents attached):

October 5, 2010 - Notice of Disapproval regarding Enbridge's Supplement Resource Plans

June 27, 2011 - Notice of EPA Determination of Enbridge Non-Compliance

June 28, 2011 - Notice of Potential Non-Compliance

Please detail all incidents of Enbridge's regulatory non-compliance pertaining to this incident and disclose all related documents.

m) With regard to addressing the individual needs of area residents affected by the spill, a Michigan Messenger article from January 31, 2011 (document attached) states that Enbridge is arguing that it is not legally liable for damages from the spill. Is this report accurate? Please provide all documentation relating to third party claims relating to the incident.

n) In a county court case in Michigan, the company argued that it cannot be held liable for the spill of diluted bitumen because it followed all relevant laws regulations and industry standards. Enbridge claimed the damage was not foreseeable. The company had often claimed after the spill that it would take responsibility in addressing the needs of affected people and businesses. A quote from the company in the court proceedings, contained in the article, said "The statements at issue, that were made in Defendants' press releases and brochure, were mere expressions of intention, not offer." Is this report accurate? Please make full documentary disclosure in relation to the litigation being referred to.

o) Apart from compliance issues with spill clean-up, there are many sources who expressed displeasure with Enbridge's handling of the situation. The EPA's June 28, 2011 letter to Enbridge was titled: "Re: U.S. EPA Notice of Potential Non-compliance in response to the Administrative Order issued by U.S.EPA on July 27, 2010, pursuant to 311(c) of the Clean Water Act and Supplement to the Administrative Order issued by U.S.EPA on September 23, 2010 - Inadequate Enbridge Response Management". In the letter, the EPA expressed concern about Enbridge's senior management on-site involvement of the Kalamazoo spill. Please disclose the letter and advise whether Enbridge contests the accuracy of any aspect of the letter. If so, what aspects are contested and why?

p) Canada Business (www.canadabusiness.com) article Enbridge: Under Pressure posted April 7, 2011. Here the US Deputy Secretary of Transportation said:

"I am deeply troubled by Enbridge's detection of and response to this oil spill," said John Porcari, the deputy secretary of transportation, at a hearing in September [2010]."
Please provide all available information or concerning Enbridge's detection of and response to this oil spill.

q) Over one year after the spill, the EPA's dedicated Enbridge spill website (www.epa.gov/enbridgespill) posts the following information:

"After a year of extensive cleanup work in the Kalamazoo River system, the U.S. Environmental Protection Agency has identified pockets of submerged oil in three areas covering approximately 200 acres that require cleanup. Work during the summer of 2011 is focused on:

- Revisiting shoreline areas cleaned up in 2010 where winter weather and spring floods exposed previously unseen oil or spill impacts.
- Recovering pockets of submerged oil in the sediment. EPA has identified three major submerged oil areas including the delta leading into Morrow Lake."

Please provide copies of all studies, reports, correspondence or the documentation concerning the impacts and effects of this major spill of diluted bitumen. Please provide a detailed explanation of the implications that this spill, and the events occurring before and after the spill, have for the transport of the same substance by way of the NGP Project.

r) Please provide a detailed description of what Enbridge's QA/QC procedures were prior to the Kalamazoo, Michigan spill.

s) Please provide a detailed report on Enbridge's management of internal corrosion protection in Line 6B prior to the July 26, 2010 spill.

t) Please provide detailed information on why internal corrosion on Line 6B was an issue. Please confirm that Line 6B carries the same product as NGP is proposing for its pipeline from Bruderheim to Kitimat.

u) Please provide information on whether or not Line 6B had internal coating.

v) Please provide each inspection report, by Enbridge personnel as well as by regulatory inspectors, which found anomalies along Line 6B prior to the rupture.

w) Please provide the reports which detail Enbridge's decision not to fix all anomalies found during inspections along Line 6B prior to the rupture.

x) Please provide documentation of the meeting to which Enbridge was called in Washington in February 2010.
y) Please provide a detailed report on the detection of and response to this oil spill in terms of SCADA and the Edmonton operators of Line 6B. Include an exact timeline as well as details on the line shutdown and re-start while the rupture was still occurring.

z) Please provide a response to both the EPA's September 23, 2010 letter as well as the aforementioned quote by the deputy secretary of transportation.

aa) Please provide a detailed log of the number of times that Line 6B has registered false positives and the ensuing response both by SCADA and by operators.

bb) Please provide an in-depth case study of the causes and response to the Kalamazoo, Michigan spill of diluted bitumen in July, 2010.

c) Please explain why Patrick Daniel at first denied that Line 6B was carrying diluted bitumen.

d) Please provide a detailed analysis of the environmental and social impacts and effect of the Kalamazoo, Michigan spill in July, 2010.

e) Please provide an explanation for why the EPA felt compelled to cite Enbridge with this requirement to submit a Response Management Work Plan Revision.

ff) The letter discussed in the preamble also references Enbridge's August 14, 2010 Response Management Plan which was submitted following the "U.S. EPA's August 13, 2010 determination that Enbridge's senior management involvement on-site was inadequate and not commensurate with the needs of the response organization established to meet the objectives of the Order [Administrative Order issued by the U.S. EPA on July 27, 2010]." Please provide a written explanation of how Enbridge's on-site involvement was inadequate.

gg) Please provide all correspondence between Enbridge and regulatory agencies after the July 26, 2010 spill, as well as the current status of any outstanding infractions.

hh) Please provide an explanation of Enbridge's community support and the current status of any litigation which resulted from the spill.

ii) Please provide a comparison between spill modelling from Line 6B and the actual spill effects documented since the July 26, 2010 spill.
jj) Please provide the evidence that the difference between diluted bitumen and conventional crude oil has been taken into account by NGP in its spill modelling provided in the Application and its appendices.

Response:

a) Yes, the data is accurate. All of the remaining features were maintained to an appropriate safety factor using pressure restrictions while Enbridge determined the feasibility and permitting timeline of a plan to mitigate these features through replacement of certain pipe segments. Pipeline replacement segments that were completed in March 2011 concluded the remediation of the last remaining features.

b) On January 21, 2010, Enbridge Energy, Limited Partnership received a warning letter from PHMSA. This correspondence advised the Partnership to correct a gap regarding internal corrosion monitoring instruments installed on Line 6B. Enbridge does not believe that this gap at any time represented a risk to the public or the environment.

While receiving the warning letter is concerning, Enbridge believes this identified gap represents a small component of a comprehensive suite of corrosion monitoring and management activities on Line 6B. Enbridge was in the process of transitioning to a new monitoring technology and took action to respond to the letter by installing a new internal corrosion pipe wall loss monitor in June 2010 on Line 6B. This is new and better technology than that specified in the applicable regulations, and Enbridge believes the deficiency outlined in the correspondence was addressed with these measures.

c) Please see Attachment Haisla Nation IR 1.10c).

d) Enbridge participates in dozens of inspections each year on the Lakehead System. During those inspections, comprehensive reviews of operating procedures are performed, hundreds of routine inspection records are reviewed, or observations for compliance in facility or construction audits are performed. These are thorough inspections that take multiple days in many instances.

These inspections resulted in 29 enforcement actions by the regulatory agencies over an eight-year period. Seventy per cent of these actions were in the form of Warning Letters or Notice of Amendments that identified shortcomings in plans or procedures, or enforcement actions regarding a practice that was not of immediate concern to pipeline safety.

Enbridge take all enforcement actions seriously. Enbridge has shown by its actions that it is responsive to the regulators’ guidance and recommendations and Enbridge’s compliance is a matter of public
record. Public Information on Enbridge’s record with PHMSA is available online at the PHMSA website.

e) The request lacks sufficient specificity to provide a response.

f) The request lacks sufficient specificity to provide a response. Enbridge maintains a rigorous integrity and compliance program that includes in-line inspections, dig investigations, and repair programs that are conducted in accordance with applicable regulations. The integrity and compliance program is intended to assure safety and compliance with applicable regulations and we believe the public record reflects our continued compliance and responsiveness to regulatory inquiries, guidance and recommendations.

g) Mr. Daniel’s statement was accurate when made. Enbridge has worked diligently at all times to meet deadlines set by the U.S. EPA for clean-up of the source area and Talmadge Creek, and primary cleanup of the Kalamazoo River and submerged oil. While Enbridge did not meet the recent August 31, 2011 deadline established by the EPA, there were many changed field conditions that occurred after the deadline was established in June 2011 that contributed to increasing the scope and complexity of the remediation effort during the course of the summer. Nevertheless, Enbridge continues to work diligently under the existing regulatory orders and work plans and will continue the remediation efforts so long as necessary.

Enbridge has worked closely with local residents from the outset to resolve claims, discuss work activity on specific properties and answer questions. Enbridge has resolved the great majority of claims with those residents who are most affected, including those who own properties along Talmadge Creek and the Kalamazoo River. Enbridge appreciate the willingness of local residents to work directly with Enbridge to resolve their claims. Each claim is evaluated on an individual basis and on its own merits.

h) Please see Northern Gateway’s response to Haisla Nation IR 1.10g).

i) Please see Northern Gateway’s response to Haisla Nation IR 1.10g).

j) Please see Northern Gateway’s response to Haisla Nation IR 1.10g).

k) Please see Northern Gateway’s response to Haisla Nation IR 1.10g).

l) Public information regarding the Line 6B incident is available online at the EPA’s website, the Michigan Department of Environmental Quality (DEQ)’s website and at Enbridge Inc.’s website.
m) Enbridge has never denied responsibility for the leak. Statements from the outset have acknowledged Enbridge’s responsibility for the leak. However, there have been some claims that were denied or contested based on their correlation to the incident itself or lack of documentation to support the claimed damages, which has always been a requirement for compensation for legitimate damage claims. In some instances, individuals have exercised their right to pursue remedies through the legal system and Enbridge is responding to those claims accordingly.

As the cause of the incident is still under investigation, statements made in court filings are part of the process of litigation and intended to preserve Enbridge’s legal rights. These statements do not represent a change in Enbridge’s intentions. Enbridge remains fully committed to paying all legitimate damages that are a direct result of the incident. Enbridge will not comment further on the specific details of pending litigation.

n) Please see Northern Gateway’s response to Haisla Nation IR 1.10m).

o) Public information regarding the Line 6B incident is available online at the EPA’s website, the Michigan DEQ’s website, and at Enbridge Inc.’s website. Enbridge responds to all issues and concerns raised by the EPA and will continue to work cooperatively with the EPA and other regulatory agencies to proactively respond to the incident.

p) Public information regarding the Line 6B incident is available online at the EPA’s website, the Michigan DEQ’s website, and at Enbridge Inc.’s website. As the cause of the incident is still under investigation by the NTSB, the NTSB has advised Enbridge not to comment on any specific details associated with the investigation until after the NTSB incident report is released.

q) Enbridge has committed since the outset of this incident to restore the impacted area as fully as possible and to the satisfaction of the regulatory agencies and the local community. Enbridge remains fully committed to that goal.

Submerged oil was identified in approximately 180-200 acres of the river system, 90 percent of which is in three primary locations near the Ceresco Dam, the Mill Pond area and the delta/fan area as the river enters Morrow Lake. The submerged oil is present in small amounts ranging in size from a pencil eraser to an adult fist; these are referred to as globules. The submerged oil is located in the fine sediments. These sediments are being agitated using a number of techniques (mechanical agitation, aeration and hydraulic flushing) to release the oil and sheen
into the water, where it is captured and removed. Enbridge will continue to monitor submerged oil with the EPA and the Michigan DEQ and develop recovery plans going forward as remaining sheen and oil deposits are identified.

Public information related to the Line 6B Incident is available online at the EPA’s website, the Michigan DEQ’s website, and at Enbridge Inc.’s website.

r) The request lacks sufficient specificity to provide a response. Please see Northern Gateway’s response to Haisla Nation IR 1.10p).

s) To the extent the request seeks information relating to the July 2010 Line 6B Marshall, MI incident, that information will not be provided as the cause of the incident is still under investigation by the NTSB. The NTSB has advised Enbridge not to comment on any specific details associated with the investigation until after the NTSB incident report is released. Public information on Enbridge’s record with PHMSA is available at the PHMSA website.

t) Please see Northern Gateway’s response to Haisla Nation IR 1.10p). For information regarding type of product proposed to be carried by Northern Gateway, please see Northern Gateway’s response to Haisla Nation IR 1.9d) and 1.38c).

u) Line 6B does not have internal coating.

v) The request lacks sufficient specificity to provide a response.

w) Please see Northern Gateway’s response to Haisla Nation IR 1.10a) and 1.10b).

x) Please see Attachment Haisla Nation IR 1.10x).

y) Please see Northern Gateway’s response to Haisla Nation IR 1.10p).

z) Please see Northern Gateway’s response to Haisla Nation IR 1.10p).

aa) Please see Northern Gateway’s response to Haisla Nation IR 1.10e).

bb) Please see Northern Gateway’s response to Haisla Nation IR 1.10p).

cc) Please see Northern Gateway’s response to Haisla Nation IR 1.9d).

dd) Enbridge has worked closely with local residents from the outset to resolve claims, discuss work activity on specific properties and answer
questions. Enbridge has resolved the great majority of claims with those residents who are most affected, including those who own properties along Talmadge Creek and the Kalamazoo River. Enbridge appreciate the willingness of local residents to work directly with Enbridge to resolve their claims. Each claim is evaluated on an individual basis and on its own merits. Additional information on Enbridge’s community response efforts is available online at Enbridge Inc.’s website.

In accordance with the *Natural Resources Damages Assessment* (NRDA) process, the effects of the Line 6B incident on the environment are being assessed by designated trustees of the impacted natural resources to determine the need for remediation or reparations. That assessment is ongoing at this time.

ee) Enbridge cannot speak for the EPA. Enbridge responds to all issues and concerns raised by the EPA and will continue to work cooperatively with the EPA and other regulatory agencies to proactively respond to the incident. The incident response remains a top priority for Enbridge and Enbridge’s management team remains fully committed to the goal of restoring the impacted area as fully as possible and to the satisfaction of the regulatory agencies and the local community.

ff) Please see Northern Gateway’s response to Haisla Nation IR 1.10ee).

gg) Public information related to the Line 6B incident is available online at the EPA’s website, the Michigan DEQ’s website and at Enbridge Inc.’s website.

hh) Enbridge has worked closely with local residents from the outset to resolve claims, discuss work activity on specific properties and answer questions. Enbridge has resolved the great majority of claims with those residents who are most affected, including those who own properties along Talmadge Creek and the Kalamazoo River. Enbridge appreciate the willingness of local residents to work directly with Enbridge to resolve their claims. Each claim is evaluated on an individual basis and on its own merits. Additional information on Enbridge’s community response efforts is available online at Enbridge Inc.’s website.

Enbridge will not comment on the specific details of pending litigation.

ii) This type of spill modeling was not conducted for Line 6B.

jj) The information provided in the Application (Volume 3 and Volume 7B), refer to different types of hydrocarbons transported by the pipelines.
The oil pipeline will transport a variety of products including diluted bitumen and synthetic oil. As described in the Application (Volume 3, Section 1.6.1), the pipeline will be designed, constructed and operated to meet or exceed applicable regulations, codes and standards as well as Enbridge’s standards, specifications and manuals. As discussed in the Application (Volume 7B), with respect to the oil pipeline, the data on physical and chemical properties, weathering and fate, and effect of spills on the biophysical environment are based on both diluted bitumen and synthetic oil. The hypothetical spill examples for the oil pipeline are all based on synthetic crude. This is a conservative assumption because this product has a lower viscosity compared to diluted bitumen and would tend to travel further overland and potentially enter more watercourses.
1.11 Wisconsin Spill - February, 2007

Reference:  

i)  Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 12, p. 12-1 (A1S9X8)  

ii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 12.1, p. 12-1 (A1S9X8)  

iii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 1.6.1, p. 1-3 (A1S9X8)  

iv) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble: The construction of Enbridge's Southern Access pipeline in Wisconsin began in 2007 and within the first year, 500 violations were cited by the Wisconsin Department of Justice (WDOJ). Included in the 500 were 282 wetlands violations and 176 land disturbance and erosion control violations near navigable water and wetlands. In 2009, the WDOJ determined that Enbridge must pay $1,100,000 in fines for more than 100 of its environmental law violations across 14 counties. These facts are documented on the WDOJ website (www.doj.state.wi.us) and the Wisconsin Wetlands website (www.wisconsinwetlands.org/enbridge.htm).

Construction violations were not the only mistakes made by Enbridge in Wisconsin at that time. An existing Enbridge pipeline ruptured outside the town of Curtis in January, 2007, spilling more than 109,800 litres of oil onto an adjacent farm field. According to a Journal Sentinel article from February 16, 2007 (document attached), an Enbridge spokeswoman said "the pipeline inexplicably cracked open"; the rupture spewed oil until an operator could shut down the flow from the operations center in Edmonton.

One month later, a Southern Access pipeline construction crew struck one of the existing pipelines on February 2, 2007, releasing 567,800 L of heavy crude into a Rusk County Farm field. The spill seeped into the groundwater, contaminating the local water table and was one of the largest pipeline ruptures in state history (Journal Sentinel February 16, 2007 article).

Request:  

a) Please provide documented details of the fines accrued by Enbridge by the Wisconsin Department of Justice for each of its environmental law violations.

b) Please explain how "the pipeline inexplicably cracked open". What was the actual cause of this pipeline rupture? Please provide a detailed explanation of what occurred including environmental monitoring reports, pipeline inspection reports, and other related studies, technical reports correspondence.

c) Please provide details of the cleanup efforts from the February 2, 2007
spill and how the groundwater was both affected and remediated. Please provide water testing and site remediation records.

**Response:**

a) Enbridge was not fined by the Wisconsin Department of Justice ("WDOJ") in connection with either of the 2007 incidents. The preamble to this information request accurately states the fines that were assessed in 2009 by WDOJ.

b) In January 2007, Enbridge’s Line 14 ruptured and leaked about 1,500 barrels of oil into a farm field. No wetland or drinking water was at risk. Within a week of the leak, Enbridge had thoroughly remediated the site by removing all of the oil and contaminated soil. Also within that timeframe, the pipeline was repaired and returned to service. 

   *Attachment 1 Haisla Nation IR 1.11b*, is a copy of PHMSA’s September 4, 2008 correspondence, wherein PHMSA acknowledges the measures taken by Enbridge following the incident and consents to Enbridge’s request to return the line to normal operations. Also attached is a copy of the June 2007 Closure Report submitted by Enbridge to the Wisconsin Department of Natural Resources (WIDNR) requesting approval to cease further remediation efforts (Attachment 2 Haisla Nation IR 1.11b). WIDNR approved closure of the site on June 15, 2007, as indicated in the Attachment 3 Haisla Nation IR 1.11b).

c) Remediation of the February 2007 leak is ongoing. As of August 2011, following consultation with the Wisconsin Department of Natural Resources (WDNR), Enbridge requested approval for a temporary shutdown of the remediation system due to low and stable hydrocarbon concentrations in emissions from the soil vapor extraction system. Public information relating to the incident is available from the WDNR.
1.12 **Cheecham, Alberta Spill - January, 2009**

**Reference:**

i) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 12, p. 12-1 (A1S9X8)

ii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 12.1, p. 12-1 (A1S9X8)

iii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 1.6.1, p. 1-3 (A1S9X8)

iv) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

**Preamble:**

In January, 2009, a failed vent valve leaked at an unmanned facility near Fort McMurray, Alberta, spilling 914,000 litres of oil. Oil sprayed vertically 30 to 40 metres in the air and oil mist was blown off-site, contaminating an area of 450 metres by 1,500 metres downwind of the facility, as documented in Enbridge's 2010 Corporate Social Responsibility Report (document attached). The leak was undetected for two to three hours, and was not picked up by the detection system.

Questions and concerns are raised on a number of levels with regard to this spill and potentially similar issues with the NGP: mechanical failure risks, lack of leak detection by SCADA and the remoteness of most of the NGP pipelines. All pump stations (with the exception of the terminals) are unmanned, as is the entire 1,177 km of pipeline corridor.

**Request:**

a) Please provide documentation and instrumentation detail on the SCADA monitoring system which did not immediately register the failed valve.

b) Please indicate in detail the differences between the monitoring thresholds on the Cheecham pipeline and the planned sensitivity for the NGP pipelines.

c) Please explain why the Cheecham monitoring system did not detect the leak.

d) What steps does NGP propose to take to ensure that the detection problems with respect to the Cheecham spill are not repeated in the context of the NGP pipeline?

**Response:**

a) SCADA instrumentation consists of pressure measurement at the suction and discharge of the station, in addition to pressure measurement distributed at the suction and discharge of every pump, flow meter run and manifold. Leaks through small bore piping cause a very small pressure drop that remained undetected by the monitoring system.
b) Enbridge uses multiple approaches for leak detection on its oil pipelines. These approaches are designed to provide comprehensive and overlapping leak detection capabilities. Two of the approaches to be used in detecting leaks on the Northern Gateway pipelines include the use of monitoring thresholds, which if exceeded will trigger leak detection alarms in the Enbridge Edmonton Control Centre and will require investigation to determine root cause. These two approaches are:

- Scheduled line balance calculations. These are sometimes called “over/short reports” in the industry. They are calculations of oil inventory done at fixed intervals (example: 2 hour, 24 hour intervals, etc). The purpose for leak detection is to identify unexpected losses of inventory that may indicate possible leaks. Enbridge currently utilizes a line balance feature within the Commodity Movement Tracking (“CMT”) system. Line balance calculations are monitored by the Enbridge Edmonton Control Centre.

- Computational Pipeline Monitoring (“CPM”). This is computer-based monitoring using continuous measurements of pipeline conditions. This is an industry standard for dedicated leak detection. CPM is the primary Enbridge real-time system for detecting leaks on all of its liquids pipelines. This application is developed and maintained by the Leak Detection department to support the Enbridge Edmonton Control Centre operations.

An estimate of the minimum detectable leak size for the Northern Gateway pipelines for both of these approaches will be determined during detailed engineering. An estimate of how the sensitivity of the Northern Gateway pipelines compare to Line 19 (“the Cheecham pipeline”) cannot be completed at this stage in the design.

c) See response to Haisla Nation IR 1.12a) above.

d) Enbridge is actively investigating and testing a number of alternative leak detection technologies that are complimentary to the current leak detection system and aimed at detecting smaller leaks. If the performance is acceptable, Enbridge would plan to implement one or more of these alternative technologies on the Northern Gateway pipelines.
1.13 Northern Gateway Project and Keystone Diluted Bitumen Pipelines

Reference:  
i) Terms of Reference, Joint Review Panel Agreement (A1R4D5)  
ii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 12, p. 12-1 (A1S9X8)  
iii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 12.1, p. 12-1 (A1S9X8)  
iv) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 1.6.1, p. 1-3 (A1S9X8)

Preamble: The Keystone Pipeline transports diluted bitumen from Alberta to refineries in Illinois and Oklahoma; it was commissioned in 2010. The proposed extension of this system, Keystone XL, is currently undergoing regulatory assessment. The Keystone XL project aims to transport diluted bitumen from Alberta via pipeline to Texas.

The fact that the Keystone system and NGP carry the same oil product as well as the fact that they are new and/or proposed projects renders them worthy of comparison, even though they are run by different companies.

In a June, 2011 letter from the US Environmental Protection Agency (EPA) to the US Department of State (document attached), the EPA provided its comments on the Keystone XL Project's Draft Supplemental Environmental Impact Statement (SDEIS). This letter states that pipeline oil spills are a very real concern and refers specifically to two of Enbridge's 2010 spills in Michigan and Illinois.

TransCanada's Keystone I pipeline carrying diluted bitumen has already spilled 4 times in six months of operation. However, the company's Environmental Impact Statement predicted 1.4 to 1.9 spills over 10 years (NRDC and Sierra Club Comment Letter to US Department of State, 2010, document attached).

Request:  
a) Do you agree that the Keystone routes do not face the geotechnical risks and hazards or the remoteness of the route the NGP pipeline will cross? If not, please explain why not.

b) Please provide a detailed plan on how NGP pipelines spill risk will differ from the Keystone I pipeline which, in its first 6 months, has already had 4 leaks.

c) Please provide a detailed comparison between Keystone I pipeline's EIS projection of spills and NGP's spill projection.

Response:  
a) Northern Gateway cannot comment specifically on the Keystone routes. Generally, any long distance pipeline construction in North America
faces geotechnical risks and hazards. Pipeline planning and construction addresses these matters through the engineering design, geographical assessments, geotechnical assessments and risk assessments, pipeline construction techniques, and adherence to industry and regulatory standards, codes and regulations that apply or relate to the proposed pipeline route. Similarly, Northern Gateway has successfully addressed geotechnical risks and hazards in its planning of the Project. Please refer to Northern Gateway’s Response to JRP Request for Additional Information (March 2011), for additional information.

b) Northern Gateway understands that the referenced leaks were of a minor nature and fully contained within facility sites. Northern Gateway anticipates that the causes of the leaks will be understood well in advance of detailed engineering and construction of the Project. Any applicable lessons to be learned will be applied accordingly, including the assessment of risks associated with pipeline commissioning and start-up.

c) PHMSA statistics, used in the Keystone 1 EIS projection, generally agree with NEB statistics for pipelines in Canada. Please see the Northern Gateway’s response to Haisla Nation IR 1.9h).
Aboriginal and Treaty Rights

1.14 Adverse Effects on Aboriginal Rights


Preamble: The Application states that "Northern Gateway has determined that the Project will [sic] is not likely to cause significant adverse effects on the environment. Northern Gateway is therefore confident that the Project will not have significant adverse effects on those who depend on the land and water for sustenance, including Aboriginal groups who may exercise their Aboriginal or Treaty rights in the use of land for traditional purposes."

Request: a) Please clarify whether NGP has concluded that the Project will or that the Project is not likely to cause significant adverse effects on the environment.

b) Please define "likely".

c) Given this definition, was the Exxon Valdez oil spill likely?

d) Please define "significant"?

e) Did the Exxon Valdez oil spill have a significant effect on the environment?

f) Did the Exxon Valdez oil spill have significant adverse effects on those who depend on the land and water for sustenance, including Aboriginal groups who exercise their Aboriginal or Treaty rights in the use of land for traditional purposes?

g) Does NGP concede that its project will infringe the Aboriginal title of the Haisla Nation to lands along the proposed pipeline route and to lands at the proposed terminal site?

h) If not, explain the basis for this conclusion and provide all documentation relevant to this conclusion.

Response: a) Conclusions for the Environmental and Socio-economic Assessment (ESA) are provided. Please refer to Application (Volume 6A, Section 15, Volume 6B, Section 16 and Volume 8B, Section 15).

In the case of effects associated with the routine activities during construction, operation and decommissioning of the Northern Gateway
pipeline, the ESA concluded that:

- The Northern Gateway pipeline would not result in significant adverse effects on the terrestrial environment (Application (Volume 6A)). To achieve this, Northern Gateway has committed to a suite of project design features, mitigation measures and environmental management measures. Of note, specialized measures will be employed during pipeline construction to minimize effects on freshwater fish and fish habitat. A number of measures, including centre surveys and detailed routing of the pipeline and an access management plan, will be used to minimize effects on sensitive wildlife species such as grizzly bear, caribou and mountain goats.

- The Northern Gateway pipeline would not result in significant adverse effects on the marine environment (Application (Volume 6B and Volume 8B)). As with the terrestrial effects, Northern Gateway committed to a suite of measures to ensure environmental effects would be minimized over the life of the Project.

Given these conclusions for routine activities, as no significant adverse environmental effects are predicted for terrestrial or marine biota or the ecosystems on which they depend, the Project is also not expected to result in any significant adverse effects on the abundance, distribution or diversity of resources harvested by Aboriginal people or the land which supports these resources. Use of standard mitigation measures, such as route refinements, construction monitoring and construction techniques designed to minimize disturbance of traditional use resources and site specific features (e.g., trails) will be incorporated into Project design and execution.

Accidents and malfunctions that could be associated with the Northern Gateway pipeline were also assessed for the pipeline, marine terminal and marine transportation components of the Project (see Application Volume 7B, Volume 7C and Volume 8C)). Depending on the biophysical setting (e.g., location, season of year, species present, weather conditions, sea conditions) and the magnitude and duration of a spill, there is potential for significant adverse effects to occur to some biota and the ecosystems that support these species. These effects on certain biota could, in turn, affect resources commonly understood to be of importance to Aboriginal peoples or the ecosystems that support these resources. The exact nature of these effects could differ widely as a result of many variables, as would the success of clean-up operations, habitat rehabilitation and species recovery.

While there is potential for spills to result in significant adverse consequences on the biophysical environment, the probability of large
spills is considered to be low and therefore any significant adverse effects is unlikely. Nonetheless, given the potential adverse consequence of a major spill on the biophysical environment, Northern Gateway has committed to a broad suite of project design measures, construction procedures, operational measures and protocols, and health and safety measures and audits. Northern Gateway is committed to meeting or exceeding minimum regulatory requirements and industry practice to drive the possibility of an accident or malfunction to as close to zero as practically possible during the life of the Project.

b) The term “likely” is used in this context as a qualitative estimate of probability. For specific information on how adverse environmental effects were characterized and quantified, please see the Methods section (Section 4) in each of the above volumes. In addition, specific definitions for the effect characterization terms are provided in the assessments for each biophysical discipline. Furthermore, as discussed in more detail in Northern Gateway’s response to Haisla Nation IR 1.14d), certainty was also considered in relation to the effects prediction and mitigation success.

c) Northern Gateway has not completed a risk assessment of Prince William Sound operations pre-1989 and cannot comment on the likelihood of the Exxon Valdez Oil Spill (“EVOS”).

The Alaska Department of Environmental Conservation’s website discusses the vast changes in oil spill prevention and response planning that has occurred since 1989. Since the EVOS occurred, more than 11,000 tankers have been escorted out of Prince William Sound.

d) As is discussed in the Methods section of the Application (Volume 6A, Volume 6B and Volume 8B, Section 4), a determination of the significance of project environmental effects is made using standards or thresholds that are specific to the Valued Environmental Components (“VEC”), Key Indicators (“KI”) and/or the measurable parameters used to assess the environmental effect.

Determinations include a discussion of prediction confidence based on:

- scientific certainty relative to quantifying or estimating the environmental effect, including the quality and/or quantity of data and the understanding of the effect mechanisms
- scientific certainty relative to the effectiveness of the mitigation measures

e) Northern Gateway did not conduct an effects assessment of the EVOS. As is discussed elsewhere in various Northern Gateway responses to the
Haisla Nation, the Project concurs that, under certain conditions, a large oil spill could result in significant adverse environmental effects. However, the probability that such a spill will occur has been shown to be low.

f) Concerns of the Haisla Nation regarding potential effects of a hydrocarbon spill on the current use of lands and resources for traditional purposes are valid. However, the assumption that a spill would cause irreparable environmental devastation and destroy First Nations cultures is not borne out by analysis of the long-term effects caused by the EVOS.

Immediately after the EVOS, subsistence harvests in Tatitlek, Chenega Bay, Nanawalek (English Bay), Port Graham and Ouzinkie virtually ceased (Fall et al. 2001:170). People were suspicious of the quality of the wild resources and feared the harvests had effectively been poisoned.

The Oil Spill Health Task Force was formed in 1989 to assess the health of the foods by analyzing fish and shellfish from the region. Finfish were found to be safe to eat, but shellfish and crabs from highly contaminated beaches were not. People continued to express fear over the health of wild foods and it took another three years of testing and agency dissemination of results to allow most people to feel comfortable enough to conclude that wild foods were safe to eat.

Immediately after the spill, emergency food relief programs, in which other non-spill area villagers shared portions of their subsistence harvests (with logistics assistance by the State of Alaska and Exxon), provided most households with subsistence food. Other fish and grocery distribution programs also provided short-term compensation for the loss of subsistence foods. These programs were not a perfect solution, but enabled households to continue to function.

Meanwhile, incomes increased during the oil spill year (1989) for all household types due to increased wage incomes. Clean-up jobs provided income above normal levels, and the active elder households (normally low income producers) actually earned the most income during the oil clean-up phase.

In addition to increased employment opportunities immediately after the spill, the EVOS Trustee Council provided compensation to Alutiiq villages for community-based projects during the years following the EVOS. This partially countered the injuries to the natural environment which those communities relied upon (Fall et al. 2001). Projects included fish stock enhancement, subsistence and educational facilities,
cultural education projects, wild foods safety projects, mariculture development projects, wild resource assessments and local participation in restoration projects. These community-focused projects reduced the long term effects of the initial spill effects and enhanced the subsistence economy and cultural values shared by the communities.

Fall et al (2001:287) concluded that during the oil spill crisis, the basic organization of the factors of production and distribution remained stable. The spill did not trigger a collapse at the basic local level of the extended household networks typical of the Alutiiq villages. “While the spill created major local disruptions of food procurement and employment patterns, the spill did not transform the pattern of relationships in the subsistence sector. The traditional extended kinship networks adapted to the short-term crisis of food production and distribution at the local level without major dislocations in the underlying structure of production and distribution.”

Fall et al (2001:292) concluded “While the injuries have been great, and tragic to some users (such as the Alutiiq), they have not been considered irreparable . . .” The pattern of relationships within the villages remained intact partly because resources were available (specifically food relief and income derived from clean-up jobs) to compensate for lost subsistence harvests and households shared them as they typically shared harvested natural resources.”

The EVOS example indicates that short-term compensation for adverse socio-economic effects can help reduce long term effects. The important caveat being that the extended household networks remain intact and the short-term compensation is such that it can be integrated into the networks.

Northern Gateway is prepared to work with coastal Aboriginal communities to identify methods and procedures, specific to the North Central coast of British Columbia, to compensate in kind and financially for adverse socio-economic effects. These measures may differ from those described for the communities affected by the EVOS.

References:

Aboriginal title. However, Northern Gateway does acknowledge the potential for claims of Aboriginal rights and title along the proposed pipeline route and at the proposed terminal site. Northern Gateway believes that the Crown consultation activities, including the Crown Consultation Framework established for the Project will be sufficient to adequately address, and if necessary, accommodate the interests of the Haisla Nation and other First Nations whose exercise of asserted Aboriginal rights or use of lands subject to claimed Aboriginal title could be affected.
1.15 Socio-Economic Impacts - Direct and Indirect

Reference:  
 i) Exhibit B24-2 Volume 5A - Additional Evidence June 2011, Section 5.9.3, p. 5-321 (A1Z6R1)
 ii) Exhibit B3-16 Volume 6C - Application dated May 2010, Section 4 (A1T0G6)

Preamble: In response to Haisla Nation concerns about potential socio-economic impacts of the project, the Application refers to Vol. 6C, Section 4 for the socio-economic assessment.

Request:  
 a) What parameters have been used to assess indirect socioeconomic impacts on Haisla Nation traditional use of land and resources?

 b) In what way does the socio-economic impact assessment consider indirect changes to Haisla Nation traditional use of lands and resources resulting from the presence of an industrial project and the fear of a spill or malfunction?

 c) Please provide all relevant studies and documents obtained, prepared, undertaken, or commissioned by NGP relevant to this issue.

Response:  
 a) The assessment of project effects on the social and economic effects of the Project on regional employment opportunities and regional business opportunities, regional population changes, community services, regional transportation and infrastructure, and individual family and community well-being was filed as Application Update (Volume 6C, Section 4.4 (October 2010)). This section describes the potential social and economic effects of Project construction and operations in terms of six different regions along the pipeline corridor (including the Kitimat terminal). The analysis of Project effects in the Coastal BC region examined the possible effects of construction and operation at a regional level, with the region including six Aboriginal groups, one of which was the Haisla Nation (Application (Volume 6C, Table 4.4-1)). Project effects were not assessed for individual communities or Aboriginal communities.

 b) An assessment of the effects of a project on traditional use by Aboriginal people is required under the Canadian Environmental Assessment Act (“CEA Act”); specifically, the definition of environmental effects in the Act includes “the current use of lands and resources for traditional purposes by Aboriginal persons”. In addition, the draft List of Issues to be considered by the JRP for the Project (NEB and Minister of Environment 2009) includes “potential impacts on... Aboriginal interests:”
Effects on traditional use by Aboriginal groups associated with the Project were assessed using two major types of information:

- Information received from Aboriginal groups, including traditional use studies, comments on issues and concerns, and input on mitigation, Project design, monitoring and follow-up (Application (Volume 5B)).

- Information from the assessment of effects on resources known or assumed to be of importance to Aboriginal people for traditional use.

Northern Gateway has offered to engage with coastal Aboriginal groups and to fund Traditional Land Use Studies (“TLUS”). To date, engagement has varied depending on the level of interest and the preference of each individual community. Some communities have declined to participate; some have been interested in simply receiving information from Northern Gateway about the Project, while others have engaged in a more comprehensive way and talked about a variety of issues, including environmental study methodologies, shipping, and emergency response issues. Some Aboriginal groups have accepted funding from Northern Gateway to complete ATK studies. Discussions are ongoing with the Haisla Nation as to the form of engagement and the completion of an ATK study previously commenced under funding provided by Northern Gateway.

Where an Aboriginal group had completed an ATK study for the Project through a funding agreement, and the information was available by December 2009 (the environmental and socio-economic assessment (“ESA”) was filed in May 2010) information was used in the ESA to inform the scoping and assessment of issues (e.g., identification of Valued Environmental Components (“VECs” or Key Indicators (“KIs”), identification of important issues). Summaries of the TLUS that were completed to date for the Project are summarized in Application, (Volume 5B) and the Application Update (Volume 5B, Appendix C). In addition, an assessment of Project effects on commercial trapping and hunting, which includes Aboriginal people, is provided in the Application (Volume 6C). ATK studies completed in the future will be considered during detailed engineering and design for the Project.

The second approach to assessing potential effects of the Project on traditional use of lands and resources by Aboriginal people was through the assessment of the Project effects and cumulative effects on various components of the biophysical environment that represent resources commonly understood to be of importance for Aboriginal people or that
support the land base and habitat conditions essential to the sustainability of these resources. The assessment of Project effects and associated cumulative effects on the biophysical environment used a consistent methodology that meets the requirements of the CEA Act, and takes into account the policies and guidance from the Agency (e.g., Application (Volume 6A, Section 3)). Key issues and environmental effects are clearly identified and, as appropriate, are assessed qualitatively or quantitatively. Criteria for characterizing environmental effects are defined, as are thresholds for the determination of significance for biophysical resources.

The selection of VECs for biological disciplines also took into account species, species groups or indicators that are or represent resources commonly understood to be of importance for Aboriginal people or that support the land base and habitat conditions essential to the sustainability of these resources.

The assessments for freshwater fish, vegetation, wildlife, and marine biota included specific sections that refer to information provided through the TLUS. This included issues raised by Aboriginal people, information on traditional land use and ecological knowledge, recommendations on project design changes, and recommendations on mitigation.

The intent of the second approach was to identify where the project effects or cumulative effects associated with the Project might potentially result in a significant adverse effect on a biophysical component or on the land base or ecosystem functions that support that biophysical component. If significant adverse effects to the biophysical environment were identified, then it is reasonable to assume that effects to resources commonly understood to be of importance to Aboriginal peoples or the land base on which they occur could also result from the Project.

In the case of effects associated with the routine activities during construction, operation and decommissioning of the Project, the ESA concluded that:

- The Project would not result in significant adverse effects on the terrestrial environment Application (Volume 6A). To achieve this, Northern Gateway has committed to a suite of project design features, mitigation measures and environmental management measures. Of note, specialized measures will be employed during pipeline construction to minimize effects on freshwater fish and fish habitat. A number of measures, including centre surveys and micro-routing of the pipeline and
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an aggressive access management plan, will be used to minimize effects on sensitive wildlife species such as grizzly bear, caribou and mountain goats.

- The Project would not result in significant adverse effects on the marine environment Application (Volume 6B and Volume 8B). As with the terrestrial effects, Northern Gateway committed to a suite of measures to ensure environmental effects were minimized over the life of the Project.

Northern Gateway would welcome input from the Haisla Nation on the proposed Project design features, mitigation measures and environmental management plans. Northern Gateway would also like to work with the Haisla Nation in implementing these measures and monitoring their effectiveness.

Given these conclusions for routine activities, as no significant adverse environmental effects are predicted for terrestrial or marine biota or the ecosystems on which they depend, the Project is also not expected to result in any significant adverse effects on the abundance, distribution or diversity of resources harvested by Aboriginal people or the land which supports these resources. It is not appropriate for Northern Gateway to comment on whether these changes would affect aesthetic, cultural and spiritual aspects of harvesting and land use of importance to Aboriginal people.

Accidents and malfunctions that could be associated with the Project were also assessed for the pipeline, marine terminal and marine transportation components of the Application (Volume 7B, Volume 7C and Volume 8C). Depending on the biophysical setting (e.g., location, season of year, species present, weather conditions, sea conditions) and the magnitude and duration of a spill, there is potential for significant adverse effects to occur to some biota and the ecosystems that support these species. These effects on certain biota could, in turn, affect resources commonly understood to be of importance to Aboriginal peoples or the ecosystems that support these resources. The exact nature of these effects could differ widely as a result of many variables, as would the success of clean-up operations, habitat rehabilitation and species recovery.

While there is potential for spills to result in significant adverse consequences on the biophysical environment, risk assessments for the pipeline, marine terminal and marine transportation concluded that the probability of large spills was low. Given the potential adverse consequence of a major spill on the biophysical environment, Northern Gateway has committed to a broad suite of project design measures,
construction procedures, operational measures and protocols, and health and safety measures and audits to ensure that the probability of a major spill event is low. Northern Gateway has exceeded federal and provincial regulatory requirements and industry practice in many instances to ensure that accidents and malfunctions do not occur during the life of the Project.

Northern Gateway has engaged Aboriginal groups in spill response planning for the pipeline and marine areas (e.g., input into preliminary control point mapping; briefing of two aboriginal groups on marine spills response and environmental protection). Northern Gateway will continue to engage Aboriginal groups in project planning and emergency response planning and would be welcome an opportunity to do so with the Haisla Nation. During future detailed spill response planning, Northern Gateway is committed to involving Aboriginal groups in the development of more detailed plans such as Geographic Response Plans, control point mapping, and finalization of environmental sensitivity atlases.

Northern Gateway is also committed to working cooperatively with Aboriginal people to understand effects on traditional knowledge and traditional use and identify reasonable mitigation measures for these effects. This could include engagement of the Haisla Nation and other Aboriginal groups and people in:

- completion of traditional land use studies that include the assessment of effects on traditional use and recommendation of mitigation measures
- ongoing dialogue on Aboriginal concerns and issues in relation to the project
- the construction, operation and decommissioning of the Project through direct employment, contracting, provision of services and participation in advisory committees
- design and implementation of environmental monitoring programs and research
- environmental protection and management
- direct participation in the development of emergency response plans and, if Aboriginal groups are interested, participation and training in emergency response and recovery

c) Please refer to Northern Gateway’s response to Haisla Nation IR 1.15b) above.
1.16 Archaeological permits for Haisla Territory

Reference: i) Exhibit B3-16 Volume 6C - Application dated May 2010, Section 3, p. 3-6 (A1T0G6)

Preamble: The Application states: "For heritage resources, the equivalent of the technical data reports are the permitting reports provided and that will continue to be provided to the permitting agencies in Alberta and British Columbia. These reports can be obtained by directly contacting ACCS in Alberta and the Archaeology Branch in British Columbia."

Request: a) Please provide copies of all permitting reports provided to the Archaeology Branch in British Columbia in relation to the Project, for Haisla Nation Territory directly to the Haisla Nation on a confidential basis.

b) Please provide all information relevant to the illegal destruction of Haisla Nation Culturally modified trees (CMTs) at the proposed terminal site.

c) Will NGP agree to not destroy further CMTs during the construction of its pipeline and terminal without First Nation consent?

Response: a) There are two post impact assessment reports, listed below, which were provided to the Archeology Branch in British Columbia relating to the Haisla Nation Territory. These reports have previously been provided to the Haisla Nation which provided comments to the Archaeology Branch on the initial report. Copies of these reports can again be provided to the Haisla Nation on a confidential basis.


b) In addition to the two post impact assessment reports, the following documents relate to the destruction of the CMTs:


4. Letter Dated September 21, 2007 from I.R. Wilson Consultants Ltd to Archeology Branch re: Response to September 20 Letter from Diane Barbetti

5. Letter dated September 21, 2007 from Archeology Branch to Diane Barbetti, Kitamaat Village Council re: Application for Heritage Inspection Permit


8. Kitimat (Culturally Modified Tree) CMT Assessment – Update, July 16, 2008

Northern Gateway expects that this documentation may also be considered confidential by the Haisla Nation and is prepared to request that the JRP accept this documentation on a confidential basis pursuant to Section 16 of the *NEB Act*.

c) Neither Northern Gateway nor any of its employees or contractors will damage or destroy CMT’s without first consulting the First Nation or First Nations on whose traditional territory the CMTs are located. Northern Gateway will also comply with all requirements of the *Heritage Conservation Act* of British Columbia when undertaking geophysical or archeological assessments, and will seek to employ best industry practice in dealing with these resources.
1.17 Haisla Heritage Sites

Reference:  
i) Exhibit B3-18 Volume 6C - Application dated May 2010, Section 6, pp. 6-28 to 6-36 (A1T0G8)

Preamble:  
The Application identifies a number of potentially impacted Heritage Resources in Haisla Nation Territory (p. 6-28), including four with high heritage value at the Kitimat Terminal, including two rock art sites (p. 6-30).

The Application states: "Project-specific effects on heritage resources are mitigated to the standards established by the provinces. Provincial legislation is intended to ensure that these effects are not significant. Northern Gateway will record and add to the provincial databases sites encountered during project work, provided these sites are not held in confidence by the community" (p. 6-36).

Request:  
a) Does NGP intend to destroy or alter any Haisla Nation Heritage Resources?

b) What mitigation measures are proposed for the high value sites at the proposed Kitimat Terminal?

c) What discussions has NGP had with the Province of British Columbia with respect to these proposed mitigation measures?

Response:  
a) The construction of the Kitimat Terminal will necessitate the removal of culturally modified trees ("CMTs") and mitigation will be necessary (see Northern Gateway’s response to Haisla Nation IR 1.16c). Mitigation includes a range of options, and several may be selected concurrently. The process would include:

1) meeting with the Haisla Nation to discuss significance and mitigation measures;
2) obtaining a Heritage Conservation Act alteration permit to monitor construction activities at heritage sites;
3) additional testing and sampling at heritage sites;
4) archaeological excavation; and/or
5) relocation of cultural material, if possible.

The level of mitigation depends upon the severity and extent of the disturbance and the significance of the archaeological site being disturbed.

b) Four high heritage value sites have been identified in the area of the proposed Kitimat Terminal. Archaeological sites F1Te-5, F1Te-7, F1Te-
18 and FITE-33 have been identified in the Application and archaeological technical report (Weathers et al. 2007). Mitigation measures are unique to each site and site type as described below.

**FITE-5** is a rock art site located south of the Terminal. The site was identified in 2005 as located outside of the Project area boundaries. The site will not be directly affected by Project development (Weathers et al. 2007:201), and mitigation should not be required.

However, the Terminal development may lead to increased pedestrian traffic and the threat of vandalism. There could also be risk from chemical weathering processes associated with air emissions and discharges from existing industrial development in Kitimat, as well as the Project.

Should these concerns be valid, Northern Gateway would meet with the appropriate First Nations and the Province of British Columbia to discuss mitigation options.

**FITE-7** is a rock art site located closer to, but still outside, the boundaries of the Terminal. The site will not be directly affected by Project development (Weathers et al. 2007:202), and mitigation should not be required. FITE-7 has a high overall significance and the appropriate First Nations should be consulted prior to determining ethnic significance. As described in FITE-5, should there be any valid concerns, Northern Gateway would meet with the appropriate First Nations and the Province of British Columbia to discuss mitigation options.

**FITE-18** is a CMT site located to the south of the Terminal. The site pre-dates A.D. 1846. As of 2007, the site was located outside project development boundaries and would not be affected by project development (Weathers et al. 2007:201) and mitigation should not be required.

**FITE-33** is a large CMT site covering approximately 200 ha within the Terminal boundaries. The site pre-dates 1846. The site has high heritage value and the appropriate First Nations should be consulted prior to determining ethnic significance (Weathers et al. 2007:201-202). The construction of the Kitimat Terminal will necessitate the removal of CMTs and mitigation will be necessary. For example, a representative sample of stem rounds would be collected and dated. The size of the sample should follow guidelines established by the Archaeology Branch and would be approximately 10% of modified trees. Work must be undertaken under a *Heritage Conservation Act* site alteration permit” (Weathers et al. 2007:210).
To summarize, FITe-5 and FITe-7 fall outside of Project development boundaries and therefore should be successfully avoided. However, they may be susceptible to vandalism and increased chemical weathering. FITe 18 is located outside of the Terminal footprint and does not require mitigation. FITe-33 is within the development footprint and requires mitigation. Northern Gateway will meet with the appropriate First Nations prior to alteration. Modification to these site areas would need to take place under the Heritage Conservation Act, alteration permit and with the mitigation measures discussed under Northern Gateway’s response to Haisla Nation IR 1.16a).

c) Northern Gateway has not held discussions with the Province of British Columbia with respect to these proposed mitigation measures. However, mitigation recommendations from the 2005 and 2006 field work are included within the final report submitted to and on file with the Archaeology Branch at the provincial Ministry of Forests, Lands and Natural Resource Operations. Archaeological assessments are a multi-phase process, and currently archaeological studies are in the preliminary archaeological impact assessment phase gathering baseline data. Mitigation measures fall under a later alteration permit once development work has begun. Aboriginal consultation occurs as part of the permit issuance and additional consultation with the Haisla Nation would take place during detailed engineering.

Reference:

Weathers, Beth, Ian R. Wilson, Kira Kristensen, Ryan Spady, Shane Bond, Steve Douville, Casey O’Neill, Christina Neal and Jennifer Nord

1.18 Socio-Economic Impacts on Traditional Land Use

Reference:  
i) Exhibit B3-16 Volume 6C - Application dated May 2010 (A1T0G6)  
ii) Exhibit B3-17 Volume 6C - Application dated May 2010 (A1T0G7)  
iii) Exhibit B3-18 Volume 6C - Application dated May 2010 (A1T0G8)

Preamble:  
This volume is titled "Environmental and Socio-economic Assessment (ESA) - Human Environment" and purports to contain an assessment of key issues that are of particular interest to regulators, participating Aboriginal groups, and other stakeholders. The volume includes assessments of socio-economic conditions, non-traditional land use, and heritage resources. It does not include an assessment of traditional land use.

Request:  

a) Have baseline studies been conducted to determine the levels of fish, wildlife and plant resources within the area potentially affected by the Project?

b) Have studies been conducted to determine or assess the traditional use of fish, wildlife and plant resources within the potentially affected by the Project?

d) Have the potential environmental and socio-economic impacts of the project on traditional land use been assessed?

e) Please provide copies of any environmental and socio-economic impact assessment for traditional land use by the Haisla Nation.

Response:  

a) Baseline studies were conducted to characterize specific groups of biota (i.e., fish, vegetation, wildlife, marine biota), as well as the physical and biological environment that support these biota (e.g., atmospheric environment, ground and surface water, terrain, soils, fish habitat, wildlife habitat) within the area potentially affected by the Project. Summaries of these baseline studies can be found in the Application (Volumes 6A, 6B and 8B). Additional and more detailed technical information on the field studies completed for Northern Gateway Project are provided in the Technical Data Reports for these environmental components.

b) Information on the current use of lands and resources for traditional purposes by Aboriginal persons were obtained primarily through the conduct and completion of Traditional Land Use Studies by Aboriginal groups as well as consulting publicly available information. Please see Haisla Nation IR 1.15.

d) Please see Haisla Nation IR 1.15.
e) The primary document for the assessment of effects on Traditional Land Use is the Application (Volume 5B). Information on effects on biological resources and the ecosystems that support these biota are provided in Application (Volumes 6A, 6B, and 8B).

The assessment of Project effects on the social and economic effects of the project on regional employment opportunities and regional business opportunities, regional population changes, community services, regional transportation and infrastructure, and individual family and community well-being was filed as Application Update (Volume 6C, Section 4.4 (October 2010)). This section described the potential social and economic effects of project construction and operations in terms of six different regions along the pipeline corridor (including the Kitimat terminal). The analysis of Project effects in the Coastal BC region examined the possible effects of construction and operation at a regional level, with the region including six Aboriginal groups, one of which was the Haisla Nation (see Application (Volume 6C, Table 4.4-1)). Project effects were not assessed for individual communities or Aboriginal communities.

It should be added that baseline social and economic conditions in the region were based largely on a detailed assessment of data from the 2006 census, and the census data for the Kitamaat 2 reserve are known to be incomplete.
GENERAL - Aboriginal and Treaty Rights

1.19 Environmental Bonding

Reference: N/A

Preamble: The Project has the potential to cause severe environmental degradation to Haisla Nation lands and waters.

Request:  

a) Will NGP provide an irrevocable letter of credit, in an amount negotiated with the Haisla Nation, to address clean-up costs and compensation in the event of a spill or spills?

b) Will NGP, prior to construction, provide an irrevocable letter of credit to cover the full costs of decommissioning and restoration of the pipeline and the terminal facility?

c) If the answer to either a) or b) is no, please explain why not.

Response:  

a) No.

b) No.

c) Compensation mechanisms are already in place that are generally applicable to all operators in Canada. Regarding security for decommissioning and restoration costs of the pipeline and terminal facilities, this type of security is currently being addressed through the NEB Land Matters Consultation Initiative and a funding regime will be put in place that will be equally applicable to all operators.
PIPELINE

Pipeline Location and Route

1.20 Location and Route

Reference: i) Terms of Reference, Joint Review Panel Agreement (A1R4D5)
ii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 2.3.3, p. 2-5 (A1S9X8)
iii) Exhibit B 19-4 Volume 3 Application Update dated December 2010, Section 2.4, p. 13-14 (A1W8Y6)
iv) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 2.2.2, p. 2-1 and 2-2 (A1S9X8)

Preamble: In reference ii), it is stated that one of the primary reasons for selecting the eastern pipeline route is that it follows existing rights-of-way, and that road access for construction and maintenance is consequently better. If the proposed route in references ii) and iii) followed existing rights-of-way in British Columbia as it does in Alberta, it would preclude the need to blast two 5.5 km tunnels through the Coast Mountains. This route would add approximately 250 km to the proposed pipeline but would significantly increase comparative safety and significantly lower environmental risk.

NGP states that the proposed location of the proposed Kitimat Terminal was selected in part due to "limited effects on watercourses, waterbodies, marine and aquatic vegetation and habitat, and important fish areas." It was also selected in part due to "limited potential effect of shoreline oiling".

Request: a) Please explain why the proposed pipeline does not follow existing rights-of-way (primary Highway 16 and Highway 37), when this would allow for better road access and less incursion into pristine areas.

b) Please provide copies of all correspondence, studies, analyses and discussions of the merits and drawbacks of this alternate route.

c) Please indicate whether NGP would accept as one of the conditions for project approval, a relocation of its proposed pipeline to the existing rights-of-way.

d) Please qualify and quantify "limited effects" by using GNOME modelling (which has been done before for this area of the North Coast and is therefore available) and not only a mass-balance approach as contained in the Application. Modelling areas must include the Kitimat River estuary.
e) Please provide a detailed accounting of NGP’s experience, if any, with tunnel blasting for pipelines.

f) Please explain how it is possible to know the extent and potential effect of shoreline oiling. Please provide copies of all modelling, analyses, reports, studies and other documentary records relating to the shoreline oiling issue.

Response: a-c) The Application (Volume 3, Section 2), describes the routing criteria that Northern Gateway used to select the pipeline route. Although, the referenced route follows Highway 16 and Highway 37, Northern Gateway’s pipeline route also follows significant lengths of linear infrastructure including forest service roads from south of Houston to Kitimat. Northern Gateway’s pipeline route also offers significant advantages compared to the referenced route, as follows:

- Proposed coast mountain tunnels are a significant investment in pipeline safety throughout construction and operations phases of the Project
- Tunnels provide significant hydraulic advantages including reduced pumping requirements, reduced power costs, and elimination of the need for a pressure let-down station
- Approximately 250 km shorter
- Reduces Project capital and operating costs
- Reduces Project footprint
- Avoids routing through or in proximity to various communities including Telkwa, Smithers, Moricetown, New Hazelton, Thornhill, and Terrace
- Avoids paralleling significant lengths of the Bulkley and Skeena Rivers
- Avoids the addition of more pump stations

Northern Gateway would not accept a relocation of the pipeline route to parallel Highway 16 and Highway 37 as a condition of Project approval.

d) The filed Hydrocarbon Mass Balance Estimates: Inputs for Spill Response Planning Technical Data Report (filed with the JRP in June 2011), details the Project-specific modeling capacity that has been developed. The report includes a description of the hydrodynamic model, include the regional model, local model, kinematic wind model, as well as the oil spill model. Summaries of hypothetical spills at the terminal are discussed in the Technical Data Report and in the Application (Volume 7C, Section 9).
Reference:


e) The Northern Gateway Project team has extensive experience in the investigation, design, construction and maintenance of a range of tunnel types and lengths, including long alpine tunnels constructed in British Columbia for British Columbia Rail and Canadian Pacific Railway.

f) Please refer to Northern Gateway’s response to Federal Government IR 116.
## Pipeline Design and Safety

### 1.21 Valve Locations

**Reference:**


**Preamble:** The Application identifies the following valve locations:

<table>
<thead>
<tr>
<th>KP</th>
<th>Valve Location Description</th>
<th>Oil</th>
<th>Cond.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1086.9</td>
<td>Hoult Creek</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1124.7</td>
<td>Clearwater Pump Station</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1143.3</td>
<td>Wedeene River</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1148.4</td>
<td>Little Wedeene River</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1149.4</td>
<td>Little Wedeene River</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1153.3</td>
<td>Tributary to Kitimat River#5</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1172.2</td>
<td>Kitimat Terminal</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

**Request:**

a) For each of the segments between these valves, what is the maximum volume of liquid that will be in the segment at any one time?

b) For each of the segments between these valves, what is the minimum delay between the detection of a leak and the closing of the relevant valves?

c) For each of the segments between these valves, what is the maximum amount of product that could spill, presuming the valves are closed with minimum delay?

d) For each of these valves, what factors could delay or prevent the closing of the valve?

e) For each of the segments between these valves, what is the maximum delay between the detection of a leak and the closing of the relevant valves?

f) For each of the segments between these valves, what is the maximum amount of product that could spill, presuming the valves are closed with maximum delay?

g) For each of these segments, what is the first water body which would be impacted by the spill
h) For each of water bodies, do they drain into the Kitimat River

h) For each of these water bodies, do they drain into Kitimat Arm?

Response: 

a) The preliminary valve locations have been revised since the Application was filed. The current list of locations was included in the Application Update (Volume 3 (December 2010), Appendix F, Table F-1).

Valve locations and descriptions corresponding to those identified in the preamble are:

<table>
<thead>
<tr>
<th>KP (Route Rev T)</th>
<th>Valve Location Description</th>
<th>Oil</th>
<th>Condensate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1083.7</td>
<td>Tributary to Clore River (East Side)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1084.6</td>
<td>Tributary to Clore River (West Side)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>1097.9</td>
<td>Upper Kitimat 1</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>1115.5</td>
<td>Upper Kitimat 2</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>1129.3</td>
<td>Clearwater Pump Station</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1147.9</td>
<td>Wedeene River</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1153.1</td>
<td>Little Wedeene River (East Side)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1154.1</td>
<td>Little Wedeene River (West Side)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1158.0</td>
<td>Tributary to Kitimat River #5</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1176.9</td>
<td>Kitimat Terminal</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

The volume of liquid in any segment of pipeline is a function of the length of the segment. For the oil pipeline this can be calculated as:

- Volume of liquid in $m^3 = 0.615 \times$ length in metres

and for the condensate pipeline as:

- Volume of liquid in $m^3 = 0.193 \times$ length in metres
The maximum volume of product between valve segments is shown in the table below:

<table>
<thead>
<tr>
<th>Segment between valve locations</th>
<th>Maximum Oil Volume in segment (m³)</th>
<th>Maximum Condensate Volume in segment (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tributary to Clore River (East) to Tributary to Clore River (West)</td>
<td>554</td>
<td></td>
</tr>
<tr>
<td>Tributary to Clore River (West) to Upper Kitimat 1</td>
<td>8180</td>
<td>8801</td>
</tr>
<tr>
<td>Upper Kitimat 1 to Upper Kitimat 2</td>
<td>10824</td>
<td></td>
</tr>
<tr>
<td>Upper Kitimat 2 to Clearwater Pump Station</td>
<td>8487</td>
<td></td>
</tr>
<tr>
<td>Clearwater Pump Station to Wedeene River</td>
<td>11439</td>
<td>3590</td>
</tr>
<tr>
<td>Wedeene River to Little Wedeene River (East)</td>
<td>3198</td>
<td>1004</td>
</tr>
<tr>
<td>Little Wedeene River (East) to Little Wedeene River (West)</td>
<td>615</td>
<td>193</td>
</tr>
<tr>
<td>Little Wedeene River (West) to Tributary to Kitimat #5</td>
<td>2399</td>
<td>753</td>
</tr>
<tr>
<td>Tributary to Kitimat #5 to Kitimat Terminal</td>
<td>11624</td>
<td>3648</td>
</tr>
</tbody>
</table>

b) The minimum response time for a leak is a combination of a 2 minute detection time and 3 minutes for full closure of the valves.

c) For the segments provided in Haisla Nation IR 1.21a), the maximum amount of product released is determined by Northern Gateway’s computer model that calculates the potential maximum volume released at any location based on both the dynamic (pressurized) volume, prior to full valve closure, and the static (gravity) drain down taking into account natural topography and pipeline profile characteristics.

The maximum amount of product release for the segments in question are provided below together with the location where that maximum spill would potentially occur (other locations within the segment would have lower amounts). The amounts are based on the response time of 5
minutes for full valve closure as noted in Northern Gateway’s response to Haisla Nation IR 1.21b).

<table>
<thead>
<tr>
<th>Segment between valve locations</th>
<th>Maximum Oil Volume in m³, released within segment (KP location)</th>
<th>Maximum Condensate Volume in m³, released within segment (KP location)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tributary to Clore River (East) to Tributary to Clore River (West)</td>
<td>953 (1084)</td>
<td>1265 (1084)</td>
</tr>
<tr>
<td>Tributary to Clore River (West) to Upper Kitimat 1</td>
<td>2290 (1095)</td>
<td>675 (1095)</td>
</tr>
<tr>
<td>Upper Kitimat 1 to Upper Kitimat 2</td>
<td>2075 (1098)</td>
<td>974 (1104)</td>
</tr>
<tr>
<td>Upper Kitimat 2 to Clearwater Pump Station</td>
<td>1946 (1124)</td>
<td>1273 (1124)</td>
</tr>
<tr>
<td>Clearwater Pump Station to Wedeene River</td>
<td>1639 (1137)</td>
<td>1030 (1129)</td>
</tr>
<tr>
<td>Wedeene River to Little Wedeene River (East)</td>
<td>1854 (1151)</td>
<td>570 (1151)</td>
</tr>
<tr>
<td>Little Wedeene River (East) to Little Wedeene River (West)</td>
<td>1239 (1153)</td>
<td>364 (1153)</td>
</tr>
<tr>
<td>Little Wedeene River (West) to Tributary to Kitimat #5</td>
<td>1731 (1158)</td>
<td>645 (1158)</td>
</tr>
<tr>
<td>Tributary to Kitimat #5 to Kitimat Terminal</td>
<td>2469 (1163)</td>
<td>720 (1163)</td>
</tr>
</tbody>
</table>

d) The factors that could delay or prevent these valves from closing would be hardware failures, software failures, infrastructure failures, or communication failures. Many of these failure points will have redundancy to help ensure a single point of failure would not cause a delay or prevention of closing these valves.

e) The maximum delay between the detection of a leak and the closing of valves is 13 minutes, the combination of a 10 minute response time and 3 minutes for full closure of the valves.

f) Based on a response time of 13 minutes the amount of product released for the segments listed above will increase by an amount represented by an additional 8 minutes of flow. For the oil pipeline, based on the
theoretical design capacity of 92,742 m$^3$/day, this would add 515 m$^3$ to the volumes in the table above. For the condensate pipeline, based on the theoretical design capacity of 34,094 m$^3$/day, this would add 189 m$^3$ to the volumes in the table above. As noted in the Northern Gateway’s response to JRP IR 3.3a), Northern Gateway is currently reviewing the assumptions made in the Preliminary Valve Location Engineering Assessment and these assumptions will be updated in the future version of the report.

g) The maximum spill locations for the segments listed in Haisla Nation IR 1.21c) have oil spill extents previously represented on maps A-118 through A-128, in the Northern Gateway’s Response to the JRP Request for Additional Information (March 2011). As noted in Section A of the Response, the spill extents should be viewed with many caveats and cautions, for example:

- Many of the assumptions used for the spill extent modelling are conservative; for example, maximum volume release of hydrocarbons, maximum throughput, release of entire volume to surface and watercourse discharges based on maximum mean monthly discharges. Combining these conservative assumptions results in reduced likelihood that any of these hypothetical spill extents would represent an actual situation.

- Site-specific mitigation measures and emergency response are excluded from the spill modelling represented in the maps, because these details will be developed during detailed engineering. As a result, the hypothetical spills shown on the maps are unmitigated and the potential spill extents are overstated.

- Each extent represents a maximum full-bore volume release within the 1-km segment of the oil pipeline. The likelihood of a full-bore, or indeed any rupture, of a pipeline built to today’s regulatory requirements and modern pipeline design, construction and operational standards, is highly unlikely. Please refer to Northern Gateway’s response to J. Wier IR 2.27 for a discussion.

For the spill locations listed in Northern Gateway’s response to Haisla Nation IR 1.21c) above, the first watercourse impacted by the modeled spill and the whether the extent of the spill enters the Kitimat River and eventually into Kitimat Arm are shown below. Note that even though the Kitimat River drains to Kitimat Arm a spill extent entering the Kitimat River may not necessarily end up in Kitimat Arm. Condensate spill modeling has not been done.
<table>
<thead>
<tr>
<th>Oil Spill KP (Route Rev T)</th>
<th>First watercourse impacted</th>
<th>Spill extent enters the Kitimat River</th>
<th>Spill extent enters Kitimat Arm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1084</td>
<td>Tributary to Clore River</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>1095</td>
<td>Hoult Creek</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>1098</td>
<td>Hoult Creek</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>1124</td>
<td>Kitimat River</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>1137</td>
<td>None</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>1151</td>
<td>Unnamed tributary to Little Wedeene River</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>1153</td>
<td>Little Wedeene River</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>1158</td>
<td>Unnamed tributary to Kitimat River</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>1163</td>
<td>Unnamed tributary to Kitimat River</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

h-h) Please refer to Northern Gateway’s response to Haisla Nation IR 1.21g) above.
1.22 Pipeline Design and Materials

Reference:

i) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 3.1, p. 3-1 (A1S9X8)
ii) Exhibit B 20-2, Northern Gateway response to request for additional Information, dated March 2011, Section C.1.1, p. 14 (A1Y3U9)
iii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 5.1, p. 5-1 and 5-2 (A1S9X8)
iv) Exhibit B 19-4 Volume 3 Application Update dated December 2010, Section 5.1, Table 5-1 and Table 5-2, p. 5-1 (A1W8Y6)
v) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 5.10, p.5-7 (A1S9X8)
vii) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble: In reference ii) the pipeline design approach is stress based ("Barlow's formula" in Enbridge Standard D06-101). The Standard also states that the engineer must assess whether additional loadings (e.g., seismic loads, landslides) require additional pipe strength or protective measures. Little information, however, is given regarding the design methodology that will be used to consider these additional loadings.

Further to reference ii), a published article by Nyman et al., (2008) as well as the Pipeline Research Council International (PRCI) guidelines (Honegger and Nyman, 2004, documents attached) indicate that strain-based design should be used for pipelines that may be subjected to ground deformation. No reference, however, to strain-based design is made in the document. Only a passing reference to Enbridge's "strain management plan" is made but it is not clear what this plan entails. As well, no mention is made of the pertinent ISO standard 23469: Bases for design structures - Seismic actions for designing geotechnical works.

In reference iii) two different standards, CSA Z245.1 and API Spec 5L, are listed as possibilities to which the line pipe will be designed. In reference iv) a range is listed for minimum wall thickness of the pipeline parameters. Thicker pipeline is safer though more expensive.

Two different steels are listed as potentials for the pipelines. Grade 483 (X70) steel is listed for the pipelines on p. 5-1 but then on p. 5-2, it is stated that "the feasibility of using Grade 550 (X80) steel and associated reduced wall thicknesses for all , or a portion of the oil pipeline will be evaluated during detailed engineering." This is not clarified in reference iv), and thus it is important that the type of steel that will be used for the proposed pipelines is disclosed. The choice of steel is integral to pipeline integrity and longevity.
In reference v) it is stated that buoyancy control might be required along some sections of pipelines which are located under watercourses and in wetlands. The buoyancy control will be achieved through the use of pipe weights, concrete coating or screw anchors. There is a danger, however, that weights used for this purpose can move or twist the exterior pipeline coating. This can result in disbondment (when coating detaches from the pipe) allowing for corrosion and cracking to develop and grow. In reference vi) the table lists localized conditions and standard mitigation methods. Under the "Pipeline buoyancy control" condition, however, no mention is made of exterior coating protection.

**Request:**

a) Please provide detailed information regarding the design methods that will be used to assess additional loadings of landslides and seismic conditions.

b) Please provide strain-based design information which includes reference to both the PRCI guidelines as well as to ISO standard 23469.

c) Please describe the "strain management plan".

d) Please list the differences between CSA Z245.1 and API Spec 5L and provide the criteria on which the standard was selected.

e) Please elaborate on the choice of wall thickness and provide the pros and cons which led to the final decision of wall thickness for both the oil and the condensate pipelines.

f) Please disclose the type of steel planned for the pipelines and detailed reasoning behind its choice.

g) Does NGP agree that X80 steel can have inherent susceptibility to hydrogen-induced cracking when welded? Does NGP propose to use X80 steel? How will NGP address the inherent hydrogen induced cracking problem?

h) Does NGP agree that X80 steel pipe is more difficult to weld than lower strength materials and that the welding parameters are therefore far more stringent and must be done under careful observation? How does NGP propose to address this issue?

i) Please provide the detailed design which demonstrates exactly how the technology and methods that NGP proposes to employ for buoyancy control will not constitute any risk to exterior coating integrity. Please provide evidence that there will be no damage to exterior pipe coating when utilizing these buoyancy control measures.
j) Please provide information on how, should the exterior coating be compromised in any way, this will be addressed in terms of both notification and repair.

Response: 

a) As discussed in the Application (Volume 3, Section 3), landslides capable of creating significant additional loading on the pipelines have been avoided wherever possible. Similarly, areas of potential seismically induced liquefaction or spreading have also been avoided. If it is necessary to estimate the additional loadings that might be applied to the pipe by soil movements, methods such as those outlined in American Lifelines Alliance (ALA) (2001 with addenda through Feb 2005) Guidelines for the Design of Buried Steel Pipe, (ALA is a partnership between the American Society of Civil Engineers and the Federal Emergency Management Agency) will be used to estimate the additional loadings on the pipelines. Additional information may include drilling and monitoring information.

For seismic shaking, the degree of seismic shaking will be based on Atkinson, G.M. 2009, Preliminary Seismic Evaluation of Enbridge Northern Gateway Pipelines Project.

b) If required, the strain-based design will comply with CSA Z662-11, Annexes C and O. Although Annex O makes specific reference to natural gas pipelines, the concepts and requirements of this annex would be taken into consideration.

c) A “strain management plan” has not yet been developed. If required, this would be done during detailed engineering. Detailed route selection and other design criteria have not been finalized and strain issues, if any, have not been identified or quantified at this time.

d) As described in the Application (Volume 3, Section 5.1), line pipe will be manufactured to CSA Z245.1 or API 5L. Both CSA Z245.1 and API 5L have been listed to allow for flexibility of pipe supply. Although the specification layout and some testing criteria (e.g. drop weight tear testing optional in API 5L, impact test temperatures differ), the technical requirements specified by Enbridge are expected to equalize the requirements. Other than markings, it is anticipated that the actual steel pipe would be identical regardless of the industry specification applied.

e) Please refer to Northern Gateway’s response to JRP IR 3.1a) and 3.1b).

f) It is expected that the “type” of steel will be a micro-alloyed, thermomechanically treated, high strength, low alloy steel. Grade 483 will be
used for the condensate pipeline. The grade for the oil pipeline has not been finalized (Grade 483 or 550, API X70 or X80). Although Grade 550 will theoretically provide an approximate 14% steel tonnage savings compared to Grade 483, additional factors will also be considered. Factors to be included, but not limited to, are any associated grade extras, mechanical property requirements including toughness, field welding requirements, construction issues and potential sources of supply. Regardless of the steel grade used, the pipe design criteria, manufacturing, testing and inspection requirements would not differ.

g) Higher strength steel may be more susceptible to hydrogen cracking if improper welding procedures and processes are applied. Welding procedures developed for higher grade materials and welding quality activities such as welder testing and qualification and weld parameter monitoring are applied as standard practice to mitigate such concerns for all pipeline welding projects. As stated in the Northern Gateway’s response to Haisla Nation IR 1.22f) above, the decision on the use of Grade 550 (X80) for the oil pipeline has not been finalized. It is a consideration and will be fully assessed during detailed engineering.

h) Grade 550 (X80) steel is not necessarily “more difficult” to weld than Grade 483 (X70) steel, providing that proper welding procedures are utilized. A number of large diameter, Grade 550 (X80) pipelines have been successfully constructed and many more have been proposed by various pipeline companies. Please refer to Northern Gateway’s response to Haisla Nation IR 1.22g) above for further information.

i) Buoyancy control is typically achieved through the use of concrete weights, concrete coating, saddle weights or screw anchors. All of these methods provide suitable well proven protection for the pipe coating. For example, concrete weights have a protective liner placed between the concrete and the pipe coating.

Modern buoyancy control design and installation methods maintain the integrity of pipeline coatings. Details regarding buoyancy control and exterior coating will be finalized during detailed engineering.

j) Prior to burial of the pipeline the coating integrity is verified through an inspection process. Should coating damage occur during the life of the pipeline, it is addressed through an integrity management system which includes cathodic protection and inspection.
1.23 Pipeline Product Characterization

Reference:  
i) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 4.2.2, p. 4-1 (A1S9X8)  
ii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Table 4-2, Section 4.2.2, p. 4-2 (A1S9X8)  
iii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 4.3.2, p. 4-3 (A1S9X8)  
iv) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble:  
NGP proposes that the pipeline will operate as a batched pipeline, alternating between diluted bitumen and synthetic oil. NGP's Application fails to specify either the diluent to be used or the percentage of diluent to be blended with the more viscous bitumen. Without a detailed schedule, protection of both the workers and the environment is difficult when exact knowledge of the released product is lacking. The operation of a batched pipeline has significant implications for spills, since determination of environmental effects, as well as containment and clean-up strategies, is directly dependent on the characteristics of and constituents in the product released.

With regard to the chemical nature of the diluents that are added to reduce the viscosity of the bitumen, it is known that the exact composition varies among shippers. An analysis of each potential diluent, however, is required in order to determine the potential health and environmental impacts of a leak or rupture.

In reference ii), Table 4-2 lists the average sulphur (w/w) of diluted bitumen as 2.7%. Due to the known corrosive nature of sulphur in metal pipelines, more information is required to ascertain the actual operating conditions and operating parameters. Standard deviation of the average sulphur value should be stated, as well as a discussion provided on the possible negative effects of sulphur on pipeline integrity which is not mentioned at any point in the Application. Crandall (2002) states that Athabasca Dilbit and SynBit have 3.7% sulphur and 2.8% sulphur, respectively (document attached). These values are higher than those listed in the Application.

In references i) and iii), the products which are planned for the Project's pipelines have not been fully characterized either physically or chemically.

Only average sulphur is listed for condensate; only sulphur and Ni plus V are listed for diluted bitumen.

Benzene, a known carcinogen, is a component of diluted bitumen and condensate, and was of great concern after Enbridge's Kalamazoo spill in July, 2010. On the EPA's website dedicated to Enbridge's spill, it states the following:
"The air sampling results have shown one chemical - benzene - at a level of potential concern for long-term health."

Information is required on the content of this chemical.

Request:

a) Please provide precise information concerning the product that NGP proposes to run through the oil pipeline. Please provide documentation of the scheduling.

b) Does NGP agree that the blending of bitumen with condensate will vary with the viscosity of the bitumen and with the type/source of the condensate?

c) Does NGP agree that each blend will have different chemical composition?

d) Does NGP agree that at different times NGP proposes to deliver an entirely different product through the pipeline - synthetic oil?

e) Does NGP agree that the composition of the product that NGP proposes to transport will also change based on such factors as cost and availability?

f) Does NGP agree that it is therefore impossible for NGP to predict, in advance, the composition, or even the nature of the substance to be found in its proposed pipeline?

g) Since the composition of neither bitumen nor its diluent is constant or consistent, please provide information on how the blending will be monitored.

h) Please provide complete chemical characterizations of the diluent(s) that NGP proposes to use to blend the bitumen. Since the exact composition may vary among shippers, please provide analyses which cover all variations.

i) Please provide studies which establish the potential health and environmental impacts of a leak or rupture of a pipeline carrying diluted bitumen.

j) Please provide all available information concerning the potential health and environmental impacts in relation to the diluent component of the spill.

k) Please provide the standard deviation of the average value given for
sulphur in diluted bitumen.

l) Please provide the average value and standard deviation of sulphur in synthetic oil.

m) Please explain the discrepancy between the projected average sulphur content of diluted bitumen in the NGP Application (2.7%) and the average sulphur content of diluted bitumen as discussed in Crandall (2002): 3.7%.

n) Please provide a detailed examination of the possible negative effects on pipeline integrity from this higher sulphur content both in general and as compared to conventional crude oil. Please provide copies of all studies, reports and correspondence in NGP’s possession and control relating to this issue.

o) Please provide the complete characterization of bitumen, synthetic oil, condensate and diluent upon which the Project has based its risk assessment, design integrity and determination of toxic effects on biota and habitat in the case of a spill.

p) Please provide detailed information, including human health and ecological toxicity studies, on the diluent(s) to be used. If the diluent will vary, this too must be detailed in terms of how and when, and additional human health and ecological toxicity studies must be supplied.

q) Please provide information on how detailed engineering of the pipeline, appurtenances, storage facilities and marine terminal take into the account the properties of bitumen, including increased acidity, particulate matter and sulphur content.

r) Please provide a detailed description of the heavy metal component of bitumen.

s) Please provide all available information and documentation on spill impact and effects related to the heavy metal content of bitumen.

t) Please provide all available information on spill impact and effects related to benzene content in condensate and diluted bitumen. Please include all monitoring data and public warning documentation following the Kalamazoo spill in July 2010.

u) Does NGP anticipate that precipitation of solids will occur in the diluted bitumen pipeline or the diluted bitumen storage tanks? If so, provide details.
v) If the answer to question u) is "no", please provide details on how NGP will ensure that no precipitation of solids will occur in the diluted bitumen pipeline or the diluted bitumen storage tanks.

Response: 

a) Please refer to Attachment Haisla Nation IR 1.23a for crude oil characteristics of various products (MacKay Heavy Bitumen, Synthetic Light, Cold Lake Bitumen, CRW Condensate) that may be transported in the oil pipeline. Scheduling information is not available at this time and will be developed prior to the commencement of operations.

b) The blending of the bitumen will vary with the viscosity of the bitumen and the type or source of the condensate that is being used and in conjunction with changes to the reference temperatures that will be used. All products will conform to the tariff requirements for the oil pipeline.

c) If the source of the condensate changes then the chemical composition of the blend may change. If the ratio of the diluent changes the chemical composition may not change, but the composition quantities in the blend may change. All products will conform to the tariff requirements for the oil pipeline.

d) Northern Gateway proposes to ship a variety of oil products including both diluted bitumen and synthetic oil. All products will conform to the tariff requirements for the oil pipeline.

e) There are a variety of factors that will contribute to the composition of the oil transported on the Northern Gateway oil pipeline. These factors include, but are not limited to, market conditions and oil supply available to shippers on the Northern Gateway oil pipeline. All products will conform to the tariff requirements for the oil pipeline.

All oil accepted for transportation on Northern Gateway would be subject to the pipeline rules and regulations which provide for a combination of safe transportation, practical operation of the pipeline and industry-driven limits for petroleum quality.

f) Every commodity nominated for transport on the Northern Gateway oil pipeline will require prior approval through the Enbridge New Service Request Process, currently implemented on the Enbridge Mainline System. Approved commodities will fall within established parameters as defined in the tariff for the oil pipeline, allowing Northern Gateway to effectively track all transported commodities on its oil pipeline.

g) Similar to the Enbridge mainline system, Northern Gateway will
monitor incoming crude batches to ensure that they meet the applicable oil pipeline tariff requirements. All of the oil will be tested on a receipt basis for adherence to our density and S&W tariff, and viscosity tariff where applicable. The actual blending of the commodity will occur upstream of Northern Gateway and will be the responsibility of the producer/shipper.

h) The typical condensate quality specifications are provided in Attachment Haisla Nation IR 1.23h).

i-j) Effects of spills on the human and biophysical environment have been described in the Application with reference to four hypothetical marine spill scenarios. Ecological and Human Health Risk Assessment studies in respect of terrestrial locations are being undertaken to supplement that information. See Northern Gateway’s response to Federal Government IR 118.

k) The commodity that was selected as representative of the diluted bitumen category was MKH. The average sulphur value of the MKH was 2.96% while the standard deviation was 0.369.

l) The synthetic oil sample that was identified as being representative of the category was SYN. The average sulphur value is 0.19% while the standard deviation is 0.0212.

m) Crude oils are unique in their chemical composition. The representative diluted bitumen selected for the assessment was MacKay Heavy Bitumen Diluted with Synthetic Light Oil. Each year, Enbridge compiles a summary of selected chemical and physical properties of crude oils and condensates moved in the liquid pipelines system, which is included as Attachment 1 Haisla IR 1.23m) (2010 Crude Characteristics). As noted in the Attachment, total sulphur (% by wt.) varies, between crude oils. The average sulphur content of MacKay Heavy Bitumen Diluted with Synthetic Light Oil is approximately 2.7% by weight. The average sulphur content of the diluted bitumen to be shipped by Northern Gateway will fall within the tariff requirements for the oil pipeline. Attachment 2 Haisla Nation IR 1.23m) (Canadian Crude Quick Reference Guide). The average sulphur content of diluted bitumens described in the guide is 3.7 % by weight.

n) The majority of sulphur present in diluted bitumen is tied up in a class of hydrocarbons known as asphaltenes. These materials do not pose a direct internal corrosion threat to the pipeline. The Integrity Management System developed during detailed engineering will include the analysis on internal corrosion.
Please also refer to Northern Gateway’s response to Haisla Nation IR 1.6a) viii).

o) The Application is based on a range of representative oils that may be transported in the oil pipeline. The oils that were selected as representative include:

- Syncrude Synthetic Light Oil
- CRW condensate (CRW)
- MacKay River Heavy bitumen diluted with synthetic light oil (MKH)

The chemical composition of the above oils is included in Appendix E of the Marine Ecological Risk Assessment for Kitimat Terminal Operations (Stephenson et. al, 2010).

Physical property tests relevant to oil spill response are included in two Technical Data Reports authored by SL Ross (SL Ross 2010a, 2010b):


p) It is expected that the condensate properties will not vary considerably, as it will be required to fall within a standard specification range. Condensate will not be shipped as unique batched commodities. It will be received in tanks at the Kitimat Terminal and shipped as a comingled product to the Bruderheim station.

q) The materials for all pipelines and facilities that will contact the oil products will be designed to the appropriate non-sour service codes and specifications and will be suitable for the range of products that Northern Gateway will transport. These products will conform to Northern Gateway’s pipeline tariff requirements.
r) Metal components of the tested bitumen are included in Appendix E of the Marine Ecological Risk Assessment for Kitimat Terminal Operations (Stephenson et. al, 2010).

s) See Northern Gateway’s response to Haisla Nation IR 1.23i) and 1.23 j).

t) See Northern Gateway’s response to Haisla Nation IR 1.23i) and 1.23j).

Please see Attachment Haisla Nation IR 1.23t) for a copy of the Calhoun County Public Health Department’s July 29, 2010 press release captioned “Health Department Recommends Evacuation of Residents” and its August 3, 2010 press release captioned “Health Department Issues Water Ban”.

Information and documentation related to the Line 6B Incident of July 2010, including monitoring and sampling information, can be found at the Enbridge Inc. website, the U.S. Environmental Protection Agency website, and the Michigan Department of Environmental Quality website.

u) Northern Gateway does anticipate the precipitation of solids from diluted bitumen. Any formation of solids will be handled as per Enbridge’s current operating standards and maintenance processes.

v) Not applicable.
1.24 Corrosive Nature of Diluted Bitumen

Reference:

i) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 4.2.2, p. 4-1 (A1S9X8)

ii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Table 4-2, Section 4.2.2, p. 4-2 (A1S9X8)

iii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 5.3, p. 5-2 (A1S9X8)

iv) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble:

Enbridge's Application shows no evidence of consideration being given to the unique risks posed by diluted bitumen. Diluted bitumen is significantly more corrosive to pipeline systems than conventional crude oil.

Request:

a) The 2004 crude oil pipeline inspection in Prudhoe Bay, Alaska revealed severe internal microbial corrosion (Lilly et al., 2006, document attached). A March 2006 oil spill of 208,460 litres at the same site was confirmed by the Alaska Department of Environmental Conservation as having been caused by internal corrosion (document attached). Does NGP agree that internal corrosion on the pipeline carrying crude oil is a significant risk factor in oil spills?

b) The Crude Oil Policy Association's 2009 Quick Reference Guide states that both of the average sulphur and the average acid concentrates of diluted bitumen are eight times higher than in average benchmark crudes. Does NGP accept the Association's figures as accurate?

c) Does NGP concede that diluted bitumen contains significantly higher levels of corrosive substances than crude oil?

d) The National Petrochemical and Refiners Association (document attached) state that the maximum acid concentration of diluted bitumen can reach eighteen times that of acid concentration in crude oil. The Association has found that tar sands derived bitumen contains significantly more abrasive quartz sand than conventional crude. Does NGP accept the accuracy of the National Petrochemical and Refiner's Association report? Does NGP accept that diluted bitumen is significantly more corrosive than crude oil?

e) In an email dated November 23, 2010, NGP stated: "The pipelines will not transport hydrocarbons containing significant corrosive substances and therefore an internal pipe coating will not be needed". Please explain how it is that in late 2010 NGP still was not aware of the corrosive nature of the substances that NGP is proposing to move through its pipelines?

f) Does NGP now agree that it would be transporting "significant
corrosive substances”? Given the obvious error in NGP's email, does NGP now agree that internal pipe coating will be needed? Please provide all studies, reports, correspondence and written analyses assessing the risks, costs and benefits of internal pipe coating.

g) Does NGP agree that an internal pipe coating would reduce the risk of corrosion-based spills of diluted bitumen?

h) Only six years after construction of a crude oil pipeline in Texas, microbial and internal corrosion forced the replacement of 1,520 metres of pipe (United Pipelines Systems, 2005, document attached). Please provide NGP's analysis of this incident and how it fits with NGP's assertion that it will not be transporting "hydrocarbons containing significant corrosive substances".

i) A study of Alberta’s hazardous liquid pipeline system prepared by the Alberta Energy and Utilities Board in 2007 (document attached) indicates a total of 5,333 incidents over the course of a sixteen year time span. The same study indicates that internal corrosion accounted for 49% of reported pipeline incidents in the Alberta hazardous liquid pipeline system. Does NGP accept the accuracy of the Alberta Energy and Utilities Board study? Given internal corrosion accounted for over 2,600 incidents within the period studied, does NGP now retract its assertion that NGP pipelines “will not transport hydrocarbons containing significant corrosive substances”? If no, why not?

j) Please provide detailed information as to how NGP proposes to monitor changes in the corrosive properties of the product it proposes to transport.

k) Please provide your rate of corrosion calculations based on flow and content of fluid.

l) Please provide copies of all studies, correspondence and reports in NGP’s possession and control that relate to NGP’s design decision not to protect the pipelines with internal coating.

m) Please provide a detailed cost estimate of including an HPDE liner in the pipeline to lessen internal corrosion risks.

n) Does NGP accept that the 2006 spill in Alaska due to internal corrosion underlines significant risk that is applicable to the proposed pipeline?

o) Please provide a detailed analysis of the 2006 spill Alaska due to internal corrosion and explain the steps that NGP proposes to take to avoid similar spills due to internal corrosion.

p) A comparison to Alberta’s hazardous liquid pipeline system and that of the US reveals four times greater number of incidents in Alberta from 1990 – 2005 (Alberta Energy and Utilities Board Study 2007, document attached); US Department of Transportation and Pipeline Hazardous Materials Safety Administration website information, document
Does NGP take issue with any aspect of the above-noted reports? Does NGP agree that the substantially greater number of incidents in Alberta are due to the fact that the American system runs predominantly on standard crude in its oil pipelines while Alberta runs predominantly oil sands derived oils? If not, what is NGP’s explanation for the significantly higher rate of incidents in Alberta? Please provide all reports, studies and correspondence relating to this issue.

Response:

a) It is not valid to compare pipeline leak experience between pipelines with differences in product, operations, and maintenance/integrity programs. Internal corrosion is one possible mode of age related deterioration that a pipeline may experience. However, Enbridge does not believe that it will be a significant risk factor for the Northern Gateway pipelines. Enbridge has developed a depth of understanding regarding internal corrosion, and integrity management programs to match, that has resulted in successful management of potential internal corrosion issues in its mainline system. The Northern Gateway pipelines will include an internal corrosion monitoring and mitigation program as part of the Integrity Management System to be prepared during detailed engineering.

b) The referenced document “Crude Oil Policy Association's 2009 Quick Reference Guide” cannot be located and therefore Northern Gateway cannot respond to the question. If the document can be made available, a response can be provided.

c) Every commodity nominated for transport on the Northern Gateway oil pipeline will meet the tariff requirements for the pipeline and will require prior approval through the Enbridge New Service Request Process, currently implemented on the Enbridge Mainline System. Approved commodities will fall within established parameters, allowing Northern Gateway to effectively track all transported commodities on its oil pipeline.

The level of corrosive substances in diluted bitumen (water, sediment, chemical species corrosive under normal pipeline operating conditions, and bacteria) is fundamentally similar to conventional heavy crude oils.

d) Northern Gateway does not agree that the diluted bitumen is significantly more corrosive than oil under design operating conditions.

Please refer to Northern Gateway’s response to Haisla Nation IR 1.24c).

e) Please refer to response Northern Gateway’s to Haisla Nation IR 1.24c).

f) Enbridge does not agree that a pipeline internal coating is required for
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the Project.

Please refer to Northern Gateway’s response to Haisla Nation IR 1.24c).

**g)** The design, construction, and operation of the pipeline will incorporate the appropriate elements to address internal corrosion however internal coating of mainline pipe is not anticipated to be an effective element. Northern Gateway does not agree that an internal coating would reduce the overall risk of a corrosion based spill. Post construction and continuing into operation, the Enbridge integrity management programs and processes working in conjunction with other company processes will monitor the pipeline operation and determine whether preventative measures such as pipeline cleaning or corrosion inhibitor treatment are required.

Internal pipeline coatings can provide some protection against internal corrosion, and internal coatings may be appropriate for some pipeline projects (those transporting majority aqueous materials). However, Enbridge’s integrity management efforts through the design, construction and operation of pipelines have been proven to address internal corrosion on our currently operating pipelines. During operation, our integrity programs are based on regular integrity verification using in-line inspection tools – industry experience has shown that corrosion detection tools can cause damage to internal coating systems that can cause accelerated corrosion in some circumstances. For this reason, on balancing the internal corrosion risk and the benefit of internal coatings against the threat of in-line inspection (“ILI”) internal coating damage, Northern Gateway does not consider that internally coating the Northern Gateway oil pipeline would reduce the overall risk of corrosion.

**h)** Please refer to Northern Gateway’s response to Haisla Nation IR 1.24c).

**i)** The 2007 Alberta Energy and Utilities Board study referenced in the request was not attached with the electronic filing however a similar report appears available on the ERCB website (which replaced the AEUB in January 1, 2008).

Northern Gateway acknowledges the AEUB published study on pipeline performance circa 2007, available on the ERCB website and further acknowledges an AEUB level of effort to ensure accurate data contained in this report.

Northern Gateway has not been able to recreate the statistics presented based on the available AEUB report. The report presents data and graphs in groupings which are inconsistent with the terminology used in
the IR and it was not clear how the information presented could be re-compiled to generate the statements made.

The ERCB published a news release in February 16, 2011, which stated there were only three spills resulting from internal corrosion on all diluted bitumen pipelines between 1990 and 2005 (eight spills from 1975 to 2010). Please refer to Attachment Haisla Nation IR 1.24i). Please refer to response to Haisla Nation IR 1.24c).

j) Please refer to Northern Gateway’s response to Haisla Nation IR 1.24c).

k) Enbridge does not calculate rate of corrosion based on flow and fluid content. Enbridge integrates information from numerous data sources relevant to internal corrosion management to develop and implement an appropriate prevention, monitoring and mitigation program. Such information sources include:

- experience on the entire Enbridge system that transports many commodities in various operating conditions
- industry experience including standards and codes
- research and development activities led by Enbridge and industry

l) Please refer to Northern Gateway’s response to Haisla Nation IR 1.24f) and 1.24g).

m) Please refer to Northern Gateway’s response to Haisla Nation IR 1.24g).

n) No. Please refer to Northern Gateway’s response to Haisla Nation IR 1.24a), 1.24c) and 1.24i).

o) Northern Gateway understands that, unlike the proposed operating conditions for the Northern Gateway pipelines, the 2006 Alaska spill took place in a low flow rate pipeline that was not regularly cleaned, and had not been inspected in 14 years. The low flow rate allowed a high level of pipeline sediment to accumulate, which resulted in microbially influenced under deposit corrosion. Enbridge has an integrity management program that includes the following steps that would prevent this type of release:

- All products must meet the tariff requirements for the oil pipeline
- Enbridge assesses the quality of every batch entering the pipeline to ensure that unacceptable levels of potential corrodents, if any, are identified
- Enbridge conducts regular analysis of pipeline operations to determine the potential for pipeline corrodents to settle, contact
and persist on the pipe floor where they might cause corrosion. These analyses are used to determine the requirement of cleaning programs that would displace any accumulated corrodents

- Enbridge conducts regular ILI to identify corrosion metal loss

p) Please refer to Northern Gateway’s response to Haisla Nation IR 1.24i). The ERCB Report explained the differences in reporting and interpretation of pipeline leak histories from Alberta and the United States. The ERCB concluded that the rate of releases due to internal corrosion in diluted bitumen pipelines in Alberta was less than half the US reported leak rates.
1.25 Pipeline Integrity

Reference:

i) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 5.3, p. 5-2 (A1S9X8)


iii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 10.2.5, p. 10-5 (A1S9X8)

iv) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble:

In reference i), it states that the pipelines will be externally coated; there will be no internal coating. Microbial corrosion of pipelines is a major source of pipeline failure. Microbial activity within the pipeline or pipeline exterior (soil to pipe interface) leads to corrosion of uncoated pipe or areas of pipe with coating holidays. Sulphur is present both in soil and in steel and this risk is therefore high.

In discussing protective coatings in reference i), NGP provides no discussion on hydrogen damage which is possible from myriad sources. Any movement of soil can nick or scrape the pipeline surface, or external hydrogen blistering can result in unprotected areas of pipe which then rapidly corrode.

Reference i) provides no information on how the pipeline will address the issue of freeze/thaw cycling and its potential for external coating damage. The yearly occurrence of such cycling ensures pipeline damage in areas of coating holidays. Maintenance and inspection details must therefore also be provided which speak to this particular concern.

In reference ii), pipeline monitoring programs are discussed. The Application, however, makes no mention of the effects of sulphur on the integrity of the pipeline. Sulphur damage leads to serious degradation of pipelines. This has major implications for inspection and monitoring of pipeline materials and welds prior to burial and once the pipelines are in use.

No information is provided in the Application on the potential for stress corrosion cracking. This is a major feature of any Integrity Management Program for pipeline maintenance and is not discussed in reference i). This potential damage has major implications for inspection and monitoring of pipeline materials and welds once the pipelines are in use.

In reference iii), pipeline installation is very briefly described. Detail is needed on the pipeline trench excavation and whether the pipelines will be lowered onto hardened soil or onto backfill. Direct placement on packed soil is known to cause pitting corrosion along the bottom of the pipeline.
**Request:**

a) Please provide a discussion of the potential for damage to pipelines by microbial corrosion and provide the precise pipeline design which addresses this issue.

b) Please provide details on how hydrogen damage will be inspected for and monitored. Details should be provided concerning how effective monitoring for external coating damage will be carried out.

c) Please provide design information which addresses the potential for freeze/thaw cycling to damage external pipeline coatings, and provide the mitigation plan should such damage occur.

d) Please provide a detailed discussion of the pipeline monitoring and inspection practices that will be employed to lessen or address sulphur damage to the pipelines.

e) Please provide a detailed discussion of the monitoring and inspection practices that will be employed to monitor and inspect for stress corrosion cracking.

f) Please provide a detailed plan for lowering the pipeline segments into the trench, and including a description of the trench bed preparation.

**Response:**

a) Enbridge understands that microbiologically influenced corrosion (“MIC”) is one category of processes that can lead to corrosion metal loss, and that MIC is possible in any pipeline system. Enbridge addresses the broad spectrum of corrosion threats (including MIC) through The Integrity Management System as described in Northern Gateway’s response to Haisla Nation IR 1.6x). This will be completed during detailed engineering.

b) Potential hydrogen damage will be considered as part of the Integrity Management System as outlined in Northern Gateway’s response to Haisla Nation IR 1.6x).

c) Enbridge has pipelines that currently operate in freeze thaw conditions. Experience has demonstrated that fusion bond epoxy, the primary coating proposed for the Northern Gateway pipelines, performs well in freeze thaw conditions.

d) Potential sulfur damage will be considered as part of the Integrity Management System as outlined in Northern Gateway’s response to Haisla Nation IR 1.6x).

e) Stress corrosion cracking evaluation is an integral part of Enbridge’s ongoing Integrity Management System. As stated in Northern
Gateway’s response to Haisla Nation IR 1.6x) this evaluation for the Northern Gateway pipeline will be included in the Integrity Management System developed during the detailed engineering.

f) Pipe handling during construction and trench preparation will be addressed in the construction safety manual that will be developed prior to commencement of construction.
1.26 Cathodic Protection

Reference: i) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 5.4, p. 5-3 (A1S9X8)  
ii) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble: In reference i), the cathodic protection (CP) system for the pipelines is discussed briefly. Information is required, however, on how the CP system will address such varying soil resistivity that will inevitably be encountered over the length of pipeline. NGP will need to explain how the CP system will address the known potential for geomagnetically-induced currents in northern British Columbia (Trichtchenko, document attached). A CP system which does not adequately address varying current demand will result in corrosion from under-protection or hydrogen damage from over-protection.

The CP system section in reference i) does not discuss the important requirement for online monitoring of selected test posts as well as all rectifier units. This is essential for remote areas; monitoring stations should be installed at intervals not greater than 3 km along the pipeline according to ISO 15589-1. The Application does not include details of CP monitoring plans on this matter.

Request: a) Please provide details on how the CP system will address varying soil resistivity encountered over the length of the pipeline, and how the pipelines will be protected from corrosion due to varying current demand.

b) Please provide details on how the CP system will address the known potential in northern BC for geomagnetically-induced currents.

c) Please provide detailed information on the capability of SCADA to monitor and adjust CP continuously. As well, please confirm that monitoring stations of the CP system will be installed at intervals not greater than 3 km along the entire pipeline, as per ISO standards.

Response: a) Cathodic protection (“CP”) prevents external corrosion of coated pipeline systems in natural soil or water environments by temporarily changing the equilibrium between a metal and its environment through the application of direct electrical current. Where external coating defects allow soil exposure and unimpeded flow of electrolytic current, criteria based on cathodic polarization CP can significantly reduce external corrosion rates by several orders of magnitude. This technology has been employed and refined for over 150 years, and its effectiveness has been well proven and thoroughly demonstrated. Enbridge design standards and maintenance procedures, parallel with Canadian regulations, contain detailed requirements for timely and
effective CP installation, monitoring, and maintenance.

The detailed CP design is not yet complete. Enbridge has experience in the design and operation of cathodic protection systems on pipelines traversing wide ranging soil resistivity. The varying current demand of different soils may be managed by adjusting the design, spacing and location of cathodic protection current sources. Factors for consideration can include but are not limited to:

- Rectifier voltage and current capacity specifications
- Groundbed configuration
- Anode and backfill material selection specific to application

b) Telluric currents have been observed on many pipelines around the world and the effect they might have on any new pipeline must be considered. The majority of telluric currents originate from electric fields that are associated with variations in the earth's magnetic field produced by electric currents in the ionosphere 100 km above the earth’s surface. Typically these effects become more prominent at higher latitudes and closer to the source of where the magnetic deviations occur.

It is also recognized that geo-electric fields have tendency to be more influential near the coast resulting from movement of conductive saltwater through the magnetic field of the earth. Tidal water movements through the earth’s magnetic field can also generate ground potentials that can affect pipelines.

If necessary, specific measures will be incorporated into the CP design in order to compensate for the most extreme telluric current fluctuations. Dependent upon telluric modeling and final design, these may include, but are not limited to:

- Potential-controlled rectifiers to drain off telluric currents at major bends and electrical extremities of the pipeline
- Mitigation of geo-magnetically induced currents through appropriate grounding of the pipeline at design based prescribed intervals
- Effectiveness of mitigation through satellite communication / web-based real-time monitoring of test coupons to obtain instant-off polarized potential readings

The necessity for supplementary earth grounding of the pipeline and active geomagnetic compensating CP current sources will be established during detailed engineering.
c) Enbridge does incorporate remote monitoring equipment on some of its pipeline system, that is designed to capture induced DC (or AC) voltage fluctuations in real-time with immediate notification transmission of out-of-range readings. These monitor systems are equipped with either satellite or cellular communication capability and readings are transmitted to the web interface at a defined time interval. Consideration for remote monitoring equipment for CP will be considered during detailed engineering.
1.27 Welding, Valves and Fittings

Reference:

i) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 1.6.3, p. 1-3 (A1S9X8)

ii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 5.2, p. 5-2 (A1S9X8)

iii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 5.5, p. 5-4 (A1S9X8)

iv) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble:

In reference i), the Application states that a joining program, "which includes welding procedures and non-destructive examination (NDE) inspection specifications, will be developed...". Welding procedures are a vital aspect of pipeline integrity since the smallest flaw can lead rapidly to corrosion. It is therefore not sufficient to refer to procedures being developed in the future.

It is stated in reference ii) that a joining program will be developed in accordance with OPR-99. Welding procedures, however, differ according to whether X70 or X80 steel is being used for the pipelines.

In reference iii), it is stated that all valves and fittings will be compatible with the line pipe to which they are connected. It is unclear what is meant by this general statement.

Request:

a) Please provide the specific welding procedures and the detailed joining program for the type of steel to be used.

b) NDE inspection specifications are vital aspects of pipeline maintenance and integrity, particularly in the case of pipelines running over such remote and often rugged terrain. Please provide detailed information of the proposed NDE inspection specifications.

c) It is not possible to assess the environmental effects of the Project without the Construction Environmental Protection and Monitoring Plan (EPMP) is submitted. Please submit the detailed Construction EPMP.

d) It is not possible to assess the environmental effects of the Project without the detailed commissioning plan being submitted. Please submit the detailed commissioning plan.

e) Please provide assurance that there will be no obstruction in the pipelines, valves and fittings for running in-line inspection tools.

Response:

a) Specific welding procedures and the Project specific joining program will be developed during detailed engineering and prior to
commencement of construction. As the pipe grades and wall thicknesses have not been finalized, it is not possible to develop and qualify the specific welding procedures at this time.

b) The general NDE inspection requirements are contained in Enbridge design standards and the Enbridge Pipeline non-destructive testing specifications. It is expected that the majority of the NPS 36 oil pipeline welds will be made using a mechanized process and, as such, these welds would likely be inspected using an automated ultrasonic testing (“AUT”) process. Where necessary and appropriate (i.e. with thinner wall pipe), oil pipeline welds could also be inspected by radiographic (“RT”) techniques. It is expected that the NPS 20 condensate pipeline welds will be made using shielded metal arc welding (“SMAW”) and RT inspection would be employed. Some welds (i.e. fillet type welds) are not amenable to AUT or RT and it is expected that these welds would be examined using magnetic particle or liquid penetrant methods. The specific requirements for NDE/NDT will be developed during detailed engineering to meet the Project requirements and will be included in the Project specific joining program.

c) In the Environmental Assessment, Northern Gateway was able to determine that significant adverse environmental effects were unlikely to occur based on the implementation of best management practices and mitigation outlined in Application (Volume 7A). Site specific measures will be dependent on detailed engineering and detailed routing. As specified in the Application (Volume 7A, Section 1), a detailed EPMP will be developed during detailed engineering and will include general and specific protection measures. Northern Gateway submits that this level of detail is not required to determine whether significant adverse effects on the environment are likely and has used a precautionary approach in its environmental assessment and significance determination and has typically not been required of other projects similar in scale at this point in the review and approval processes.

d) The commissioning plan for the Project will be developed during detailed engineering.

e) The pipelines are designed to ensure that they will be capable of running in-line inspection tools. Inspection procedures during pipeline construction and installation of valves and fittings monitor the proper construction and installation, including checking that no obstructions are present.
1.28 Pipeline Right-of-Way Maintenance


Preamble: In response to Haisla Nation concerns about monitoring the pipeline for leaks and spill, the application state: "Vegetation on the 25-m wide permanent ROW will be controlled to allow monitoring of the ground conditions over the pipelines".

Request: a) Is it Enbridge's intention to keep the entire 25-m wide pipeline corridor free of vegetation?

b) How will vegetation control be achieved in environmentally sensitive areas and near water bodies?

c) If Enbridge intends to use methods other than manual brushing in these areas, what are these methods?

d) What are the environmental impacts associated with these methods?

e) What are the human health impacts associated with these methods?

Response: a) The pipeline corridor will not be ‘free of vegetation’. Native vegetative cover will be maintained to minimize wind and water erosion along the right-of-way (“RoW”). However woody vegetation will be cut to allow aerial patrol and other monitoring to identify areas of concern on the RoW. Woody vegetation would not be restricted in certain, select areas for environmental reasons or for biotechnical slope stabilization.

b) Vegetation control measures will consists principally of mechanical means (i.e. brushing) to maintain the permanent RoW free of woody vegetation. Picking and herbicides may be used to control invasive species, the latter especially if the species in considered to be noxious

c) In the province of British Columbia, Northern Gateway will submit a Pest Control Plan that outlines the compounds that would be used to address weed species and the situations in which these products would be used including proximity to water and sensitive environmental areas. This plan would be submitted to the provincial government and the approval process considers appropriate for consultation with Aboriginal communities and interested stakeholders.

d) The environmental effects of the Project included those related to the construction and operation of the pipelines. The maintenance of the
pipeline RoW was included in that assessment (see Application (Volume 7A)).

e) The 25 metre-wide permanent RoW will be cleared of vegetation and will be maintained free of large woody vegetation using mechanical methods. Therefore, impacts to human health from chemicals associated with maintenance of the RoW are not expected. Any chemicals required to address noxious weed problems on the RoW in British Columbia will need to be outlined in a Pest Control Plan to be submitted to provincial authorities. Furthermore, Northern Gateway requires all contractors to abide by stringent safety requirements while working on the RoW.
1.29 **Effectiveness of SCADA**

**Reference:**

i) Exhibit B1-5 Volume 3 - Application dated May 2010, Section 11, p.11-2 (A1S9X8)

**Preamble:** The Application describes the SCADA system and states: "The SCADA system was developed and is currently supported by Enbridge staff. … It has many proprietary features built in that allow Enbridge to safely maximize pipeline capacity while minimizing risk."

**Request:**

a) Was the SCADA system in use on Line 6A in the United States?

b) If yes, how much time elapsed between the spill and spill detection? How much time elapsed between spill detection and spill shutdown? How much product was spilled?

c) Was the SCADA system in use on Line 6B in the United States?

d) If yes, how much time elapsed between the spill and spill detection? How much time elapsed between spill detection and spill shutdown? How much product was spilled?

e) Please provide the following information for any spills from Enbridge pipelines in which the SCADA system was in use: time elapsed between spill and spill detection; time elapsed between spill detection and spill shutdown; and volume of product spilled.

**Response:**

a) Yes.

b) Please see Northern Gateway’s response to Haisla Nation IR 1.7c).

c) Yes.

d) Please see Northern Gateway’s response to Haisla Nation IR 1.7c).

e) Please see Northern Gateway’s response to Haisla Nation IR 1.7c).
1.30 Aerial Monitoring – Snow

Reference: i) Exhibit B3-1 Volume 6A - Application dated May 2010, Section 2.5.1, p. 2-14 (A1T0F1)

Preamble: The Application states that the pipeline right-of-way will be monitored through aerial reconnaissance, to provide an overview of the state of the right-of-way.

Request: a) What monitoring process will be used during the months in which the right-of-way is covered in snow?
b) What monitoring process will be used during periods when aerial reconnaissance is impossible due to inclement weather conditions?

Response: a) The Northern Gateway RoW and pipeline will be monitored in the same manner year-round. Northern Gateway, as well as the rest of the Enbridge pipelines that are required to be aerially patrolled, are patrolled a minimum of 26 times a year with no more than 21 days between successive patrols. It is expected that a helicopter will be used for aerial patrol of the Northern Gateway system to allow for a more detailed patrol in mountainous terrain. An Aerial Report Database is kept detailing the dates of patrols, any irregularities noted during a patrol, and the follow-up action taken to address any of the noted irregularities. Pilots are trained to look for and identify concerns in all seasons. In addition to aerial patrol, the pipeline will be monitored 24 hours per day, 7 days per week from the Enbridge Edmonton Control Centre. This will include monitoring of flows and pressures at numerous locations along the pipelines by the line operators as well as by the leak detection system. The station sites will be visited and inspected at least every two or three days as technicians perform routine maintenance on the equipment, as well as performing security and integrity checks on the facilities. The pipelines in the tunnel sections will be visually inspected on a regular basis by means of motorized vehicle (i.e. truck or all-terrain vehicle).

b) In the event of inclement weather, the aerial patrol of the RoW will resume as soon as it is safe to do so. Aerial patrol scheduling will consider weather forecasts to minimize impacts to the completion of routine reconnaissance. To date, Enbridge has not experienced a case of missed or incomplete aerial patrols due to an extended period of inclement weather (more than 21 days) on any of its lines that are mandated for aerial patrol. Following periods of unusual heavy precipitation or runoff, Northern Gateway will also conduct additional aerial patrols, when required, to confirm the integrity of the RoW.
1.31 Inspection and Maintenance

**Reference:**

i) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 5.6, p. 5-4 (A1S9X8)

ii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 5.6, Table 5-3 and Table 5-4, p. 5-5 (A1S9X8)

iii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 5.12, p. 5-7 (A1S9X8)

iv) Exhibit B 1-5 Volume 3 - Application dated May 2010, Sections 8.5 - 8.7 p. 8-4 and p. 8-5 (A1S9X8)


vi) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 9.3, p. 9-12 (A1S9X8)

vii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 10.2.8, p. 10-6 (A1S9X8)

viii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 12.1.1, p. 12-1 (A1S9X8)

ix) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

**Preamble:**

In reference i), a brief description of scraper trap facilities is provided. Cleaning will be an important issue as a part of regular maintenance since running cleaning pigs of different type and potentially with agents and solutions can reduce deterioration of the internal surface of the pipeline. Other inline inspection (ILI) methods will likely also be used. If NGP intends to run inspection and cleaning tools in all sections of the pipelines, then facilities for running pigs would have to exist in all piping stations.

In reference ii) the design parameters of the scraper trap facilities are listed. However, no lengths are mentioned in the tables. It is important for the launchers and receivers to be long enough, as some of the tools might be longer than others.

In reference iii) the use of signs and markers is discussed, including where marker signs will be placed. There are signallers built into the pipe to detect passage of any type of pigging device, but no mention is made of their location.

In references iv) and v), oil and condensate piping at pump stations is discussed. Since inline inspection will be performed along discrete pipeline sections, some if not all of the pump stations should be equipped with launchers and receivers. This, however, is not discussed in the Application.

In references iv) and v), the instrumentation and controls provided for each pump station are listed. No mention is made, however, of pig signallers. For inline inspections to be performed between pump stations, these signallers are
necessary.

In references iv), v) and vi), various buildings needed for the pump stations and Kitimat Terminal are discussed. It is stated that all pump stations and the Terminal will have workshop space, among other areas. Inline inspection tools can be large, and the area of these workshops is not stated. Clarification is required that inline inspection tools can be accommodated in these areas.

In reference vii), the pipeline cleaning and pressure testing is described. Internal cleaning scrapers will remove construction debris upon completion of each section of pipeline. The Application does not discuss the fact that this an important opportunity to establish the baseline condition of the pipeline. Future inline inspections can then use this data for comparison purposes, when searching for corrosion or other problems.

In reference viii) there is brief discussion concerning prevention programs which aim to maintain pipeline integrity. It is stated that integrity measures are based on operating regime and consideration of product, pipeline route and associated hydraulics. The Application does not state, however, that all amenities required for inline inspections will be put in place, even though these are key to the maintaining of pipeline integrity and therefore safety.

**Request:**

a) Please provide information on where NGP intends to run cleaning pigs. For example, is the intention to be able to run them in all sections? Or is the intention to run them through multiple sections at a time?

b) Please provide information on where NGP intends to run other ILI tools.

c) Please provide more information on where exactly facilities for running pigs will be located. If only at the Bruderheim Station and Kitimat Terminal, as currently indicated in the Application, please explain in detail how inspection and cleaning will occur.

d) Please provide the dimensions of the launchers and receivers for both the oil pipeline and the condensate pipeline.

e) Please provide information on where the signallers will be built. If the plan is not to install them around launchers and receivers, please provide the reasoning since this can assist in running the tools.

f) Please discuss which pump stations will be equipped with launchers and receivers.

g) Please provide rationale on why some may not be thus equipped, considering the fact that this might become a limiting factor for running inspections later on.
h) Please provide information on where pig signallers will be installed.

i) Please provide confirmation that workshop space at pump stations will be able to accommodate inline inspection tools where it is anticipated that launchers and receivers will be used.

j) Please provide confirmation that workshop space at Kitimat Terminal will be sufficient to accommodate inline inspection tools.

k) Please provide information on the intention to run inline inspections to establish the baseline condition of the pipelines during cleaning and pressure testing. If the intention is not to run ILI, please provide supporting reasoning.

l) If the answer to k) is that ILI will in fact be run during this period, please provide the schedule of such testing and whether it will be done after or during initial tests, using the same water.

m) Please provide a detailed list of all amenities required for ILI which will be put in place to ensure that integrity and safety are maintained.

Response:

a) The Northern Gateway pipelines will be designed to run cleaning and in-line inspection “(ILI”) tools. The details of the Integrity Management System (“IMS”) as described in Northern Gateway’s response to Haisla Nation IR 1.31b) below will be completed during detailed engineering.

b) All Enbridge pipelines fall within the framework of an overall IMS as required by CSA Z662. The core goal of the IMS is to prevent leaks or ruptures caused by corrosion, cracking, mechanical damage and strain of the transmission pipeline system. The details of the IMS for the Northern Gateway pipelines will be developed during the detailed engineering. These details will include consideration for corrosion, cracks and mechanical damage including:

- Base line ILI surveys
- ILI Inspection frequency
- Geotechnical slope instability
- Cathodic Protection
- Internal Corrosion

c-h) As described in the Application (Volume 3, Section 5.6), scraper trap facilities will be installed on the oil and condensate pipelines at the Bruderheim Station and at the Kitimat Terminal and at selected intermediate pump stations. These assemblies will be capable of launching or receiving the latest models of ILI tools, as well as standard
cleaning scrapers used for batching, cleaning and verifying pipeline integrity.

As shown in Application (Volume 3, Appendix H, Figures H-2 to H-10), scraper trap facilities are currently shown on the condensate pipeline at all pump stations and on the oil pipeline at all pump stations having oil pumping facilities. The locations of the scraper trap facilities will be finalized during detailed engineering and will ensure that ILI tools and batching and cleaning scrapers can be run.

Intermediate oil pump stations will normally operate with bypass assemblies in place. When necessary for in-line inspection or other purposes, the bypass assemblies will be removed and the scraper trap assemblies will be connected.

The Application (Volume 3, Section 5.6, Tables 5-3 and 5-4) provides details relating to the design of the scraper trap facilities. The barrel outside diameters, material grade and wall thicknesses for the various components of the oil and condensate scraper trap facilities will be finalized during detailed engineering and may change depending on the particular manufacturer.

Pig signalers will be installed at appropriate locations, including in the vicinity of the scraper traps, to successfully conduct all pigging operations.

i) Necessary workspace will be made available at each pump station or terminal where launchers and receivers will be used.

j) Please refer to Northern Gateway’s response to Haisla Nation IR 1.31i).

k) Northern Gateway will run a geometry ILI tool prior to placing the pipelines in-service. The detailed IMS described in Northern Gateway’s response to Haisla Nation IR 1.31b) above will develop further details on the level of base line surveys to be completed. This will be done during detailed engineering.

l) Please refer to Northern Gateway’s response to Haisla Nation IR 1.31k).

m) The equipment requirements necessary to facilitate ILI runs will be identified during detailed engineering.
1.32 Monitoring and Supervisory Control and Data Acquisition (SCADA)

Reference:  
- i) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 12.1, p. 12-1 (A1S9X8)  
- ii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 11.1, p. 11-1 (A1S9X8)  
- iii) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble:  
In reference i) the Application states that the pipelines will be monitored to identify defects. It does not discuss, however, what exactly will be monitored. There are recently-developed systems installed on pipelines which "listen" for hits on a pipeline and could help avoid third-party damage, or mitigate the size of a spill should damage occur. Such damage to the pipelines could occur during construction or while the pipelines are operational.

In reference i) the Application discusses monitoring programs, which include CP, in-line inspections, investigative excavations and slope stability monitoring. It is important that a baseline survey be performed which would allow for monitoring changes and defect growth once in-line inspections begin. Further to reference i) the discussion of the slope stability monitoring program does not discuss the use of inline inspection tools which have inertial navigation. Such tools are used to detect the center line of the pipelines and are typically run in lines where land movement is possible, such as the planned NGP route. The tools detect how much the pipeline has moved and therefore establish the resulting strain.

The SCADA monitoring system, it is thought, will alert operators to abnormal operating conditions, including spills or leaks. Diluted bitumen, however, has a tendency to give "false positives" in pipelines, which renders interpretation of SCADA data and therefore discovery of leaks very difficult. This is of critical concern when one considers that operators on the NGP pipelines are in Edmonton, many hundreds of kilometres away from most of the pipeline. A "false positive" occurs when the pressure inside a pipeline drops below the pressure at which the natural gas condensate evaporates. This is known as "column separation" or "slack line" in the industry and can cause a bubble which impedes the flow of oil. What is grave is that column separation and pipeline leaks generate similar signals to SCADA.

Request:  
- a) Please explain in detail the type of monitoring to be installed along the pipelines. If "listening" technology is not planned, please provide all reasoning behind this decision, and how safety from third-party damage will otherwise be monitored.

- b) Please provide information on the baseline survey which will be undertaken. If one is not planned, please provide detailed reasoning and...
risk assessment as to why not.

c) Please provide details on establishing the initial center line of the pipelines, as well as subsequent use of inertial mapping to detect movement of the pipeline, since this region is known for ground movement due to various causes.

d) Please provide a detailed explanation of column separation which occurs in diluted bitumen pipelines.

e) Please provide the detailed changes to the SCADA monitoring system which account for and remedy the problem of false positives in a diluted bitumen pipeline.

**Response:**

a) Enbridge is actively investigating and testing a number of alternative leak detection technologies that are complimentary to the current leak detection system and aimed at detecting smaller leaks including third party damage. If performance is acceptable, Enbridge would plan to implement one or more of these technologies on the Northern Gateway pipelines.

During the construction and operation phases of the pipelines, Enbridge employs a number of measures to mitigate the risk of third party damage:

1) Prevention measures during construction include:

   - Pursuant to Section 108 & 112 of the *National Energy Board Act* ("NEB Act"), leave will be obtained from the appropriate authority prior to construction across, on, along or under any such utility or pipeline. Northern Gateway will also ensure that notice be provided to facility owners within 30m of any mechanical excavation and will comply with the Pipeline Crossing Regulations pursuant to Section 112(5) of the *NEB Act*.
   - Listings programs, procedures, and/or specifications for damage prevention of adjacent pipelines and pipeline crossings;
   - Crossing approvals. All Crossing Agreements and or permissions granted will be reviewed for site specific conditions and copies will be onsite prior to construction. Appropriate notice will be provided to all affected parties and or facility owners where a One Call System is not offered.
   - Field management of crossing
   - Provide construction notices

2) Prevention measures during operations include:
• Inspection and maintenance of the ROW
• Pipeline Identification & line markers
• Ground Disturbance practices and procedure
• Public Awareness Program
• Crossings monitoring

b) See Northern Gateway’s response to Haisla Nation IR 1.31b).

Baseline surveys are an integral part of the IMS as described above and the details of these surveys will be developed during detailed engineering.

c) Please refer to Northern Gateway’s response to Haisla Nation IR 1.32b).

d) The Northern Gateway pipelines will be designed to ensure the conditions that lead to column separation do not occur. Column separation could occur when the pressure in a section of the pipeline is at or below the vapor pressure of the product in the pipeline. The vapor pressure of the oil changes depending on its temperature. Wherever a column separation occurs, the oil at that location will move from the liquid state to the vapor state, forming a vapor cavity. The size of the vapor cavity in the pipeline will grow and shrink over time as the pressure in the pipeline decreases and increases. Vapor can form when the oil is flowing (typically referred to as slack line flow) or stationary in the pipeline (and the pressure conditions above apply). The column separation will collapse and disappear when the pressure at the location of pipe experiencing the column separation is increased above the vapor pressure of the diluted bitumen.

e) A component of the SCADA system used for leak detection is the Material Balance System (“MBS”). The MBS is a type of computational pipeline monitoring (“CPM”) system called a real-time transient model (“RTTM”) which models the pipeline in real time. Due to inherent uncertainties modeling an oil pipeline, a column separation can produce a false MBS leak alarm.

False leak alarms associated with column separation are minimized or eliminated by developing an accurate pipeline simulation model, then adjusting MBS parameters through rigorous tuning so that the MBS closely models the actual pipeline operation under all conditions. Measurements of pressure, flow rate, and temperature at locations along the entire pipeline are used in the tuning of the MBS.

Based on detailed engineering analysis of areas with the potential for column separation, pressure instrumentation can be added to help identify column separation. The Northern Gateway pipelines will be
designed to ensure the conditions that lead to column separation do not occur.
1.33 Land Acquisition

Reference: i) Exhibit B1-3 Volume 1 - Application dated May 2010 Section 8, pp. 8-1 to 8-4 (A1S9X6).

Preamble: The Application identifies land acquisition issues for fee simple and Crown lands along the pipeline route and for the terminal sites. It identifies the necessity to acquire rights from private landowners and the Crown, but makes not reference to Aboriginal interests in land.

Request: a) Please identify steps taken to identify what potential encumbrances, both registered and unregistered, exist over the proposed terminal site.

b) Please identify all steps that Enbridge proposes to take to address the Haisla Nation’s underlying Aboriginal title to the proposed pipeline route and proposed terminal site.

c) Does NGP agree that the Haisla Nation is the only Aboriginal Nation claiming Aboriginal rights within and Aboriginal title to the proposed terminal site?

Response: a) The geomatics consultant retained by Northern Gateway receives spatial data from the Integrated Land Resource Registry (“ILRR”), a resource made available by the Province of British Columbia. This spatial data relates to crown interests documented in the British Crown Land Registry and can be retrieved through both the ILRR and the Tantalis Gator system. All this information is available from Geo BC, a government-wide initiative that manages BC’s provincial GIS structure and information on private land and interests in Crown land.

b) The proposed terminal site is located on Provincial Crown land that is designated for industrial use under The District of Kitimat Official Community Plan (December 2008) Schedule D – Future Land Use (Southern Area). Should the Project be approved, Northern Gateway intends to obtain tenure to the terminal site through a lease or long-term license of occupation, or purchase.

Northern Gateway acknowledges that the Haisla Nation asserts rights and title to Crown lands in the Kitimat area, including the proposed terminal site. Northern Gateway has been, and continues to be prepared to discuss with the Haisla Nation and the British Columbia Government measures to accommodate the rights and interests of the Haisla Nation as they pertain to the proposed terminal site. From Northern Gateway’s perspective this could include measures such as municipal tax revenue sharing, employment and contracting opportunities, and the sharing of
lease revenue – all of which could provide substantial benefits to the Haisla Nation and its members. To date, discussion of economic accommodation have not progressed. However, Northern Gateway remains committed to pursuing such discussions when and if the Haisla Nation is in a position to do so.

c) Northern Gateway is aware of the Haisla Nation’s claim. Northern Gateway is not aware of any other Aboriginal group that has made a claim to the terminal site.
1.34 Impacts to Marine Species in Upper Kitimat Arm

Reference:  

i) Exhibit B3-12 Volume 6B - Application dated May 2010, Section 3, p. 3-3 (A1T0G2)  
ii) Exhibit B3-12 Volume 6B - Application dated May 2010, Section 5, p. 5-1 (A1T0G2)  
iii) Exhibit B3-13 Volume 6B - Application dated May 2010, Section 10, p. 10-27 to 10-29 (A1T0G3)

Preamble: In reference i), the Application states "For localized areas such as Kitimat Arm, the distribution and habitat of non-commercial species is not defined" (reference i), p. 3-3).

In reference ii), the Application also states "Where marine habitat loss related to the construction of the Kitimat Terminal cannot be avoided, habitat restoration, enhancement and/or creation will be provided to compensate for any harmful alteration, disruption, or destruction of fish habitat (HADD) or marine fish habitat (reference ii), p. 5-1).

In reference iii), the Application states that movement patterns and habitat use of eulachon in the upper Kitimat Arm are not well known (reference iii), p. 10-27), and that the exact spawning locations for rockfish have not been identified (reference iii), p. 10-29).

Request:  
a) Please explain how a marine habitat compensation program will be developed when "the distribution and habitat of non-commercial species in Kitimat Arm is not defined".

b) Please explain how NGP is confident that a marine habitat compensation program can be developed without knowing what it is to compensate for.

c) Please explain how potential impacts on eulachon and rockfish can be mitigated when the distribution of or spawning locations for these species have not been identified.

d) When NGP reached its conclusion relating to its ignorance of fish distribution and habitat, did it seek this information from the Haisla Nation?

e) Given NGP's lack of knowledge about fish distribution and fish habitat in the Kitimat Arm, has NGP commissioned detailed baseline environmental studies? If no, why not?

Response:  
a) Under Section 35 of the Fisheries Act, activities resulting in the harmful
alteration, disruption or destruction ("HADD") of fish habitat may be authorized if a habitat compensation program is developed to compensate for the lost habitat. The guiding principle of a Habitat Compensation Plan is to achieve ‘no net loss’ of fish habitat. Northern Gateway’s goal is to achieve a ‘net gain’ in the productive capacity of fish habitat in Kitimat Arm.

Project activities that will result in the unavoidable loss of fish habitat are limited to the footprint of the marine terminal, within the Project Development Area ("PDA"). At this site, intertidal and subtidal fish habitats have been well characterized (see Marine Fish and Fish Habitat Technical Data Report, Beckett and Munro 2010). Between July 2005 and August 2009, twelve intertidal surveys were conducted to collect biophysical data within the PDA and adjacent shorelines. In addition, two subtidal video surveys were conducted within the PDA (June 2006 and June 2007) to quantify subtidal marine flora and fauna.

Marine habitats outside of the PDA were not surveyed. However, based on the surveys conducted within the PDA and an thorough literature search on the habitat requirements of species likely to be found in the Project Effects Assessment Area ("PEAA"), the distribution of commercial and non-commercial species within Kitimat Arm can be predicted. This information was used in the assessment of potential Project effects on marine organisms.

The development of the Habitat Compensation Plan to compensate for fish habitat lost or altered at the marine terminal site will be done in consultation with DFO. Upon approval of the project, additional surveys within the PDA will be conducted to better characterize the affected habitats, and to identify compensation strategies. These strategies may include: i) rehabilitating existing disturbed fish habitats within Kitimat Arm, and ii) designing and constructing new high-productivity fish habitats within Kitimat Arm.

b) As discussed in Northern Gateway’s response to Haisla Nation 1.34a), habitats that will be affected by the construction of the marine terminal have been extensively surveyed. These habitats and the marine organisms living in them are discussed in detail in the Marine Fish and Fish Habitat Technical Data Report (Beckett and Munro 2010). Additional surveys will be conducted during the development of the Habitat Compensation Plan to better characterize these habitats and the marine organisms that may be affected.

c) Information on the distribution and spawning habitats of rockfish and eulachon are presented in the Marine Fisheries Technical Data Report (Beckett and Munro 2010) and in the Application (Volume 6B, Section
10.5, Volume 6B, Section 10 and Section 10.5). Additional information on eulachon and rockfish is provided below:

**Eulachon**

Understanding the migratory movements of any marine fish, including eulachon, is extremely difficult given the great distances over which they travel and the unpredictability of ocean conditions from one year to the next. However, general migratory patterns and spawning locations are known for most migratory fish. For eulachon, it is expected that both adults and juveniles will be present within the PEAA at different times of the year. The assessment of potential Project effects on eulachon considered the habitat requirements of both juvenile and adult eulachon within PEAA. The Habitat Compensation Plan will also be developed to ensure that eulachon habitats are conserved.

**Rockfish**

Two species of rockfish were identified within the PDA during subtidal video surveys: copper rockfish and quillback rockfish (Beckett and Munro 2010, Marine Fish and Fish Habitat Technical Data Report, Appendix D: Subtidal Video Survey, Table D-27). Both of these species are benthic and sedentary, occupying small home-ranges that are generally on the order of several hundred metres or less (Love et al. 2002). While the ecology of most rockfish remains poorly understood, benthic species typically spawn within their home-ranges (Love et al. 2002). The habitat requirements of rockfish were considered in the ESA, and will be considered in developing the Habitat Compensation Plan.

d) As discussed in Northern Gateway’s response to Haisla Nation IR 1.34a), efforts have been made to collect information on the distribution and habitat requirements of marine species that occur within Kitimat Arm. However, Northern Gateway welcomes knowledge and input from all local users of the marine environment.

Northern Gateway has offered to engage with coastal Aboriginal groups and will continue with its efforts to engage and work with these groups.

Northern Gateway will continue to work with the Haisla Nation to explore mechanisms for the Haisla Nation to complete a Traditional Use Study relating to marine areas, and for release to Northern Gateway of the Traditional Land Use Study funded by Northern Gateway in 2005 relating to terrestrial portions of the Project. In addition, Northern Gateway would welcome the opportunity to work with the Haisla Nation to minimize potential effects of the Project on marine resources.
The Haisla Nation’s knowledge on eulachon, rockfish, and other marine species in Kitimat Arm would be valuable for defining habitats within the PDA that require additional surveys, and for scoping and completing the Habitat Compensation Plan.

e) As discussed in Northern Gateway’s response to Haisla Nation IR 1.34a), Northern Gateway has commissioned twelve intertidal surveys and two subtidal surveys to obtain baseline data on habitats that are likely to be affected by the construction of the marine terminal.

In response to a request by DFO for further information on sponge abundance and distribution in Kitimat Arm, Northern Gateway undertook additional subtidal surveys within the PEAA in May 2011. Multibeam bathymetry data were used to identify eight survey sites with suitable sponge habitat. Within the PEAA, vertical transects were surveyed using a Remote Operated Vehicle (“ROV”) with scaling lasers (to obtain accurate specimen size data) from depths of at least 100 m to the surface. A minimum of 5 transects were completed in each of the 8 survey areas and a total of 44 transects were completed in the PEAA.

During the development of the Habitat Compensation Plan, Northern Gateway will conduct additional surveys within the PDA to better characterize these habitats and the marine species that may be affected.
1.35 Restrictions on Access for Fishers

Reference: i) Exhibit B3-15 Volume 6B - Application dated May 2010, Section 13, p. 13-26 (A1T0G5)

Preamble: The Application states that the Project will limit marine fisher access in the marine PDA and identifies those recreational fishers will be excluded from the terminal area, including Moon Bay Marina down to Bish Cove, which is a noted fishing area.

Request: a) What are the potential impacts of the exclusion of fishers from the terminal areas including Moon Bay Marina down to Bish Cove on Haisla Nation food, social and ceremonial fishers?

b) What potential mitigation measures does NGP anticipate implementing with respect to restrictions proposed to be placed on Haisla Nation food, social and ceremonial fishers?

Response: a) The Application (Volume 6B) refers to alienation of the Moon Bay to Bish Cove area and clarification regarding the exclusion of other vessels from the 150m safety zone seaward of the berth structures. Moon Bay Marina is no longer in operation but is a convenient landmark for this discussion. Moon Bay Marina and Bish Cove are located about 4 and 3 km away from the marine terminal, respectively (Application (Volume 1, Section 2.5, Figures 2-2 to 2-4)) and with the exception of the possible occasional presence of construction and operational vessels no permanent alienation of these areas to any fishers is expected.

b) A 150 m marine safety zone will be established seaward from berthing structures and fishing will only be excluded in this zone. In addition, the "Wall", a popular winter fishing area between Moon Bay Marina and Bish Cove, will remain available. Of note, Bish Cove is the site of the Kitimat LNG terminal and may have restrictions that affect that fishing area.

While the specific extent and location of Food, Social and Ceremonial (“FSC”) fishing has not been fully characterized, Northern Gateway has offered to engage the Haisla Nation in conducting Traditional Use Studies (“TLUS”). Details regarding the methods of Aboriginal engagement may be found in Application (Volume 5A). It is hoped that the Haisla Nation will participate in TLUS which will provide the basis for the development of specific mitigation measures. Northern Gateway would like to continue to work cooperatively with the Haisla Nation to identify the means to minimize and/or avoid potential adverse effects on FSC fisheries.
This could include:

- the establishment of a Fisheries Liaison Committee ("FLC") to minimize conflicts between Project activities and marine fisheries including the FSC fishery;
- further refinement of environmental sensitivity atlases, using site-specific information on FSC fisheries (i.e., respecting fishing rights related to sacred and ceremonial locations; and,
- the development of geographic response plans as part of a broader oil spill response plan, using site-specific information on FSC fisheries.

Northern Gateway has committed to the development and establishment of an FLC, recognizing the importance of FSC fisheries to Aboriginal communities in the Project Development Area including the Marine Terminal. The framework for a FLC would have participating members contribute in good faith to discuss construction and operational schedules, identify sensitivities and concerns, identify protocols for compensation for lost or damaged gear, seek mutually agreeable solutions to minimize and/or avoid conflicts, and optimize communication among participants. It should be noted there are no other industrial or vessel fleet operators on the North Coast that have proposed the concept of an FLC as a means of addressing the potential effects of the Project on FSC fisheries.
1.36 Kitimat Terminal Storage Tanks

Reference:

i) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 9.1, p. 9-2 (A1S9X8)
ii) Exhibit B 1-5 Volume 3 - Application dated May 2010, Section 9.2.4, p. 9-8 (A1S9X8)
iv) Exhibit B 1-5 Volume 3 - Application dated May 2010, Appendix B, Table B-1 p. B-3 (A1S9X8)
v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble:

A study which reviews the past forty years of storage tank accidents found that 86% involved petrochemicals (Chang and Lin, 2006, document attached). Furthermore, external floating-roof tanks, by a wide margin, were the most common type of tank involved in these petrochemical accidents.

In references i) and ii), it is stated that the impoundment reservoir has only 10% more capacity than the largest tank in the Kitimat Terminal. In an earthquake, all 14 tanks (11 for diluted bitumen or synthetic oil and 3 for condensate) will be simultaneously affected and could develop leaks. This remote impoundment reservoir is shown in reference iii) on drawing 11. It is unclear whether or not each tank area will hold 110% of tank volume, or if only the remote reservoir will be designed to capture tank contents (and the contents of how many tanks).

In references i) and ii), the natural period of vibration of sloshing liquid is not discussed. It is known that for a 74-meter diameter tank, the natural period of vibration of sloshing liquid is about 10 seconds (Malhotra et al., 2000, document attached). Therefore, the response of sloshing liquid will be controlled by long-period waves which, due to an earthquake, can travel hundreds of kilometres away without significant attenuation. Most ground motion prediction equations, however, terminate at periods below 10 seconds. Therefore, the amplitude of long-period waves is not sufficiently characterized in design standards.

In reference i), NGP states that external floating roof storage tanks will be used. The dynamic response of a roof floating on sloshing liquid in a tank is complex. Seismic design standards, as discussed in reference iv), do not address the analysis and design of floating roofs. The deck of a pontoon floating roof can be torn by radial shortening caused by large vertical displacements. The deck can pull the pontoon inward causing it to buckle. The pontoon can be damaged by circumferential bending due to large vertical displacements. All of the failure modes described above have been observed during past earthquakes (Chang and Lin, 2006; Liebe 2006, documents attached). Damaged floating roofs have sunk or caused fires. Floating roofs have been damaged by
earthquakes hundreds of kilometres away because long-period waves which control the response of floating roofs can travel very far without significant attenuation.

In reference i), the external floating roof tanks are described. In code-based seismic design, the loads are reduced by a factor of 3 for mechanically anchored tanks and by 2.5 for unanchored (self-anchored) tanks. This is part of API Standard 650 as listed in reference iv). As a result of these reductions, the code-designed tanks are expected to behave in a nonlinear fashion during the design ground shaking, as described in Malhotra (2000) (document attached). The nonlinear responses can be in the form of base uplifting (Malhotra, 2000; Cortes et al., 2010, document attached) and base sliding. Base uplifting can rupture the base plate causing a leak. Base uplifting and sliding can rupture the piping connections. In a code-based design, base uplifting and base sliding are not explicitly computed. As a result, required flexibilities in piping connection are not computed. Note that even anchored tanks are expected to uplift during design ground shaking because base anchors are designed to resist on the reduced loads.

Reference i) discusses pipe racks and reference iv) lists the codes by which these racks will be designed. In a code-based seismic design of pipe racks, the loads are reduced by a factor of 3. As a result, the pipe racks are expected to behave in a nonlinear fashion during design ground shaking. Nonlinear responses can be in the form of base uplifting, base rocking and yielding of the pipe rack structure. All of these responses can damage the supported pipes. Nonlinear responses are typically not computed in a code-based seismic design.

The storage tanks from reference i), designed to standards listed in reference iv), are expected to experience inelastic response during design ground shaking. If the inelastic response occurs for a sufficient number of cycles, low-cycle fatigue damage can occur (Cortes et al., 2010; Malhotra, 2002) (documents attached). In a code-based design, the cyclic aspect of earthquake loading is not explicitly considered.

In Lieb (2006) (document attached), the published study lists roof sinking, rain, vapour and corrosion as the primary vulnerabilities of floating roof storage tanks.

**Request:**

a) Please provide the detailed rationale for including external floating-roof tanks in the Project.

b) Please provide detailed confirmation that the remote impoundment reservoir and berms around individual tanks have sufficient capacity to contain simultaneous leaks from all 14 tanks during an earthquake.

c) Please provide specific information on how long-period motions will be
characterized for computing the response of sloshing liquid in oil and condensate tanks.

d) Please provide an in-depth description of the seismic analysis and design of floating roofs. This description should include details of:
   i. Interaction between sloshing liquid and floating roof
   ii. Stresses induced in the deck due to geometric shortening
   iii. Bending of pontoon due to vertical motion
   iv. Measures taken to prevent leaks in the floating roof

e) Please provide a clear and detailed explanation of how the nonlinear response associated with base uplifting and base sliding will be computed if load reduction factors are used in seismic design of storage tanks at the proposed Kitimat Terminal.

f) Please provide a clear and detailed explanation of how the interaction between the foundation, structure and the fluid will be considered in seismic design of tanks.

g) Please provide a clear and detailed explanation of how the nonlinear responses of the pipe racks will be computed if load reduction factors are used in seismic design of pipe racks.

h) Please provide a clear and detailed explanation of how the cyclic aspect of earthquake loading will be considered in the design of structural systems that are prone to inelastic deformations such as:
   i. Bottom-shell connection of tanks
   ii. Pontoon and deck of floating roof
   iii. Pipe rack structure

i) Given the high likelihood of severe rain events in Kitimat, both in terms of intensity and accumulation, please list the extra precautions taken in design, operation and maintenance planning for the floating roof storage tanks.

j) Please provide copies of all reports, studies, correspondence and other documentation in NGP's possession or control that discusses earthquake-related risks at the proposed Kitimat Terminal.

Response:

a) External floating-roof designs are commonly used on tanks that contain petroleum products. The floating roof provides a means of reducing emissions.

b) The tanks will be designed to safely accommodate seismic loading to prevent leaks during a seismic event. The design will be in accordance with applicable codes and standards, including the National Building
The tank impoundment design will meet or exceed the requirements of the National Fire Protection Association (“NFPA”), Enbridge Design Standard D05-101 Facility and Tank Containment Systems, and the Canadian Council of Ministers of the Environment (“CCME”) Environmental Code of Practice for Aboveground Storage Tank Systems Containing Petroleum Products. As described in the Application (Volume 3, Section 9.5.3), the remote impoundment reservoir will be sized for a minimum of 110% of the volume of the largest tank plus all the water collected within the area of the tanks during a peak rainfall event and an allowance for water volume needed for fire fighting. Each tank lot group (three or four tanks) will also be sized for a minimum of 110% of the volume of the largest tank within that group.

The impoundment reservoir system will not be designed to contain simultaneous leaks from all 14 tanks.

c) This information will be developed during detailed engineering. Inclusion of seismic affects will be incorporated into the tank design. The tank design methodology to be used for seismic related earth movements is outlined in API Standard 650 – Welded Tanks for Oil Storage. The National Building Code will also apply to the applicable aspects of tank design.

d-f) Refer to Northern Gateway’s response to Haisla Nation IR 1.36c) above.

g) Refer to Northern Gateway’s response to Haisla Nation IR 1.36c) above. The design of pipe racks and other structural systems will also take into consideration the requirements of CSA S16 Design of Steel Structures and industry guidelines such as ASCE 7-05 Seismic Provisions.

h) Refer to Northern Gateway’s response to Haisla Nation IR 1.36g) above.

i) Refer to Northern Gateway’s response to Haisla Nation IR 1.36c) above. Rainfall and snowfall data including warm rain on wet snow events for Kitimat will be taken into consideration. Operation and maintenance procedures pertaining to the drainage system for run-off from the floating roof will be developed during detailed engineering.

Floating roof tanks are designed to support external loads from rain and snow. Roofs will be coated to prevent corrosion due to weather
exposure. Deck drainage systems such as articulating piping systems will be used to remove excess precipitation from the roof surface.

j) With regard to potential seismic risks, the site selection and preliminary design of the Kitimat Terminal has been based on the information provided in the Application (Volume 3, Appendix E-1, Section 3.3). Please see Attachment Haisla Nation 1.36j).
MARINE TRANSPORTATION

1.37 Use of Double Hulled Tankers


Preamble: The Application states that double hulls reduce the probability of spill due to groundings or collisions.

Request: a) Please provide reports or studies that show the relative spill risk for single hulls versus double hulls.

b) Is diluted bitumen generally more corrosive than conventional crude oil?

c) Please provide reports or studies that show the relative spill risk for single hulls versus double hulls when the product being transported is diluted bitumen.

d) Is synthetic crude generally more corrosive than conventional crude oil?

e) Please provide reports or studies that show the relative spill risk for single hulls versus double hulls when the product being transported is synthetic crude.

Response: a) Accident statistics for the last ten years (2001 to 2010 inclusive) for all crude oil tankers and oil product tankers 60 000 dwt and greater, have been reviewed.

During this period, 43 accidents with pollution have been reported - 17 from double hull tankers and 26 from single hull tankers. At the same time the number of operating double hull tankers has been more than twice as high as the number of operating single hull tankers. 7790 operating years are recorded for double hull tankers versus 3448 for single hull.

Therefore, the reported frequency of polluting accidents per year of operation has been 0.0022 and 0.0075 for double hull and single hull tankers respectively (i.e. the frequency of accidents causing pollution is more than 70 % less for double hull tankers than for single hull tankers).

b) No.

c) Please see Northern Gateway’s response to Coastal FN IR 1.5c).
d) No.

e) Please see Northern Gateway’s response to Coastal FN IR 1.5c).
IMPACTS OF OIL ON FISH

1.38 Use of Fish for Oil Spills in Other Ecosystems

Reference:

i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)

ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)

iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)

iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)

v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble:

The preface and introduction to Vol 7B: Risk Assessment and Management of Spills - Pipelines state that the purpose of this document is to "enable strategic development of prevention and response measures for the most sensitive types of land and water along the pipeline route, including identifying follow-up and monitoring." The Application also states that "Northern Gateway will integrate spill prevention and mitigation measures into standard operational practices [into a risk assessment of potential spills that] addresses effects on terrestrial and freshwater ecosystems by selecting and evaluating key components to characterize potential effects, highlight potentially vulnerable species and identify sensitive habitat areas. Effects on air, soil, groundwater, surface water, vegetation, fish, birds, mammals, amphibians, and reptiles are discussed."

For planning a spill response, Vol 7B can be regarded as the problem formulation stage for an ecological risk assessment for oil spills into the various aquatic ecosystems adjacent to or crossed by the proposed pipeline. It also serves to inform the public of the potential ecological, human health, social and economic hazards and risks of oil spills during the pipeline's operation.

However, the conclusion to Vol 7B states that "if a spill were to occur [emphasis added], chronic toxicological effects can be assessed by completing human and ecological risk assessments, which provide an indication of the degree of risk to biota and human health, and help to refine clean-up and mitigation measures."

A post-spill risk assessment would be inadequate and inappropriate. The risk assessments and clean-up and mitigation design should be done BEFORE a spill, and cover as many of the spill scenarios and contingency plans as possible. When there is a spill, the appropriate response is a thorough and ongoing monitoring and assessment of damage to fish, impacts on critical events such as fish spawning, recruitment, growth, and escapement, the proportion of fish habitat that is no longer productive, the impacts on fish populations, fisheries, and the local economy, and the rate at which there is recovery from damage. Plans for monitoring should be in place prior to a spill.
Overall, the discussion of the possible effects of oil spills in Vol 7B is incomplete and superficial. Few references were cited, with no focus on plausible exposure scenarios, or the impacts of oil on specific life stages of the fish species endemic to the Kitimat River. There is insufficient work referenced to adequately understand and assess the risks and to define appropriate mitigation for such risks.

There is a rich literature on the ecological impacts of oil spills and the toxicity to aquatic species of the components of oil. In particular, there has been significant recent experience that is highly relevant to pipeline spills into rivers (Pine River, BC, 2000; Kalamazoo River, Michigan, 2010), to the effects of medium and heavy oils on marine and freshwater species (Exxon Valdez oil spill (EVOS), 1989; medium crude oil), the Wabamun Lake spill, 2005, heavy fuel oil), and to the expertise and technology needed to manage and contain oil spills (the Deepwater Horizon blowout, 2010). Unfortunately, there was little positive gained from these spills because Vol 7B provided only scattered and incomplete references to some aspects and did not review each in a comprehensive or cohesive way.

**Request:**

a) For the EVOS, please review the literature on effects on fish species of different life stages, with particular reference to the nature and consequences of the toxicity of oil to early life stages of pink salmon, the mechanism by which spawning shoals were contaminated, and the subsequent effects on growth and survival of adults at sea after exposure to oil as embryos.

b) For the Wabamun spill, please describe the behaviour of heavy oil in fresh water and the effects of the oil, and of the clean-up, on nearshore and offshore fish spawning habitat, and on fish reproduction.

c) For the Kalamazoo River, please compare the nature of the oil spilled to the diluted bitumen, condensate, and synthetic oil that may be shipped in the NGP pipeline, and describe the behaviour of the oil as it is spread and weathered, the extent and duration of sediment contamination, and the results of any studies on toxicity to fish or impacts on fish populations.

d) For the Deepwater Horizon, please compare the oil spill response capability in the US Gulf Coast (i.e., the amount, quality, and availability of equipment, vessels, and industry and government expertise) to that available for responding to spills into the Kitimat River within 24 hours of the spill.

**Response:**

a) Potential effects of hydrocarbon exposure on larval fish are discussed in detail in the biophysical risk assessments (Application (Volume 7B,
Regarding contamination of spawning grounds by the Exxon Valdez Oil Spill (“EVOS”) hydrocarbons, Brannon et al. (1995) examined water and sediment concentrations for PAHs from Prince William Sound spawning stream sediments in 1989, and found low hydrocarbon concentrations in spawning sediments. Through regression analyses, they concluded that there would have been no substantial toxicological effects on the critical early life stages of pink salmon in PWS attributable to the spill. This was confirmed by chemical analysis of pink salmon embryo tissue sampled from oiled streams. In 1990 and 1991, embryos showed mean tissue-PAH concentrations that were at least 80 times lower than tissue concentrations reported toxic to pink salmon embryos (Brannon et al. 2001). These data and the sediment-PAH concentrations measured in oiled streams indicate that toxic levels of petroleum hydrocarbons were not present in the incubation environment (Brannon et al. 2001).

As discussed in the Risk Assessments, embryonic and larval fish exposed to hydrocarbons may experience a suite of sub-lethal effects, including: malformations, inhibited swimming, genetic damage, decreased growth, decreased size, and decreased survival (Carls et al. 1999, Heintz et al. 1999, Heintz et al. 2000, Barron et al. 2003). While these effects are irrefutable, they may not be as widespread in the natural environment as they are under laboratory conditions. Most studies on the effects of hydrocarbons on fish incubate fish eggs in aqueous environments containing elevated concentrations of hydrocarbons. Thus, the results of these studies are applicable only under conditions similar to those tested (i.e., constant, elevated exposure).

The extent to which sub-lethal effects of hydrocarbons on embryonic and larval fish translate into population-level effects is a topic of much debate. Following the EVOS, Bue et al. (1996) found evidence of increased mortality in Pink salmon larvae and pre-emergent fry in oiled vs. unoiled streams. However, Brannon et al. (2001) concluded from reanalysis of the egg mortality data and from field tests of the sampling protocol (Collins et al. 2000) that the egg mortality was not from oil, but from the effect of sampling the eggs too soon after spawning during the period of extreme embryo sensitivity to shock. In the years after EVOS, returns of wild pink salmon ranged from about 2 million (1992) to almost 13 million (1990), leading Trustees (2002) to conclude that because of the tremendous natural variation in adult returns, the extent to which wild salmon returns were affected by the oil spill could not be measured directly.
While it is clear from empirical studies that oil can have adverse effects on larval fish, the significance of this in the natural marine environment following a large spill is unknown. It is likely that the magnitude of effect depends upon a number of variables such as the timing of the spill, the species affected, the number of embryos/larvae affected, the concentration of oil, and the duration of exposure.

See Northern Gateway’s response to Coastal FN IR 1.31d) for effects on adult salmon.

References:


Heintz, R.A., S.D. Rice, A.C. Wertheimer, R.F. Bradshaw, F.P.


b) The purpose of the environmental assessment conducted by Northern Gateway was to assess the potential environmental impacts of the Project including accidents and malfunctions. Although it has an understanding of past spill events and their effects, the purpose of the environmental assessment was not to provide a detailed assessment of the impacts of the Wabamun (or any other past) spill. Northern Gateway is familiar with the literature in association with this spill; however, it is not in a position to describe the clean-up procedures used and effects associated with this spill event.

c) Please see the Northern Gateway’s response to Haisla Nation IR 1.9d). As noted in Northern Gateway’s response to Haisla Nation IR 1.23a) and 1.23d), Northern Gateway proposes to ship a variety of crude oil products including diluted bitumen and synthetic oil (MacKay Heavy Bitumen, Synthetic Light, Cold Lake Bitumen, CRW Condensate).

From July 2010 through August 16, 2011, surface water samples at Talmadge Creek, the Kalamazoo River and Morrow Lake were collected twice per week to monitor and assess any oil-related impacts. More than 1,700 water sample tests have been taken. No spill-related well contamination has been detected, nor is there any indication of issues with city water.

In accordance with the U.S. *Natural Resources Damages Assessment* (NRDA) process, the effects of the Line 6B incident on the environment are being assessed by designated trustees of the impacted natural resources to determine the need for remediation or reparations.

Regarding effects on the fish population in the Kalamazoo River, a number of specimens and data were collected by the regulatory agencies in 2010 for testing purposes. The initial specimen collection and data assessment efforts included the following: “Fish Tissue Sampling and Histopathology”, conducted August 18-20, 2010 and November 18, 2010; “Mussel Tissue and Sediment Sampling”, conducted August 25-26, 2010; “Fish Status and Trends, Benthic Invertebrate Sampling and Habitat Assessments”, conducted September 8-16, 2010; and a “Mussel
Shell Survey”, conducted October 18-25, 2010. Enbridge does not possess reports from any of these sampling and data collection events.

Included with this response are two reports prepared by the regulatory agencies and provided to Enbridge (see Attachment Haisla Nation IR 1.38c). One provides a table format summary of the sampling conducted of fish collected in Marshall, MI, Ceresco, MI and Morrow Lake in 2010. The other provides an assessment of the sampling findings and concludes that as of August 2011 there is no indication that the incident impacted the fish population and there is no need to change the preexisting fish consumption advisory on the river that was not related to the incident.

d) Northern Gateway does not believe that a comparison of the response capability of a major offshore oil and gas exploration and development region (i.e., US Gulf Coast) is relevant to the Project.
1.39 Pine River Spill

Reference:

i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)

ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)

iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)

iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)

v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble: Most of the information about the Pine River spill exists in government and consultants reports that are not easily accessed. From the scattered references to this spill, however, it appears that it had major acute impacts (fish kill within 24 hours for up to 30 km downstream); that the water, riverbanks, and sediments were heavily contaminated, and often to toxic levels, for weeks to years; that benthic invertebrate communities were damaged for more than a year, and that sediments may still be contaminated. In addition to fish kills, a major concern would be the long-term impact on trout embryos and trout recruitment of the PAH released from residual oiled sediments.

Request:


b) Please provide information on whether the Pine River is similar to, or different from the Kitimat River. Include considerations of the hydraulic conditions, total flow, nature and movements of bed sediments, fish habitat, and fish communities, and indicate how the aquatic ecosystem in each river would respond to an oil spill.

c) There are inconsistencies among the data provided on the Pine River spill (p. 7-1 and p. 7-10) related to the volume of oil spilled (half of 950 m³, 865 m³, or < 30 m³ in an earlier chapter). Please provide information on how these numbers were derived, or correct them if they are in error.

d) There are also apparent inconsistencies related to recovery time. On p. 7-10 "water quality returned to baseline conditions in less than three weeks (Pennart et al. 2004, internet site), and sediments were contaminated for two years," while on p 7-24 "concentrations of hydrocarbons (including PAH) in water, sediment and algae returned to levels below detection limits at all but one site, within three months (Alpine 2001)." Please provide information to resolve these inconsistencies or to explain the conclusions in greater detail.
e) Oil remained in sediments for two years after the Pine River spill, but Pennart et al. (2004) are quoted as stating that "dissolved PAH concentrations were well below any effect threshold for sensitive species in the river". Please provide information on where these concentrations were measured, with reference to surface waters and to interstitial waters of bed sediments, where fish embryos develop.

f) PAH concentrations were within water quality guidelines three weeks post-spill. Please provide information on how quickly fish species respond to oil in water, what the minimum exposure time is required, and how that varies with the life stage exposed.

g) Please provide information on delayed effects, and how long impacts will be evident if embryos are exposed to toxic concentrations of PAH.

h) Please provide information on whether the quoted water quality guidelines are up-to-date (when they were last revised), and whether they are based on petroleum derived alkyl PAH, total PAH, or on the USEPA Priority 16 PAH.

i) Please provide information on whether monitoring of the Pine R spill is ongoing, and whether it included measures of survival and emergence of fish embryos from contaminated sediments.

j) Please provide information on dissolved PAH concentrations measured during or after the Pine R spill, what concentrations were associated with the observed fish kill, and whether they corresponded to the lowest observable effect concentrations reported in the literature for sensitive fish species.

k) "After two years, the Pine river ecosystem… had almost returned to baseline conditions (Pembina 2004)." Define "almost".

l) "Most of the recovery of hydrocarbons that reach lakes or other slow-moving water bodies occurs within the first week" (Reference iii), p. 7-10) Please provide information on whether this refers to removal of oil mixed in sediments or only to floating oil on the water surface.

**Response:**

a) The Hodson et al. (2002) and Blaise et al. (2004) papers refer to toxicity testing following an experimental oil spill into a wetland along the St. Lawrence River. The tests were conducted to compare natural recovery (natural attenuation) with remediation strategies (nutrient amendments, removal of plants) in anoxic sediments of a freshwater wetland area.

Hodson et al. (2002) measured enzyme induction in fingerling rainbow trout exposed to sediment over a four day period. The enzyme induction test (EROD) measured a response linked to PAH bioavailability. The study demonstrated that PAHs were bioavailable for up to 15 months after initial oiling, but that the enzyme induction in fish and measurable hydrocarbon levels in sediment declined by 80% over that 15 month
period. Results were similar in oiled and untreated vs. oiled and treated (nutrient addition to stimulate plant growth and hydrocarbon degradation). The authors noted that there was only minor evidence of toxicity to fish (less than 10% mortality in some tests). The study points to chronic rather than acute toxicity effects on fish.

The applicability of results of the experimental study to a potential spill in the Kitimat River needs to consider the following:

- The chronic toxicity of PAHs to a range of organisms, including juvenile salmonids, is recognized, and the endpoints for remediation are developed considering potential for chronic as well as acute toxicity.

- The amount of oiling at the test plots described in the Hodson et al. (2002) experiment (12 L of oil in a 20 m² area) was enough to leave a thick visible layer on the sediment surface. This amount of oil would not remain following remediation of a spill from the Enbridge pipeline, so the experimental spill example assesses a more extreme situation than would occur with an accidental spill.

- The physical and biological degradation processes would be faster in the Kitimat River, where flows are considerably faster than in a wetland of the St. Lawrence River (small river flows and some tidal action, inhibited by ice cover over the winter). Natural attenuation of hydrocarbons is faster in aerobic environments (e.g., river sediment) than in anaerobic environments (wetland sediment).

- The Hodson et al. (2002) experiment tests fish in a confined bioassay situation, where the fish cannot move away from the source of contamination. In the natural environment, fish would be free to move more widely, and any remaining oiled areas would be spread further apart.

This review of the Hodson et al. (2002) paper does not change Northern Gateway’s assessment of potential effects on key resources at risk, as the potential for chronic as well as acute effects on fish are already recognized as adverse (Application (Volume 7B, Section 9.5.4)). It also supports the importance of spill prevention and timely cleanup response stressed in Northern Gateway’s assessment of risks associated with a potential spill. The information about usefulness of phytoremediation techniques in areas of anoxic sediment will be considered in further developing remediation techniques for the oil spill response planning process.

b) Northern Gateway does not agree with the need to conduct a review of
additional literature on additional studies of experimental oil spills in Canada and elsewhere. While such studies may provide greater scientific understanding of the mechanisms of chronic and acute toxicity to organisms, it would not change Northern Gateway’s assessment of potential effects on key resources at risk, as the potential for chronic as well as acute effects on fish are already recognized as adverse (Application (Volume 7B, Section 9.5.4)).

Information about effectiveness of specific remediation techniques will be incorporated into the Oil Spill Response Plans throughout the life of the project, as this information becomes available.

c- l) A detailed account of the scientific information available on the Pine River is currently being prepared in response to this request. That summary will be provided as a supplement to Northern Gateway’s response to Haisla Nation IR 1.39 when it is available.
1.40 **Kitimat River**

**Reference:**

i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)

ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)

iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)

iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)

v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

**Preamble:**

The Kitimat River and its tributaries vary widely in their total discharge due to high seasonal fluctuations in precipitation and snow cover. For part of the year, low flows may lead to exposed gravel bars and shoals and extensive reaches may be shallow braided channels. At other times, high flood waters may submerge all bars, and strong currents may re-work channel locations and shapes. Under these conditions, conventional oil recovery systems may not function efficiently, and the oil may travel the length of the river very rapidly before they can be deployed.

**Request:**

a) Please provide information on the hydraulic conditions (discharge rates, range of current speeds, river width and depth) of the Kitimat River at high and low flow rates, and the technology that would be deployed for oil recovery.

b) Please provide information on the transit time of oil from all potential spill sites (stream crossings; areas where the pipeline is within 1 km of the river) to the estuary?

c) Please provide information on how long it will take for oil recovery equipment to be deployed to stop the flow of oil into or down the Kitimat River for each potential spill site or tributary spill site.

d) P. 7-10: "PAH levels may remain above sediment quality guidelines, unless remediated": Please provide information on how sediments are remediated, how long it would take, and how it would disturb the river's ecosystem.

e) Assuming a spill of 2000 m³ at the Hunter Creek Crossing, please provide information on the extent (distance downstream) of sediment contamination and depth to which it would be contaminated (and remediated). Please provide information on how clean the sediments should be once remediated.

**Response:**

a) Channel flow velocities are a function of discharge, channel slope, and channel area. Discharges in the Kitimat River will vary with location
and drainage area; discharges at points closer to the headwaters of the river are less than discharges at the mouth of the river. Similarly, the channel flow area (width and depth) is smaller at the upstream end of the river than at the downstream end. The slope of the channel bed is higher in the upper reaches than near the mouth of the river.

Channel widths, flow velocities and travel times at three locations along the Kitimat River under low, moderate and high flow conditions are provided in Appendix C.11 of the Technical Data Report “River Control Points for Oil Spill Response”. The hydraulics of the Kitimat River will be further investigated during detailed engineering for the development of site-specific oil spill response plans. The proposed investigations are outlined in the Technical Data Report “River Control Points for Oil Spill Response”, Section 4.

The response tactics for responding to an oil spill in the Kitimat River are outlined in the General Oil Spill Response Plan Section 4.7.1. Specifics with respect to containment, mechanical recovery and bank treatment are provided in Section 7 (Tables 7-1, 7-2 and 7-3 respectively). Deployment strategies and technology used may vary depending on flow velocity (oil containment boom angle, for example) and localized conditions (back eddies, etc.).

b) The Response to the JRP Request for Additional Information (March 2011) provides maps showing modeled spill extents for full-bore ruptures for each kilometre of the oil pipeline. Please refer to the assumptions used in the modeling and the caveats and cautions when interpreting the results.

The modeling shows 53 spill extents that could potentially enter the Kitimat River over the 12 hour period used for the modeling. Thirty-two of these enter Kitimat Arm and 21 do not. As discussed in the Response this modeling uses very conservative assumptions and assumes no mitigations in place to reduce the impact of the spill. These hypothetical spill extents do not represent an actual situation since emergency response and other mitigation measures have not been included in these scenarios.

Please refer to Northern Gateway’s response to JRP IR 4.16 for a description of the Pipeline Oil Spill Response Plan which will be developed before the commencement of operations. This plan will describe emergency response actions, objectives and strategies to mitigate the effects on land or in the water during all seasonal conditions under a range of operational and environmental settings.

c) The General Oil Spill Response Plan (“GOSRP”) for the Project
describes Northern Gateway's strategy for emergency management. Pre-emergency preparedness includes establishing and maintaining emergency response personnel and equipment in strategic locations along the pipeline route. In addition, Section 4.7.1 of the GOSRP describes pre-emergency tactical watercourse response planning.

During detailed engineering, Northern Gateway will develop control point mapping for the Kitimat River and will identify and establish the specific emergency response resources that will be located in the Kitimat area. These response plans will incorporate the results of the pipeline risk assessment process.

d) As discussed in Application (Volume 7B, Section 2.3, Section 5 and Section 9.5 (Example 4, hypothetical release into Hunter Creek)), a number of protective measures are part of project design, for example:

- leak detection equipment
- equipment and procedures to shut down the pipeline in the event of a release
- further development of a GOSRP and Pipeline Oil Spill Response Plan, which will outline measures and actions to be taken
- use of control intercept points to limit downstream migration of hydrocarbon following a spill

The sediment remediation approach taken would depend on the specific situation, as river velocity, water depth, location of spill, time of year, amount of oil released and other factors will dictate the remediation measures. Depending on whether hydrocarbon is stranded along the river bank or on shoals and gravel bars, the types of remediation methods would include physical methods such as flooding and washing the area, manual raking, and scraping of sediment, with released oil captured in booms and removed (see Application (Volume 7B, Section 5)). The length of time needed for clean-up would depend on the specific situation (e.g., material and volume spilled), time of year (e.g., ice, snow, spring melt), and geographic extent of the spill. Clean-up would begin immediately and would continue as needed to reach concurrence that endpoints have been met.

Potential effects of a spill and clean-up on river ecosystems are discussed in Application (Volume 7B, Section 7.8). Given that the oiling would likely occur at the water/air boundary (shoreline, exposed shoals and sandbars), disturbance related to remediation would not encompass the entire river or stream bed, leaving undisturbed areas to provide recolonizing organisms. There would be a temporary loss of some of the organisms that provide fish food, which would re-colonize over the next one to two years (Application (Volume 7B, Section 7.8)).
A 2000 m$^3$ spill into Hunter Creek is discussed in Application (Volume 7B, Section 9.5) as a hypothetical scenario. This was assessed for the most sensitive time of year (spring freshet, when river flows are highest), although smaller volumes and lower stream flows would result in a smaller environmental effect. Modeling indicates that some of the hydrocarbon could reach the Kitimat River estuary, 60 km downstream of Hunter Creek, although in the unlikely event of a spill, booms would be deployed at key locations in the Kitimat River to limit downstream movement of hydrocarbon (specific locations, types of booms, anchoring locations and access would be described in the control point maps).

Sediment contamination could occur throughout this area, mainly on shoreline areas and shoals. Contaminants such as PAHs could be deposited in slow flowing areas, mainly on surface sediments and river banks. The depth of sediment that may be oiled depends on substrate permeability to the oil, with the potential for penetration into gravel-cobble substrates greater for lighter oil compared to more viscous oil. Remediation would be done in all oiled zones that posed an unacceptable ecological risk, regardless of depth of penetration.

Endpoints for remediation (Application (Volume 7C, Section 5.8)) would be developed in consultation with government agencies, and would consider the “net environmental benefit” (i.e., would balance the adverse ecological effects of further clean-up against the risk of ongoing contaminants release). The sediment quality guidelines for PAHs and the habitat sensitivity of the area would be considered in developing the remediation endpoints.
1.41 Other Studies

Reference:  
i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)
ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)
iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)
iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)
v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble:  
There is a reference to oiled beach experiments (Blaise et al) wherein oil in sediments remained toxic to algae for 65 weeks following a controlled spill. There are other publications on the same experiment. One demonstrated that sediment PAH remained bioavailable to fish for the same length of time (65 weeks)\(^1\).


Request:  
a) Please review the Hodson et al (2002) paper within the context of sediment contamination of the Kitimat River, and indicate how this paper influences Northern Gateway's conclusions about potential impacts of a spill.
b) Please review reports of other experimental oil spills in Canada and abroad, and, and indicate how this paper influences NGP's conclusions about potential impacts of a spill.

Response:  
a) The Hodson et al. (2002) and Blaise et al. (2004) papers refer to toxicity testing following an experimental oil spill into a wetland along the St. Lawrence River. The tests were conducted to compare natural recovery (natural attenuation) with remediation strategies (nutrient amendments, removal of plants) in anoxic sediments of a freshwater wetland area.

Hodson et al. (2002) measured enzyme induction in fingerling rainbow trout exposed to sediment over a four day period. The enzyme induction test (“EROD”) measured a response linked to PAH bioavailability. The study demonstrated that PAHs were bioavailable for up to 15 months after initial oiling, but that the enzyme induction in fish and measurable hydrocarbon levels in sediment declined by 80% over that 15 month period. Results were similar in oiled and untreated vs. oiled and treated (nutrient addition to stimulate plant growth and hydrocarbon degradation). The authors noted that there was only minor evidence of toxicity to fish (less than 10% mortality in some tests). The study points to chronic rather than acute toxicity effects on fish.
The applicability of results of the experimental study to a potential spill in the Kitimat River needs to consider the following:

- The chronic toxicity of PAHs to a range of organisms, including juvenile salmonids, is recognized, and the endpoints for remediation are developed considering potential for chronic as well as acute toxicity

- The amount of oiling at the test plots described in the Hodson et al. (2002) experiment (12 L of oil in a 20 m² area) was enough to leave a thick visible layer on the sediment surface. This amount of oil would not remain following remediation of a spill from the Northern Gateway pipeline, so the experimental spill example assesses a more extreme situation than would occur with an accidental spill

- The physical and biological degradation processes would be faster in the Kitimat River, where flows are considerably faster than in a wetland of the St. Lawrence River (small river flows and some tidal action, inhibited by ice cover over the winter). Natural attenuation of hydrocarbons is faster in aerobic environments (e.g., river sediment) than in anaerobic environments (wetland sediment)

- The Hodson et al. (2002) experiment tests fish in a confined bioassay situation, where the fish cannot move away from the source of contamination. In the natural environment, fish would be free to move more widely, and any remaining oiled areas would be spread further apart

This review of the Hodson et al. (2002) paper does not change Northern Gateway’s assessment of potential effects on key resources at risk, as the potential for chronic as well as acute effects on fish are already recognized as adverse (Application (Volume 7B, Section 9.5.4)). It also supports the importance of spill prevention and timely clean-up response stressed in Northern Gateway’s assessment of risks associated with a potential spill. The information about usefulness of phytoremediation techniques in areas of anoxic sediment will be considered in further developing remediation techniques for the oil spill response planning process.

b) Northern Gateway does not agree with the need to conduct a review of additional literature on additional studies of experimental oil spills in Canada and elsewhere. While such studies may provide greater scientific understanding of the mechanisms of chronic and acute toxicity to organisms, it would not change Northern Gateway’s assessment of potential effects on key resources at risk, as the potential for chronic as
well as acute effects on fish are already recognized as adverse (Application (Volume 7B, Section 9.5.4)).

Information about effectiveness of specific remediation techniques will be incorporated into the oil spill response plans throughout the life of the project, as this information becomes available.
1.42 Freshwater Fish and Fish Habitat of the Kitimat River

Reference:  
i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)  
ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)  
iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)  
iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)  
v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)  

Preamble:  
The Application states that "the key issues of concern for fresh water fish and fish habitat are loss of biodiversity and abundance of key species." Based on "pipeline corridor studies and fish habitat surveys... the pipeline route has been realigned to accommodate sensitive habitats, important fish stocks and runs, known traditional and non-traditional harvest areas and fish species at risk." As well, "mitigation measures" were "incorporated into the project design and include limiting disturbance areas within the pipeline RoW, selecting watercourse crossing techniques on the basis of the biological and physical conditions and adhering to construction least-risk periods for fish species present, where possible... Where adverse effects cannot be avoided or mitigated, a compensation plan will be developed in cooperation with DFO".

Sockeye salmon were singled out as an unusual river-spawning race, and therefore highly vulnerable to a spill at Hunter creek where they spawn, and where the pipeline first crosses a tributary of the Kitimat River. Pink salmon were also deemed most vulnerable on basis of their 2-year life cycle, which allows little opportunity for recovery if a year-class is lost due to toxicity.

Request: Fish Species:

a) Please define the size and nature of the fisheries resources at risk in the Kitimat River, in terms of the abundance of each species present during one or more of their life stages.

b) P. 11-1: Please define "key species" in terms of relative rarity; economic and social value to sports and First Nations fisheries, value to other ecosystem components (e.g. bears, eagles), and overall productivity.

c) Please provide information on the productivity of each species, and their relative value from a sports, commercial, or cultural perspective.

d) Please provide information on how mortality of forage fish and invertebrate prey species would affect the growth of different life stages of salmon and trout.
e) Please provide information on which life stages of fish are the most sensitive to oil exposure, and why. Please support this response with a literature survey to avoid the contradictions in Volume 7B among statements that "eggs and larvae", "juveniles", and "emergence in spring" are most sensitive.

f) P. 7-25: Please provide additional information on why the stock of sockeye that spawns near Hunter Creek is unique, the consequences to this stock of toxicity to adults, to eggs and embryos, and to juveniles, and appropriate remedial measures, if any.

g) Please provide information on the nature and value of compensation which would be required if this stock of sockeye were lost.

**Habitat:**

a) Please provide information on the timing and use of habitat (spawning, nursery, growth, reproduction) by each life stage (spawning adults, embryos, fry, juveniles) of each fish species that inhabits the river during one or more of its life stages.

b) Please describe which part of the river each species uses at each life stage, including migration routes.

c) Please identify and map critical habitat, including the spawning shoals of all the species of fish that use the river for reproduction (e.g. various species of salmon and trout, eulachon, Pacific lamprey, forage species).

d) Please provide information on which of these habitats would be affected by an oil spill, and to what extent.

e) P. 7-24: Please provide information on changes to habitat suitability caused by oil spills or oil spill clean-up, such as warming following removal of vegetation, and whether these habitat changes have been considered in assessing potential impacts.

f) The review of the Pine River spill reported 50-70% mortality of fish in the first 30 km downstream of the spill. What is the distance from Hunter Creek to the estuary at Kitimat River? Please provide a graph or table showing how many species of fish would occupy this section of the river throughout the year.

g) P. 11-10: Please address in detail the specific effects of changes in sediment concentrations, water temperature, and nutrient concentrations on salmon, trout, and other species as a result of construction activities,
a potential spill, or the clean-up of a spill.

h) P. 11-25: Please provide additional details of the Habitat Compensation Program that is under development, when it will be completed, and whether it will be reviewed before construction begins.

**Response:**

**Fish Species**

a) A summary of the fish species and life histories is provided in the Application (Volume 6B, Section 11.4.3, Section 3.2, 3.5, and 3.5.4) of the Freshwater Fish and Fish Habitat Technical Data Report.

b) Key species is a generic term used only in the introduction. It was not used in the analysis.

c) The Marine Fisheries Technical Data Report (TDR; Watson and Vaughan, 2010) provides information on harvested values of commercially caught species and in some cases also provides piece numbers and total landings in weight and dollar value.

When the Northern Gateway Environmental and Socio-Economic Assessment (“ESA”) was submitted in May 2010, no Traditional Use Studies (“TLUS”) had been completed by a coastal Aboriginal group. As a result, no recent information on Food, Social and Ceremonial (“FSC”) fisheries had not been completed. Since then, only two groups (Kitselas First Nation and Gitxaala Nation) have completed a TLUS. Northern Gateway is in discussions with the Haisla Nation in regard to the form of engagement and potential for the Haisla Nation to complete a TLUS. As a TLUS by the Haisla Nation is not available, it is not possible to assign a relative value by species for the FSC fishery related to Haisla Nation fishing activities. However, the marine fisheries specialists are aware of the marine species generally considered to be important for the FSC fishery. Interviews with some Haisla Nation FSC fishers were undertaken in October 2005 and information regarding their fishing activities was confidentially recorded but were not adequate to assess relative value or productivity.

The TDR (Section 5.1.8) also describes recreational fishing activities in a general way regarding locations and target species and data relating piece catches of salmon was obtained from DFO for Fisheries Management Areas 5 and 6. The TDR (Section 5.2) provides some information on the nature of commercial-recreational fishing (fishing lodges, third party guiding) indicating it is important for local and regional tourism. Further information pertaining to the location of fishing lodges for this fishery may be found in the Application (Volume 8B, Section 13.8.4.3 and in Figure 13-8).
Although the relative dollar value is not known for all types of fisheries, the aggregate value of the fisheries is important to FSC fishers. In terms of relative value, the species comprising the fisheries are important to commercial volumes as well as to individuals in recreational, commercial-recreational and FSC fisheries. The information presented in the TDR has been adequate to characterize the importance of the four fisheries in a semi-quantitative and qualitative manner and provide the basis for effects assessment.

d) Reduced forage may result in reduced fitness and survival for affected live stages.

e) Please refer to Northern Gateway’s response to Haisla Nation IR 1.38.

f) The sockeye that spawn near Hunter Creek are unique as the juveniles are stream rearing, rather than the more common lake rearing. As a result, a larger portion of their life history occurs within the river and the risk of exposure to whatever happens in the river increases proportionately.

Protection of the Hunter Creek stock focuses first on pipeline design which includes an HDD crossing of Hunter Creek, as well as placement of valves. Additional protection measures in design, construction, and operation are summarized in the Application (Volume 7B, Sections 2.1 through 2.3).

g) If a spill were to occur, a compensation evaluation process would be undertaken with DFO and Environment Canada to determine the extent of effects to fish and fish habitat. Based on that assessment, a fish and fish habitat compensation program would be developed and implemented by Northern Gateway, in consultation with these agencies. Aboriginal groups and communities will be involved in that process.

In terms of economic effects to the Haisla Nation as a result of the loss of fish harvested from this population, fair and reasonable compensation would be paid by Northern Gateway to compensate for the loss.

Habitat

a) As noted in Haisla Nation IR 1.42a) - Fish Species above, a summary of the fish species and life histories is provided in the application (Volume 6B, Section 11.4.3) and in Sections 3.2, 3.5, and 3.5.4 of the Freshwater Fish and Fish Habitat Technical Data Report.

b-d) This information is not available at this time. Information on sensitive
habitats and use would be obtained during surveys associated with control point mapping as part of the Pipeline Oil Spill Response Plan.

Before operation of the pipelines, Northern Gateway will complete a project-specific Pipeline Oil Spill Response Plan (“POSRP”) for NEB review. The POSRP will describe emergency response actions, objectives and strategies to mitigate the effects on land or in water during all seasonal conditions under a range of operational and environmental settings. The POSRP will be consistent with Enbridge’s corporate emergency response procedures. The POSRP will also include mapping of environmental consequence areas for the RoW and downstream of the RoW where appropriate. Segment identification in term of exposure potential for sensitive areas will also be included in the POSRP. This will allow for preplanned protections measures to be implemented for key sensitivities (i.e., water intakes) in the event of a spill.

In the event of a pipeline-based spill that migrates into the marine environment Northern Gateway could activate the Marine Oil Spill Response Plan to expand the response accordingly.

As described in Application (Volume 7B, Section 5.7), a key aspect of contingency planning will be the identification of control points at specific locations along the RoW where tactical planning for spill responses is established before the pipelines become operational. Response objectives and strategies will be developed for potential response intercept or control sites along major rivers crossed by the pipeline route. Guides will be prepared that outline site-specific information such as access, staging, site characteristics, environmental sensitivities and suggested equipment and deployment. These guides supplement the POSRP. Example river control tactic sheets are provided in the Technical Data Report: River Control Point for Oil Spill Response. As appropriate, government agencies, Aboriginal groups and public stakeholders will be engaged in the development of the Control Points and identification of sensitive areas.

e) Response measures for hydrocarbon spills from the pipeline are discussed generally in Application (Volume 7B, Section 5). Emergency response measures for four geographically-specific spill scenarios are provided in Application (Volume 7B, Section 9.2.2).

The potential effects of clean-up operations on riparian and in-stream habitat will depend on a number of factors, including but not limited to:

- the volume of hydrocarbons released;
- the properties of the hydrocarbons;
• weather and hydrological conditions;
• the geographic location and amount of existing access;
• the degree of oiling and specific locations along the shoreline;
• the most appropriate option for clean-up and rehabilitation (i.e.,
  active approaches vs. leaving oil residues to disperse, evaporate and
  biodegrade naturally); and
• the sensitivity of specific receptors to various clean-up response
  options.

Given the complex nature of the factors that will determine the potential
effects of a hydrocarbon spill and response on riparian and in-stream
habitat, it is not possible to provide an assessment of effects on habitat
suitability as requested.

The potential effects which may be associated with various clean-up and
rehabilitation options will be considered within a net environmental
benefit analysis (“NEBA”). The NEBA approach is widely used to
evaluate the advantages and disadvantages of available response options
to minimize additional environmental damage. The response option that
is considered to have the greatest net environmental benefit is selected.
Depending on the particular situation, response options may have the
potential to cause greater adverse effects on the environment than
leaving the hydrocarbon to naturally disperse, evaporate and
biodegrade. The “natural recovery” option is therefore considered
alongside other available response options in the NEBA.

The NEBA will be integrated with the development of the POSRP and
the control point mapping (Application (Volume 7B, Section 5)). As
part of the spill response planning, government agencies, Aboriginal
communities and directly affected public stakeholders will be engaged
in determining local sensitivities that would be considered in the control
point mapping. The Haisla Nation would be invited to participate in the
development of the POSRP and control point mapping for areas within
their traditional territory. These plans will identify and describe
environmentally-sensitive areas, including harvesting areas and cultural
sites, as well as priorities for emergency response measures. The
POSRP and the control point mapping, in combination with a NEBA,
will be used to determine the type of equipment that would be required
for the preferred response, clean-up and rehabilitation activities.

f) The distance from the mouth of Hunter Creek to the mouth of the
  Kitimat River is 64 river kilometres.

While information is available on the species of fish that may be present
in the Kitimat River, there is not adequate information to address
seasonal variations in the abundance and distribution of these species.
As part of the POSRP and control point mapping, additional information on fish populations and sensitive habitat will be obtained for areas such as Hunter Creek and the Kitimat River. Both of these products will be developed and reviewed by DFO and other government agencies at least six months prior to commencement of operation of the pipeline and the Kitimat terminal.

g) The Project accepted and used the DFO Pathways of Effect model which considers these changes to sediment, temperature and nutrients. These were considered in planning the risk assessment, and in developing the Construction Environmental Protection and Management Plan (Application (Volume 7A)), and the selection of proposed crossing techniques. No significant adverse effects are anticipated.

h) A habitat compensation plan would be prepared during detailed engineering so that potential construction-related HADDs can be quantified. Prior to construction, the habitat compensation plan would be reviewed with DFO and interested Aboriginal groups. The compensation plan will then be submitted to DFO as part of the Fisheries Act authorization application package.
1.43 **Nature of Petroleum Products to be Transported Via Pipeline**

**Reference:**

i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)

ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)

iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)

iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)

v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

**Preamble:**

The primary materials to be shipped by pipeline are synthetic oil, diluted bitumen, and condensate. While some details are given about each product, the description of their chemical and physical properties is incomplete, and does not permit an understanding of the nature or extent of their hazards to the Kitimat River ecosystem. As well, much of the information given is inaccurate or incorrect. In Section 7.2, volatile organic compounds (VOCs) are said to include benzene, toluene, ethylbenzenes, xylenes (BTEX) and polynuclear aromatic hydrocarbons (PAH), implying that PAH will disappear quite rapidly after a spill. This is not the case, and is only relevant for low molecular weight PAH, i.e. the two-ringed naphthalenes with one or two alkyl substitutions (C0 to C2). Higher molecular weight PAH will persist in aquatic ecosystems after a spill because they are not very volatile.

There is a growing literature suggesting that the components of oil that are acutely lethal and responsible for fish kills are the volatile, light weight components. As indicated, these may disappear quickly following a spill due to evaporation, dilution, and biodegradation, although they apparently persist long enough after a spill to cause fish kills for tens of kilometres downstream (e.g. the Pine River Spill in BC). The residual oil is heavier and sinks to the river bottom where it can mix with sediments and cause chronic toxicity to early developmental stages of fish, resulting in recruitment failure and weak or missing year classes.

The compounds associated with chronic toxicity are the alkyl polynuclear aromatic hydrocarbons (alkyl PAH), particularly the alkylphenanthrenes. These may comprise 0.5 to 1.5% by weight of most liquid crude oils, but a much higher proportion (up to 6% by weight) in heavy crude oils, bitumen, and refined products such as heavy fuel oils (e.g., Bunker C). Bitumen and heavy fuel oils cause the same toxic effects on fish embryos as crude oils (e.g. Alaska North Slope crude spilled by the Exxon Valdez). However, toxicity increases in proportion to the concentrations of alkyl PAH, which means that bitumen and heavy oils are among the most chronically toxic of petroleum products. Condensates, which are similar in composition to lighter fuel oils such as diesel, should also be rich in alkyl PAH.
To understand the hazard of oil to fish, and the risk of toxicity following an oil spill, it is critical to know the chemical composition of the oil, particularly its concentrations of low molecular weight compounds and alkyl PAH. Section 4.2 of Vol 7B describes Chemical Properties of the oils to be transported but provides inadequate data on the PAH content of each product (Table 4-2, p. 4-3). While alkyl PAH includes hundreds of individual components, only 7 are reported, so that the 'sum of PAH' is likely grossly underestimated as: Bitumen - ~30 mg/kg; Synthetic Oil ~325 mg/kg; and Condensate ~435 mg/kg. In contrast, Table 4-3 (p. 4-7), footnote b, indicates that "approximately 2% of the condensate consists of PAH and alkylated PAH compounds" (this is a concentration of about 20,000 mg/kg).


**Request:**

a) Please provide a complete and detailed analysis of the chemical constituents, and their concentrations, of synthetic oil, diluted bitumen, and condensate.

b) Please provide detailed information on the concentrations of low molecular weight VOCs, including BTEX, and the more persistent and higher molecular weight PAH, including the sum of alkyl naphthalenes, alkyl anthracenes, alkyl phenanthrenes, alkyl fluorenes, alkyl chrysenes, alkyl pyrenes, alkyl dibenzothiophenes, alkyl naphthobenzothiophenes, etc.

c) Please describe how synthetic oil is prepared, including its parent materials, its typical chemical composition, and how it differs chemically from crude oil and from diluted bitumen.

d) Please indicate what percentage of each product would be considered "volatile".

e) Please provide more information on the expected or measured acute and chronic toxicities to fish of synthetic oil, diluted bitumen, and condensate based on relative concentrations of VOCs and alkyl PAH.

**Response:**

a) Please refer to Northern Gateway’s response to Haisla Nation IR 1.23a).

b) Available information on the chemical composition of the hydrocarbons, including BTEX, PAHs and petroleum hydrocarbon fractions, as defined by the Canada Wide Standards fractionation, is
provided in Table E-1, Appendix E of the Marine Ecological Risk Assessment for Kitimat Terminal Operations Technical Data Report (Stephenson et al., 2010).

The analysis of PAHs is limited to the parent (C0) series. However, the fractionation of the petroleum hydrocarbons into aliphatic and aromatic compounds, by carbon range, also provides some information on the total quantity of aromatic substances present, and would include the alkylated substances.

As noted in Federal Government IR 100, Northern Gateway has initiated supplemental chemical analysis of the hydrocarbons, and will provide further detail regarding alkylated PAHs in the hydrocarbons when it becomes available.

Reference:

c) The preparation of synthetic oil is an upstream process that Northern Gateway does not control. Each shipper of synthetic oil has its own proprietary method of preparing synthetic oil. All products will conform to the tariff requirements for the oil pipeline. Please refer to Attachment Haisla Nation IR 1.43c).

d) The volatility of a compound is related to its vapor pressure. For example, naphthalene has a higher vapor pressure than benzo(a)anthracene and, therefore, is considered to be more volatile. Volatility, however, is a relative term, and there is no “single” answer as to what is considered “volatile”.

To answer this question, it has been assumed that for the condensate, synthetic oil and diluted bitumen, it would be the C₁ to C₅ hydrocarbons (significant for the condensate only), the Canada Wide Standard F1 fraction, plus the BTEX compounds that comprise the majority of the volatiles. Using the data presented in Table E-1, Appendix E (Stephenson et al., 2010), it is estimated that volatiles comprise about 4.4% of the diluted bitumen, about 11.4% of the synthetic oil, and about 72% of the condensate.

Reference:

e) In the Preamble, reference is made to Section 7.2, which addresses the original text of the quality considerations regarding volatile organic carbons (“VOCs”). The term VOCs is broad, and functionally defined (i.e., organic carbon substances that are volatile) rather than referring to specific chemical families or classes of substances (like the polycyclic aromatic hydrocarbons, or PAHs). Some of the lower molecular weight PAH substances, such as naphthalene, are indeed volatile, but the text in Section 7.2 should not be taken as implying that all PAHs are also considered to be volatile or VOCs. In addition, the air quality assessment is independent of the water quality assessment and, therefore, this should not be construed as a suggestion that higher molecular weight PAHs might not persist in aquatic ecosystems after a spill.

The Preamble also seeks further information on the chemical composition of the hydrocarbon products, referencing Table 4-2. However, the text in Section 4.2 also refers the reader to the Marine Ecological Risk Assessment for Kitimat Terminal Operations (Jacques Whitford 2010; see Appendix E) where further detail, including additional characterization of PAHs is available. Notwithstanding the additional information referred to here, the alkylated PAHs have not yet been characterized in the diluted bitumen, synthetic crude, or condensate samples. Based upon input received through this and other IRs, Northern Gateway has initiated supplemental chemical analysis of several samples of hydrocarbons, and will provide further detail regarding alkylated PAHs in the hydrocarbons when it becomes available.

Following an oil spill, concentrations and mixtures of hydrocarbons in water or sediment vary over time as a result of the differential solubility of individual chemical constituents, and weathering or degradation processes. As a result, there is no “single” answer to the question of how toxic a particular hydrocarbon product may be. A recent paper by DiToro et al. (2007) provides additional insight into this issue.

Also see Northern Gateway’s response to Federal Government IR 118.

**Reference:**

1.44 Distribution of Oil in the Kitimat River

Reference: i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)
ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)
iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)
iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)
v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble: Overall, the potential distribution of oil coverage following a spill is loosely described in Vol 7B, section 9. The morphometry, and, at times, flow characteristics are described, but not in relation to the ultimate fate and distribution of oil after a spill, and only under a very limited set of conditions (summer high flow). As well, data on water and sediment quality guidelines, as well as methods of measuring water/sediment contamination are lacking. The extent of contamination, the types of substrates being contaminated, and the duration of contamination must be better described.

Weather and seasonal factors (temperature, wind speed, water level, snow cover) must also be considered since these factors will affect the potential distribution of oil, which will impact mitigation measures and subsequent monitoring. For example, if a spill occurred with snow cover, what would the effect be during a sprint melt? "Freezing of freshwater would affect how hydrocarbons are partitioned" (p. 4-4) - does this refer to hydrocarbons being held in the top ice layer? Other questions that must be addressed are: during what portion of the year is there ice in the Kitimat River? Is the river open or frozen at the edges? Are there ice dams or stranded ice flows on bars? What are the implications for spread and recovery of spilled oil?

Request: a) All hypothetical spills described in the application occur in summer when "environmental effects would be greatest" (p. 9-23). Please explain this statement in detail and provide an equivalent analysis for other seasons.

b) Please describe the spread of oil in winter in relation to snow and ice, and describe how oil would be recovered under these conditions.

c) Please provide detailed analyses of the extent of contamination of water, stream banks, vegetation, gravel bars, and bed sediments where fish spawn during each season under different flow regimes.

d) Please specify the fate of different hydrocarbon groups found in the three petroleum products (BTEX, alkanes, PAH, heavy waxes, asphaltenes) in terms of evaporation, dispersion, and stranding potential, during each season.
e) The hypothetical spill near Hunter Creek of 2000 m$^3$ is the largest volume of oil that could be spilled because that is the volume held between valves in the pipeline. Please re-analyze the spill scenario to estimate the volume of oil spilled if a valve was destroyed, e.g. by an avalanche or landslide.

f) The transit time of an oil spill from Hunter Creek to the estuary of the Kitimat River was estimated to be less than 24 hours. Please provide information on the extent of weathering in summer at high flow with temperatures of 15ºC or greater, and in winter with low flows, but lower temperatures, and indicate how this would affect transit times, distribution of oil, and the nature of the oil deposited on river banks and in sediments.

g) Please provide an analysis of the primary routes of exposure for different life stages of fish (e.g. direct uptake of compounds across the gills, food chain, direct contact with oil in sediments, exposure of eggs to contaminated interstitial waters).

Response: a) As noted in the Preamble, the spills scenarios presented in the Application (Volume 7B), occur during the summer. This was done primarily to focus the assessment of environmental effects on the open water period when most biophysical elements would be present and are likely to be more sensitive to oiling. For example, migratory birds and some migratory fish would be present in summer but not winter. In addition, vegetation would be in its active growth stage compared to dormant stages where plants might not be as susceptible to oiling.

However, assessors were asked as part of the assessment of each scenario to also address effects during other seasons when specific resources might be more susceptible than during the summer season for the scenario. For example, in Section 9.4.4., reference is made to “One exception is that Crooked River is one of the few areas of interior British Columbia that supports overwintering Trumpeter Swans. Therefore, protection of this species would be especially critical if a release were to occur at this location during the winter.” Similarly, in Section 9.5.4, the assessment states “The Kitimat River estuary provides year-round habitat for seabirds and seasonal habitat for staging waterfowl, particularly in late spring. Depending on the time of year, containment booms on Kitimat River and exclusion booms around sensitive habitat in Kitimat River would be needed, along with hazing to protect birds.”

Seasonal differences in spill response requirements and potential environmental consequences will be addressed during the development of the Pipeline Oil Spill Response Plan (“POSRP”). A key aspect of contingency planning will be the identification of control points at specific locations along the RoW where tactical planning for spill
responses is established before the pipelines become operational. Response objectives and strategies will be developed for potential response intercept or control sites along major rivers crossed by the pipeline route. Seasonal differences and considerations would be included in the control point mapping. Guides will be prepared that outline site-specific information such as access, staging, site characteristics, environmental sensitivities and suggested equipment and deployment. Example river control tactic sheets are provided in the Technical Data Report: River Control Point for Oil Spill Response. As appropriate, government agencies, Aboriginal groups and public stakeholders will be engaged in the development of the Control Points and identification of sensitive areas.

b) The presence of a complete ice layer over a river will slow the spread or movement of oil significantly. If there is snow cover over the ice the spread will be reduced further. Snow also acts like a sorbent and will retain a considerable amount of oil until melt. In periods when the river banks are frozen or lined with ice this will both divert oil away from the shore and provide pockets for the collection of oil. In spring breakup, where broken ice is present, the oil will mix with the ice and move with it. On-river clean-up during periods of partial ice cover would be more difficult due to both safety and difficult access to the oil.

The evaporation rate for oil in snow is substantially less than for oil directly exposed to air. Any oil frozen under or in an ice layer will not evaporate and will remain fresh until exposed during the melt period.

Specific winter techniques for oil containment and removal include snow or ice dikes, ice slotting, in-situ burning and the general methods described in Table 6-1, Table 6-2, Table 7-1, Table 7-2, and Section 7.6 in the General Oil Spill Response Plan (“GOSRP”).

c) A detailed analyses of the extent of contamination of water, stream banks, vegetation, gravel bars, and bed sediments where fish spawn during each season under different flow regimes for all watercourses crossed by the pipelines is a complex undertaking and is outside of the scope of the approach described for the Application (Volume 7B).

Additional information on the probability of a pipeline oil spill and the consequences of a spill on environmentally-sensitive areas is provided in Response to Request for Additional Information (March 2011) from the Joint Review Panel Session Results and Decision, dated January 19, 2011.

Potential hydrocarbon release volumes onto consequence areas were computer modeled for the oil pipeline. The modeling results show the
potential maximum volumes from a full-bore (a full and complete break across the entire circumference of the pipeline) release within each 1-km segment of the pipeline. The maps are a tool to be used in conjunction with detailed engineering design, planning for mitigation and emergency response, and other aspects when designing and operating the pipelines. Consequence areas included:

- officially designated protected areas
- settlements
- Indian Reserves
- watercourses (including fish habitat)
- wetlands (including sensitive vegetation)
- wildlife habitat

(d) The chemical composition of representative samples of hydrocarbons is described in Stantec (2010). The assessment of the physical properties of diluted bitumen in the environment is provided in SL Ross (2010). The report details properties for fresh and weathered diluted bitumen at temperatures of 1 °C and 15 °C. The assessment was based on standard methods and applies to both marine and freshwater conditions.

**Reference:**


e) The hypothetical spill near Hunter Creek (KP 1103.4), referred to in the Application (Volume 7B), is used to provide the context to discuss hydrocarbon behavior, environmental effects and clean-up effectiveness. Based on Northern Gateway’s computer modeling of potential maximum volume releases and based on the preliminary valve locations filed with the Application Update (Volume 3 (December 2010)), the maximum release into the Hunter Creek is 1547 m³. The spill modeling work filed with Northern Gateway’s Response to Request for Additional Information (March 2011) shows that there is only a very limited (less than 1 km) of the pipeline which, if ruptured, would release product into Hunter Creek. For this reason valves either upstream (KP 1097.9) or downstream (KP 1115.55) if destroyed, would not result in any releases into Hunter Creek.
Geohazards such as landslides and avalanches have been avoided wherever possible during pipeline routing, and have specifically been avoided in the valve placement process.

f) Please refer to Northern Gateway’s response to Haisla Nation IR 1.54c) which provides details on estimated oil transit and equipment deployment times to Tactical Intercept Points between the pipeline and the Kitimat estuary.

Weathering rates due to physical dispersion increase/decrease as flow rates and turbulence increase/decrease. Temperature would have an effect on weathering rates to some degree, but not as much as dispersion. Oil transit times would not be significantly affected by temperature but are significantly affected by flow rates, as pointed out in Northern Gateway’s response to Haisla Nation IR 1.54c).

The distribution and character of oil deposited on river banks would not be greatly temperature dependent for the types of oil involved in this project. Other factors, in particular, oil volume and flow velocities, have a much greater control over oil distribution and deposition than temperature. The evaporation and dispersion of a condensate spill in open water conditions during the winter will not be appreciably different than in the summer. The condensate will still evaporate and disperse rapidly. It may survive somewhat longer on the surface due to reduced turbulence as a result of the reduced river flows but this is unlikely to affect the overall behavior of the oil and the planned response in open water conditions.

Colder winter temperatures would have more significant effects on the diluted bitumen spills. Lower winter temperatures will slow down evaporation processes somewhat leaving the oil fresher for slightly longer periods but this will be more than offset by the reduction in oil viscosity due to lower temperatures. In winter, open water conditions, the transit times for oil to specific locations along the river will be reduced due to the lower water velocities. The higher oil viscosity and lower turbulence may result in less dispersion of the oil into the water and the stranding of a higher percentage of the oil on the shorelines. The presence of ice along the shore may reduce the amount of oil retained on the shorelines and increase the amount reaching the river mouth. Complete ice cover on the river and the presence of snow would result in the local containment of any spilled oil until spring melt.

(g) Changes in fish health and mortality risk are described in the Application (Volume 7B, Section 7.8.2).
1.45 Establishing Baselines

Reference:

i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)

ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)

iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)

iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)

v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble:

The Application indicates that baseline conditions for e.g. air, soil, hydrogeology, surface water resources, were not measured. However, in areas not impacted by human activity, contaminant concentrations were assumed to be low and/or below detection. A complete description is needed of the contaminants that would be measured (total petroleum hydrocarbons or TPH, benzene, toluene, ethylbenzenes, and xylenes, or BTEX, and polycyclic aromatic hydrocarbons, or PAH) to establish baselines and to monitor conditions during and after a spill. As well, a monitoring schedule of water quality issues is missing, and more details are required to justify sufficient mitigation and adequate monitoring studies.

Request:

a) Please indicate which hydrocarbons would be measured for baseline contaminant data for soil and sediments (section 7.3.1), and please provide current national and provincial water quality criteria for each.

b) Please provide details on how TPH, BTEX, and PAH in water and soil/sediments would be analyzed. Please include the range of specific analytes, detection limits of methods and instruments used, the frequency of monitoring, and QA/QC.

c) Please indicate whether TPH, PAH, and/or BTEX concentrations were measured as baseline conditions for surface water resources along the entire pipeline right-of-way.

Response:

a) Northern Gateway will design and implement monitoring programs including the collection of baseline monitoring data as required by Federal and Provincial regulations. Prior to construction, baseline data will be collected. Duration and frequency of sampling and list of analytes (e.g., petroleum hydrocarbons (PHCs), polycyclic hydrocarbons (PAH), and naphthenic acids (NAs)), will be finalized before operations begin and will meet regulatory requirements.

b) See Northern Gateway’s response to Haisla Nation IR 1.45a) above.

c) Northern Gateway conducted a baseline program including
hydrogeology field survey, groundwater sampling, field measurements (physical water quality parameters), laboratory analyses for major ions and nutrients (Appendix F table F1- Hydrogeology Technical Data Report, 2010). The ESA was prepared following CEA 2007 and NEB Filing Manual 2008 guidelines. Application (Volume 6A, Section 3.2.5).
1.46 Contamination of Sediments by Spilled Oil

Reference:  
i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)  
ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)  
iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)  
iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)  
v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble:  
The Application provides some discussion of hydrocarbon stranding and remobilization after a spill, with no estimates of how long the oil would remain in the river system following a spill. The fate of oil is mainly defined as a surface phenomenon, i.e., "The remaining diluted bitumen would be located on the water surface, on riverbanks or vegetation, and as dispersed diluted bitumen carried downstream" (p. 9-26). For the case of diluted bitumen spills, the proposed fate of the oil is that it would be physically washed out of the river, but there is no discussion of the effects of chronic oiling of the estuary (section 7.5.3).

Based on the EVOS, a major concern is the entrainment of oil into gravel bars or shoals where salmon, trout and other species spawn. In the case of the EVOS, oil was entrained into pink salmon spawning shoals at stream mouths by rising and falling tides. As a consequence, embryos were exposed to high concentrations of PAH that partitioned from stranded oil (oil droplets, coatings on gravel) into interstitial waters. In a salmon river such as the Kitimat or its tributaries, surface waters circulate through gravel shoals due to the pressure gradients associated with ponds, riffles and bars (hyporheic flow). If oil is mixed with water due to turbulence associated with riffles and rapids, or if oil is stranded on gravel shoals at low water and then mixed during subsequent floods, exposure scenarios similar to the EVOS can be created and cause toxicity to eggs and embryos of salmon and trout.

Overall, there is no discussion of the long-term persistence of oil, aside from losses by evaporation and the flow of oil out to the estuary (downstream to contaminate other areas). References must be made to the effects of weathering and photo- and biodegradation. For residual oil that persists in the environment, descriptions of routes of exposure of the different life stages of fish, along with the necessary duration of exposure to get toxicity, and concentrations, are lacking in the application and are necessary to understand the risk of residual oil in sediments.

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Request:

a) Please provide information on the anticipated spread and fate of the oil in the Kitimat River at high, medium, and low flow rates, including how turbulence might entrain oil into water and how hyporheic flow would carry oil into sediments.

b) Explain the distribution and effects of oil that sinks and/or mixes with sediments. Also explain how the sinking tendency of oil would influence exposure and toxicity of fish embryos buried in sediments to residual oil.

c) For each of diluted bitumen, condensate and synthetic crude oils, please estimate the proportion of spilled oil that would be entrained in sediments under different flow and temperature scenarios.

d) Please provide information on the potential concentrations in bed sediments of spawning shoals following spills of diluted bitumen, condensate, and synthetic crude in low flow and high flow conditions.

e) Please provide information on the concentrations of alkyl PAH and total petroleum hydrocarbons in interstitial waters of bed sediments of spawning shoals contaminated by diluted bitumen, condensate, and synthetic crude oil at concentrations estimated in d).

f) Please provide information on the impacts of chronic oiling of downstream reaches and the estuary of the Kitimat as oil is flushed out of sediments in the first year following a spill.

g) Section 7.4.2 reviews groundwater flow (hydrogeology) and the next section jumps to surface water resources. Please discuss stream-sediment interactions and sub-surface water flows.

h) Please indicate the extent to which surface water contamination by spilled oil will contribute to ground water contamination in recharge zones.

i) Please define "environmental protection measures" (reference iii), p. 7-22) and provide examples.

j) Please provide information on how the geographic extent and depth of penetration of sediments will be estimated for each type of spilled oil.

k) Please provide information on how the actual extent and depth of sediment contamination will be measured and mapped.
l) Please provide information on the technology and methods for cleaning oil-contaminated sediments, and the estimated cost per kilometre of river.

Response:  

a) The potential distribution of hydrocarbons in sediments along river beds, shoals, and banks is very dependent on oil type and weathering, hyporheic flow, and sediment grain size. Turbulence entrains oil into water when flow conditions overcome the natural buoyancy of the oil. In quiescent waters or when the turbulent motion of the water is insufficient to counteract the natural buoyancy of the oil, then the oil refloats to the surface.

Current speeds of moving water, in which oil is entrained, are reduced during hyporheic flow as water passes through or percolates into sediments. Under these conditions oil will try to rise to the surface. Oil is unlikely to stick to sediments as there is a water barrier that prevents adhesion but may become trapped in cavities or pore spaces that are smaller than the oil particle size.

Higher flow rates and increased turbulence typically will entrain more oil into the water column leading to the potential for oil to enter pore spaces in permeable sediments. Highly permeable sediments, such as well sorted cobble and gravel, may have more oil enter pore spaces but also are more easily flushed. Low flow rates and laminar flow are less likely to mix oil into bottom sediments.

b) Both the synthetic oil and diluted bitumen would not have a tendency to sink on their own in the short time-frames of these river releases. Some proportion of the oil would disperse in the form of small droplets (a high percentage of the condensate may disperse depending on the specific river hydrodynamics, i.e., the presence of waterfalls and rapids) and the droplets may be contacted by sediments and then sink to the river-bed due to the combined density of the oil-mineral aggregate (“OMA”). If diluted bitumen becomes heavily weathered some oil may sink in fresh water environments. Please see Northern Gateway’s response to Haisla Nation IR 1.38a) for a discussion of effects on fish embryos and larvae.

c) The proportion of the Project-related hydrocarbons that would become entrained in sediments would depend on a number of factors including but not limited to the flow rate, the substrate and structure of the river bed, the water temperature and ambient temperatures and the dispersal rates associated with hydrological features. Please also see Northern Gateway’s response to Haisla Nation IR 1.46b). Properties for fresh and weathered diluted bitumen at temperatures of both 1 and 15 °C are provided in the SL Ross (2010, referenced below) Technical Data Report. Density results for diluted bitumen, within the report are consistent with the Kalamazoo experience. The weathered diluted
bitumen would have a density approaching 1.0 g/cc which indicates that once the diluted bitumen weathers, under such cold temperatures, it may be susceptible to sinking in fresh water, as was observed in the Kalamazoo spill. Increased rates of weathering, which may be associated with higher ambient temperatures, may increase the proportion of oil entrainment into the sediments. During the winter, as ambient conditions become less amenable to high rates of weathering and evaporation, the proportion of oil entrainment into the sediments may be expected to decrease.

Reference:


d) Please see Northern Gateway’s response to Haisla Nation IR 1.46c). Additional information on partitioning of hydrocarbons in the aquatic environment and chronic effects will be provided in the Human Health Ecological Risk Assessment for hypothetical pipeline spill scenarios. Please see Northern Gateway’s response to Federal Government IR 118.

e) Alkylated polycyclic aromatic hydrocarbons (“PAHs”) have not yet been characterized in the diluted bitumen, synthetic crude, or condensate samples. As noted in Northern Gateway’s response to Federal Government IR 100, Northern Gateway has initiated supplemental chemical analysis of the hydrocarbons, and will provide further details regarding alkylated PAHs in the hydrocarbons when it becomes available.

In the event of a pipeline incident (spill), Northern Gateway will implement a comprehensive environmental monitoring program that is commensurate to the site specific conditions. The program would employ industry best practices for environmental monitoring, and be developed in consultation with relevant regulators, First Nations, and stakeholders as appropriate. The objectives of the program would be to characterize the extent of contamination arising from the incident, to monitor containment effectiveness and clean-up progress, and to guide the development of further response and remediation plans.

The scope of the program would be scalable to the risk, and would be determined based on considerations of the local environmental setting, the presence of potential receptors, the status of the spill (contained, uncontained) and the magnitude of the incident. The program would identify the specific contaminants of concern, and be designed to assess
how these contaminants have dispersed in the environment. It would typically include monitoring of all relevant environmental media, which may include air, surface water, groundwater, soils and sediments. In circumstances where the spill is in highly sensitive environmental settings, the monitoring program may also include monitoring of fish and wildlife, vegetation, and other potential biological receptors.

f) Please see responses to Haisla Nation IR 1.47d) and 1.50c) and 1.50d). Additional information on partitioning of hydrocarbons in the aquatic environment and chronic effects will be provided in the Human Health Ecological Risk Assessment for hypothetical pipeline spill scenarios. Please see Northern Gateway’s response to Federal Government IR 118.

g) Generally, surface water acts as a recharge source for shallow aquifers. Recharge is greatest through unconsolidated sand and gravel in the bed and banks of rivers, compared to silt and clay riverbeds. Unconsolidated bottom sediments are typically found in upper and mid-stream mountain locations. Typically, flow is from the surface to the subsurface during spring and early summer in high flow periods, and from the subsurface to the surface the remainder of the year. Stream water interaction with sand and gravel sediment is minimal in terms of adsorption of contaminant to the surface of bed sediments. Groundwater volume and quality is affected by surface flow and quality. Subsurface water flow direction is generally parallel to surface flow.

h) In recharge areas, dissolved organic and inorganic compounds can infiltrate to groundwater from surface water. Bitumen, condensate and heavy metals, such as V and Ni, are not very soluble in cold water and, therefore, the amount of hydrocarbon and heavy metal infiltration to groundwater is minimal. Diluted bitumen with density of 0.9 kg/L at 15°C and condensate with density of 0.7 kg/L at 15°C are lighter than water, which has a density of 1 kg/L. In the event of a spill, these types of light hydrocarbons will float on the surface of the water and the majority will vaporize to the atmosphere. Any remaining bitumen particles will coalesce into a larger mass (tar balls) or create a water-in-oil emulsion. In high energy surface water flow, tar balls will travel downstream or settle alongside of the river banks and can be removed physically, as mentioned in the Application (Volume 7B, Section 5 and Section 9.5).

i) The referenced section “environmental protection measures” refers to the Fish and Fish Habitat assessment. This sentence stresses the importance of developing protective measures for fish and other aquatic life, for the aquatic organisms, but also for users of these aquatic resources such as birds, other wildlife and humans. For example, the
water quality guidelines for protection of aquatic life are generally more protective than those for wildlife, livestock or human consumption.

The environmental protection measures are discussed throughout the Application (Volume 7C) and include:

- the pipeline design features incorporated to reduce the probability of a spill (Section 2)
- the emergency response approaches and capabilities to deal with a spill should one occur (Section 5)
- specific remediation techniques and clean-up endpoints (Section 7.5.3 and Section 7.8.3).


l) A net environmental benefit analysis (“NEBA”) will be used to determine the appropriate strategy for cleaning oil-contaminated sediments. This NEBA technique is widely used to evaluate the advantages and disadvantages of available response options. The response option that is considered to have the greatest net environmental benefit is selected. The “natural recovery” option is considered for comparison with clean-up techniques which may have the potential to cause greater adverse effects on the environment than leaving the hydrocarbon to naturally disperse and biodegrade. General onshore or watercourse bank clean-up or treatment techniques are outlined in Section 10.6 of the General Oil Spill Response Plan. The cost of cleaning oil-contaminated sediments will depend on several factors, including but not limited to:

- The endpoint established
- The type of sediment
- The amount of oiling that occurred
- The locations of the sediments to be cleaned up

Once the initial response is complete, continued monitoring for recovery or for continued natural attenuation may be part of a longer-term plan. In the event of a pipeline incident (spill), Northern Gateway will implement a comprehensive environmental monitoring program that is commensurate to the site specific conditions. The program would
employ industry best practices for environmental monitoring, and
developed in consultation with regulators, First Nations, and
stakeholders as appropriate. The objectives of the program would be to
characterize the extent of contamination arising from the incident, to
monitor containment effectiveness and clean-up progress, and to guide
the development of further response and remediation plans.
1.47  Acute and Chronic Effects of Oil Exposure

Reference:  
i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)  
ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)  
iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)  
iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)  
v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble:  
The Application does not break down acute effects (primarily mortality caused by narcosis) and chronic effects. "Hydrocarbons have the potential to affect fish species… [by] exposing them to acute or chronic toxicity." (P 7-22) - This is an inappropriate use of the terms acute and chronic toxicity. Chronic and/or sublethal effects that must be individually considered are: cancer from exposure to carcinogenic, mutagenic, teratogenic PAH, effects on early life stages of fish, such as malformations that affect behaviour, growth, reproduction, and survival (and, thus, recruitment into the population), and effects on sexual maturation, spawning migrations and behaviour, disease from impacted immune function, and emigration to feeding grounds (e.g. salmon).

Request:  
a) Please explain what is meant by "exposing them to acute and chronic toxicity".

b) Please provide more information about the toxicity of VOCs, including concentrations that are toxic - to humans, and to the biophysical environment.

c) Please define "biophysical environment".

d) Please provide a summary of what is known in terms of mechanisms of toxicity that cause toxic effects (metabolism of PAH in fish versus invertebrates, as well as transfer through the food chain).

e) Please provide a tabular summary of the most recent water quality and sediment quality guidelines for Alberta, British Columbia, and nationwide.

f) Please analyse these guidelines to determine whether they are based on recent publications (e.g. post 2000) reporting the chronic effects of very low concentrations of PAH on sensitive early life stages of fish?

g) Please indicate the extent to which these guidelines rely on application factors (aka safety or uncertainty factors) rather than actual data, and the size of those factors.
**Response:**

a) In the field of aquatic toxicology, acute toxicity tests are generally those short-term tests used to determine an LC50 value (the concentration of a substance in water that is lethal to 50% of exposed organisms, when exposed for a particular length of time). Such short-term tests are usually less than 7 days in duration, and tests of 24, 48 and 96 hours are common, depending upon the species and substances being tested. Sediment toxicity tests tend to be longer in duration (often 7 to 21 days in length), and again would be considered acute toxicity tests. Chronic toxicity tests are usually longer in duration, and typically reflect a variety of toxic endpoints, not just lethality. Chronic toxicity tests may incorporate reproductive endpoints (how many offspring are produced during the test), as well as survival and growth, and endpoints may be more sensitive. For example, an EC20 value for reproduction would determine the concentration of a substance that resulted in a 20% reduction in the production of live offspring over the course of a test.

The referenced text in the Application (Volume 7B) is intended to explain that hydrocarbon spills can alter the habitat that fish depend upon, can physically harm fish if sensitive tissues such as gills become coated or clogged with oil, and can kill (acutely or quickly) or injure fish (resulting in harm or impairment in the longer term due to residual effects or chronic low-level exposure).

b) The toxicological model used for quantitative assessments of aquatic biota exposed to hydrocarbons in the water column and in sediments is the Target Lipid Model (TLM) of DiToro and co-workers (2000a, 2000b). The TLM, which focuses on the non-polar narcosis mechanism of hydrocarbon toxicity, has by far the broadest and best validated range of application to a large suite of aquatic receptor classes, life stages and environmental media (water and sediment), and in addition is best able to address hydrocarbon mixture toxicity (as opposed to focusing on responses to single chemicals). The TLM incorporates a wide variety of organic compounds, including many that are classified as VOCs. DiToro et al. (2000a), in addition to providing the technical basis for understanding the TLM, also provide useful information on the acute and chronic toxicity of a wide variety of individual non-polar narcotic chemicals, including some that are also considered to be VOCs.

The human health risk assessment evaluated some of the VOCs that could be potentially released from the Project. The VOCs considered were benzene, toluene, ethylbenzene, total xylenes, formaldehyde, 1,2,4-trichlorobenzene, 1,1,1-trichloroethane, and 1,3,5-trimethylbenzene. These VOCs were present in the diluted bitumen, condensate, and synthetic crude in appreciable concentrations. Human toxicological information for these compounds was presented in
c) The biophysical environment is the sum of the biological, chemical and physical conditions or surroundings that an organism is exposed to.

d) There is extensive literature on the bioaccumulation, biomagnification, metabolism, and mechanisms of toxicity of PAHs, which would be impractical to synthesize at length here. However, a recent paper by Harris et al. (2011) and references therein should be helpful. Consistent with other researchers, they found that mollusks have limited capacity to metabolize PAHs, while crustaceans (crabs) have somewhat greater capacity. Vertebrates are generally good at metabolizing PAHs. These differences are driven by the availability of enzyme systems in the vertebrate liver (and to a lesser extent in the crustacean hepatopancreas) that assist in the breaking down and excretion of PAHs. Therefore, whereas bioaccumulation factors for PAHs are generally high for mollusks, they are generally low for vertebrates. However, an interesting and relevant new finding presented by Harris et al. (2011) is that alkyl PAHs appear to biomagnify in sea otters (and possibly other marine mammals) to a greater extent than the parent PAH molecules do.

As noted in Haisla Nation IR 1.47b) of this response, the toxicological model used by Northern Gateway for quantitative assessments of aquatic biota exposed to hydrocarbons in the water column and in sediments is the Target Lipid Model (“TLM”) of DiToro and co-workers (2000a, 2000b). The generic receptor in the TLM represents a sensitive (5'th percentile) species on a species sensitivity distribution that represents 33 species, including fish, amphibians, arthropods, mollusks, polychaetes, coelenterates, and protozoans.

Another major mechanism of hydrocarbon toxicity to fish is termed blue sac disease (“BSD”). BSD, which is associated with low-level exposure to three- to five-ringed PAHs, including alkylated PAHs, is characterized by an array of symptoms including pericardial and yolk sac edemas, spinal curvature, craniofacial malformation, fin rot, impaired swimming ability and mortality, and particularly affects developing fish embryos. While BSD symptoms have been documented at hydrocarbon concentrations lower than those associated with non-polar narcosis, a recent study (McIntosh et al 2010) found that under realistic exposure scenarios for spilled and dispersed oil (scenarios that are consistent with the results of modeling by Stantec (2010), the brevity of exposure duration results in toxicity thresholds (EC50 or LC50) for gametes, free-swimming embryos, and embryos exposed to crude oil that are comparable to or higher than the narcosis-based toxicity thresholds used in our assessments.
In addition, as explained in the ATSDR (1995) document referenced above, PAH compounds are commonly divided into “low molecular weight” (LPAH, two- and three-ring compounds) and “high molecular weight” (HPAH, those having four or more ring structures) compounds. The LPAH compounds are generally considered not to be potentially carcinogenic, whereas the HPAH compounds may exhibit carcinogenicity.

e) Surface water guidelines and sediment water guidelines in effect in Alberta, British Columbia and Nation-wide are provided in Attachment Haisla Nation IR 1.47e).

f) There are no guidelines for either water or sediments, based on studies of very low concentration of PAH on early life stages of fish done more recently than 2000.

g) All the freshwater PAHs guidelines from CCME rely on safety factors. These are 0.01 for Acenaphthene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, fluoranthene and pyrene; 0.1 for phenanthrene and naphthalene; and, 0.024 for fluorene. The marine CCME guideline for naphthalene has a safety factor of 0.1. All BC water guidelines also rely on safety factors.

Reference:


1.48 Chemical Constituents that Cause Toxicity

Reference:

i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)

ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)

iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)

iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)

v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble: Overall, the discussion of effects of a pipeline spill on freshwater ecosystems is incomplete. In particular, there was no explanation of the toxicity of the different constituents of oil, especially PAH, as described in a growing body of literature since 1997 (after the EVOS). Crude oil typically contains 0.5 to 1.5% by weight of PAH (5 000 - 15 000 ppm), depending on its source. The majority (90 - 95%) are alkyl PAH, the forms associated with chronic toxicity to fish, and can comprise hundreds of compounds (refer back to IR 1.6 - requests for physical and chemical descriptions of petroleum products).

Request:

a) Please provide a detailed summary of the constituents that cause acute or chronic toxicity in the petroleum products to be transported by the pipeline (diluted bitumen, synthetic oil, condensate), including the EPA priority 16 PAH, plus the sum of C0 to C4 alkyl naphthalenes, anthracenes, phenanthrenes, fluorenes, chrysenes, pyrenes, dibenzothiophenes, naphthobenzothiophenes, etc.

b) Please provide a literature review of the concentrations of whole oil or specific oil components (e.g. alkyl PAH, BTEX, alkanes, etc.) that cause acute and chronic toxicity to fish species endemic to the Kitimat River. Include the endpoint measured, concentrations, duration of exposure required to cause toxicity, and the relative sensitivities of different life stages of fish.

c) Please use the literature review requested in b) above to assess whether the federal and provincial guidelines for petroleum hydrocarbons will be adequately protective of fish in the Kitimat River, and whether site-specific guidelines are needed.

Response:

a) Available information on the chemical composition of the hydrocarbons, including PAHs, is provided in Table E-1, of Appendix E, in the Technical Data Report (Stephenson et al. 2010). The analysis reported here includes inorganic substances as well as hydrocarbons.
To date, the analysis of PAHs is limited to the parent (C0) series. However, the fractionation of the petroleum hydrocarbons into aliphatic and aromatic compounds, by carbon range, also provides some information on the total quantity of aromatic substances present, and would include the alkylated substances.

Notwithstanding this information, the alkylated PAHs have not yet been characterized in the diluted bitumen, synthetic crude, or condensate samples. As discussed in Northern Gateway’s response to Federal Government IR 100, Northern Gateway has initiated supplemental chemical analysis of the hydrocarbons, and will provide further detail regarding alkylated PAHs in the hydrocarbons when it becomes available.

b) Following an oil spill, concentrations and mixtures of hydrocarbons in water or sediment vary over time as a result of the differential solubility of individual chemical constituents, and weathering or degradation processes. As a result, there is no “single” answer to the question of how toxic a particular hydrocarbon product or mixture may be. A recent paper by DiToro et al. (2007) provides additional insight into this issue. In addition, a paper by DiToro et al. (2000a) provides information on the toxicity of a broad range of hydrocarbon compounds.

In addition, please see Northern Gateway’s response to Federal Government IR 118 regarding preparation of additional Human Health Ecological Risk Assessments.

c) Current water quality guidelines for BTEX, TPH and PAH substances nationally, in Alberta and in British Columbia are provided in Northern Gateway’s response to Haisla Nation IR 1.47.

The Canadian Council of Ministers of the Environment (CCME 1999) state that Canadian water quality guidelines are intended to provide protection of freshwater and marine life from anthropogenic stressors such as chemical inputs or changes to physical components (e.g., pH, temperature, and debris). Guideline values are meant to protect all forms of aquatic life and all aspects of the aquatic life cycles, including the most sensitive life stage of the most sensitive species over the long term. The protection goals for provincial agencies establishing water...
quality guidelines are generally similar to those of the CCME.

Northern Gateway does not believe that site-specific water quality guidelines are required at this stage of the application process.

Also see Northern Gateway’s response to Haisla Nation IR 1.47d).

Reference:


1.49 Life Stage and Species Sensitivities

Reference: i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)
ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)
iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)
iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)
v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble: The Application provides insufficient references to data on the relative sensitivities of different life stages of different fish species to the toxic constituents of oil. The spring "emergence period" for fish larvae that the application states is the most sensitive time for exposure is an oversimplification because the timing of emergence is species-dependent and emergence does not all occur at once. The same is true for spawning times and incubation times for developing embryos buried in spawning shoals. In the literature, toxic effects are often linked to concentrations of toxic constituents (i.e. PAH), none of which are reported here.

Request: a) Please provide details on specific effects of oil on different life stages of fish, for as many species as possible.

b) Please describe the toxicity of different hydrocarbons in terms of EC50s and LOEC/NOECs for comparisons.

c) Where data are available, please express toxicity in terms of "total petroleum hydrocarbons" and "total PAH".

d) Please provide a summary of the spawning and emergence times for each fish species in the Kitimat River.

Response: a-c) The following references provide comprehensive information on the toxicity of individual hydrocarbon compounds to aquatic species, and in addition, develop and validate an overall model of hydrocarbon mixture toxicity for water and sediment.

Reference:


Di Toro, D.M. and J.A. McGrath. 2000b. Technical basis for narcotic chemicals and polycyclic aromatic hydrocarbon criteria. II. Mixtures


d) Please see Attachment Haisla Nation IR 1.49d).
1.50 Effects of Weathering on Toxicity

Reference:  

i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)  
ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)  
iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)  
iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)  
v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble: Weathering is a process that begins immediately following a spill, and will change the chemistry and properties of the oil. The effects of weathering on the exposure and the toxicity of the constituents of oil to aquatic organisms, are not discussed. The most immediate effects of weathering are the loss of low molecular volatile components that are acutely toxic (may cause fish kills), leaving a heavier residue, rich in PAH, that is chronically toxic. "Weathered oil is more likely to sink in seawater than freshwater because of the differences in density" (p. 4-4). This is an error in interpretation - seawater is denser than freshwater, so oil is more likely to sink in freshwater, particularly if there are inorganic particulates in the water.

Request:  

a) Please define the effects of weathering on the distribution and ultimate fate of the condensate, synthetic oil, and diluted bitumen.

b) Please provide information on how weathering of oil will affect the extent of contamination of fish habitat, and the exposure of different life stages to the components of oil that are acutely and chronically toxic.

c) Please provide more information on the persistence of oil in sediments, and the extent to which the toxic components are mobilized by water washing.

d) Please provide information on the expected concentrations of alkyl PAH and other constituents of oil in interstitial waters of contaminated sediments.

Response:  

a-b) Please see Northern Gateway’s response to Federal Government IR 118 regarding the preparation of additional Human Health and Ecological Risk Assessments. Weathering of oil will be considered in this assessment.

c) It has long been known that the toxicity of hydrocarbon mixtures tends to decrease as the mixture weathers. DiToro et al. (2007) provide a quantitative explanation of this phenomenon. In their words, “the data ... demonstrate that the observed toxicity decreases as the degree of
weathering increases. The fraction of the more soluble, lower-molecular weight components with higher toxic potential is removed, allowing the fraction of the less soluble, higher-molecular weight components with lower toxic potential to increase. Therefore, the toxicity of the material as a whole decreases.”

The extent to which hydrocarbons and PAHs are mobilized from stream or river sediments by water washing is largely a factor of:

- the hydrocarbon spilled
- the response measures and clean-up activities undertaken
- the type of shoreline and associated sediment originally oiled
- the amount of flushing that occurs

The physical properties of the oil along with the properties of the shoreline (porosity of the substrate) will contribute to how deeply oil penetrates. Viscous oils such as diluted bitumen typically will not penetrate deeply in shorelines and sediments with low porosity (silts and clay). Although coarse-grain shoreline may be penetrated more deeply, water flushing is typically quicker acting to remove hydrocarbon.

In general it is anticipated that in fast-flowing channels, winter and spring flows are expected to flush accumulated fine sediments and hydrocarbons from erosional areas in the first year. However, habitat in back eddies, side channels, and other areas with reduced flow would likely remain affected for longer. The response measures taken and clean-up end points set for the shoreline will determine how much residual hydrocarbon is left in the environment.

e) As noted in the Northern Gateway’s response to Federal Government IR 100, Northern Gateway has initiated supplemental chemical analysis of the hydrocarbons, and will provide further detail regarding alkylated PAHs in the hydrocarbons when it becomes available.

However, to respond to the question more generally, two factors can be considered. First, the aqueous solubility of individual PAH compounds is generally considered to be lower than the solubility of smaller constituents such as the BTEX compounds and smaller aliphatic compounds, but higher than the solubility of many of the longer-chain aliphatic and complex aromatic substances. In addition, the alkylated PAHs tend to be less soluble than the parent (non-alkylated PAH) compound. Relative solubility of organic compounds can be expressed through the octanol-water partition coefficient, or the related log KOW value. Substances that have a low log KOW value (values between 0 and 4) have relatively high aqueous solubility, whereas substances that have a high log KOW value (values greater than 4) have relatively low
aqueous solubility. As oil mixtures weather, the proportion of larger, less volatile, less soluble, and by definition more persistent compounds, tends to increase.

Second, the solubility of organic compounds depends upon its presence either in pure form or as part of a mixture. When present as a pure substance (i.e., a single substance being dissolved in water) the maximum dissolved concentration will be that of its aqueous solubility. However, when present as part of a mixture (as is the case for spilled oil) the effective aqueous solubility of each individual organic compound is modified by the presence of the other compounds that are also dissolving in the water, as described by Raoult’s law (Peters et al., 1999; Sterling et al., 2003; Di Toro et al., 2007). As compounds are mixed together, the molar fraction of each constituent decreases, and the effective solubility of each individual constituent also decreases. As a result, the effective solubility of each individual compound is reduced as a result of the competition from other compounds (Peters et al. 1999; Sterling et al. 2003; Di Toro et al. 2007).

Reference:


1.51 Effects of Submerged Oil That Persists After a Spill

Reference:

i) Exhibit B 3-6 Volume 6A – Application dated May 2010, Section 11, p. 11-1 (A1T0F6)

ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)

iii) Exhibit B 3-20 Volume 7B – Application dated May 2010 (A1T0H0)

iv) Exhibit B 3-21 Volume 7B – Application dated May 2010 (A1T0H1)

v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble: The effects of sunken or submerged oil that persists are often downplayed throughout the application. “Non-recovered dispersed and residual stranded hydrocarbons would continue to weather and degrade over the ensuing months to [a] year” (p. 9-27). Several months to a year is a considerable duration of exposure from water and/or sediments for aquatic life, and must be considered in the application. “Residual hydrocarbon contaminants in sediments would likely cause mortality of benthic invertebrates.” (p. 7-24). If fish embryos are also incubating in these areas, mortality or chronic toxicity of embryos would also likely occur.

Request:

a) Please provide an assessment of the effects of oil that becomes submerged and persists in sediments. Please include the impacts on benthic species, including invertebrates and fish embryos.

b) Please comment on the biodegradation potential for persistent oil, including which microbes are present in the water of sediment of the Kitimat River according to their oil-degrading ability.

Response:

a) Please see Northern Gateway’s response to Federal Government IR 118 regarding the preparation of additional Human Health Ecological Risk Assessments.

b) Hydrocarbons typically degrade over time due to physical and chemical, as well as microbial processes (Leahy and Colwell 1990). As these occur simultaneously, degradation or weathering is typically considered as an overall process. In the early stages of weathering, evaporation and photo-oxidation are usually more important than biodegradation, which is considered to be a relatively slow process (Zhu et al. 2001). Some hydrocarbons may persist for long periods of time (e.g., weathered hydrocarbons that become “tarry”, or high molecular weight PAHs), whereas others degrade more rapidly (e.g., gasoline or light fuel oil, or low molecular weight hydrocarbons such as benzene). Dispersed hydrocarbons also degrade more readily than hydrocarbons that remain as blobs or pools of free product.

Information related to microbes present in the water of sediment of the
Kitimat River according to their oil-degrading ability is not presently available, however, such microbes are widely distributed in the environment, and would respond in an opportunistic manner to the availability of substrates (such as hydrocarbons) that they are capable of metabolizing.

**Reference:**


1.52 Long-Term Consequences of Toxicity

Reference:  
i) Exhibit B 3-6 Volume 6A – Application dated May 2010, Section 11, p. 11-1 (A1T0F6)  
ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)  
iii) Exhibit B 3-20 Volume 7B – Application dated May 2010 (A1T0H0)  
iv) Exhibit B 3-21 Volume 7B – Application dated May 2010 (A1T0H1)  
v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble: The Application also does not address the long-term consequences of toxicity, specifically, the impact on returns of migrating salmon exposed as eggs, fry, and juveniles in the Kitimat River. With the current proposal, the impacts of oil toxicity cannot be understood because the extent and duration of possible contamination are not covered in sufficient detail.

Request:  
a) If recruitment of one year class of a given salmon species is wiped out by an oil spill, please indicate the time required for the population to recover. Also indicate whether oil will persist such that subsequent year classes will be exposed.

b) For each salmon species in the Kitimat River and its tributaries, please indicate how much impairment of recruitment can be sustained before the fishery collapses.

c) Please describe the ecological, social, and economic costs of toxicity.

d) Based on fish closures the followed oil spills in other ecosystem (e.g. Wabamun Lake), please provide a review of what determines a closure for specific fisheries and how long they are closed.

e) Please provide a detailed summary of fish species harvested in the Kitimat River and its estuary (separate recreational sport fishing and fishing by First Nations communities), including the number collected annually, and when fishing seasons occur. Also indicate the socioeconomic and/or cultural impacts of a closure on First Nations communities.

Response: a-d) See Northern Gateway’s response to Gitxaala Nation IR 1.10.5.1. In addition, a comprehensive summary of the recovery following the Pine River spill is currently being prepared and will be provided to the JRP.

e) For a detailed discussion on fish harvesting and the economic value of harvested fish, please see Northern Gateway’s response to Haisla Nation IR 1.42c).
1.53 Effectiveness of Booms and Skimmers in a Fast-Flowing River

Reference:  
i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)  
ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)  
iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)  
iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)  
v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble: The Application claims that containment booms could restrict the downstream movement of hydrocarbons and would prevent hydrocarbons from entering sensitive areas. The application goes further to state that clean-up procedures would be selected based on chemical composition of the hydrocarbon spilled, yet few details are provided about the effectiveness of booms and skimmers as mitigation strategies. As well, most of the discussion sounds purely hypothetical.

Request:  
a) Please provide information on how long it would take for booms or skimmers to be deployed to stop the flow of oil into or down the Kitimat River for each of the tributary crossing points.

b) Please provide additional details for mitigation measures, including contingency plans for the various spill scenarios.

c) Please provide additional details for mitigation measures, including contingency plans for the various river flow scenarios (i.e., low flow to full flood).

Response:  
a) Please refer to Northern Gateway’s response to Haisla Nation IR 1.54.

b) Please refer to Northern Gateway’s response to Haisla Nation IR 1.54.

c) Please refer to Northern Gateway’s response to Haisla Nation IR 1.54.
**1.54 Can Oil spills be Detected and Intercepted Before They Travel Down River?**

**Reference:**

i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)

ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)

iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)

iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)

v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

**Preamble:**

The Application does not indicate the feasibility of intercepting a spill. "Most of the recovery of hydrocarbons that reach lakes or other slow-moving water bodies occurs within the first week" (p. 7-10). Does this indicate removal of floating oil on the water surface only? Typically, how much oil is actually recovered in flowing water? Overall, there is no discussion of how long it would take to detect and intercept a spill before it transits a fast-flowing river. There is a need for more details about detection of spills, but also clean-up procedures for synthetic oil, diluted bitumen, and condensate - for various scenarios (spill locations along the pipeline right-of-way). An example is provided of diluted bitumen cleanup - p. 7-10: "Flush[ing of] mobile portions from surface waters and oiled substrates into collection areas… [to] be collected and transported offsite." However, detailed plans addressing the utility of such methods are required.

**Request:**

a) Please indicate how feasible flushing of mobile oil to collection areas would be in a fast-flowing river, and describe whether collection areas are preselected.

b) Please provide an analysis of how much damage would be done to river habitats by flushing and other oil recovery methods, and how damage would be monitored.

c) Please provide information on reaction speeds to oil spills in the Kitimat River, and whether containment booms and oil recovery equipment can be deployed within the transit time of oil from Hunter Creek to the estuary (<24 hours).

**Response:**

a) A variety of tactics are available for containment and recovery in fast-flowing rivers. Typically these involve diversion of oil from areas of high flow to more low flow collection locations or recovery in those low flow areas where oil collects naturally. General oil-on-water control and recovery strategies and tactics, including those for fast-flowing currents, are outlined in Section 9 of the General Oil Spill Response Plan ("GOSRP"). It is Northern Gateway’s understanding that at the present time (September 2011), Environment Canada is considering the
completion of a “Field Guide for Oil Spill Response in Freshwater Environments” that would deal specifically with rivers and lakes. This would be a companion to the “Field Guide for Oil Spill Response on Marine Shorelines” published by Environment Canada in March 2010 and would provide additional guidance on the feasibility of containment, collection and recovery strategies and tactics in fast-flowing and other river environments.

Collection areas are selected at the time of an incident and are dependent upon a range of factors that include:

- the location of the incident
- the type and volume of oil that is released onto the river waters
- the anticipated rate of movement of the leading edge of surface oil and the deployment time to potential downstream intercept, control and/or collection sites
- the water level at the time of and immediately following an incident (this may rise or fall depending on precipitation, snow melt, etc.) as this condition will determine the exact physical character of the river channel width and depth, the physical character of the river bank(s), and the feasibility and effectiveness of equipment deployment at any given point in time
- the river current velocities in different locations downstream and within the river channel as these change depending on precipitation, snow melt, etc.

b) The selection of response tactics, including flushing and other oil recovery methods, is based on a net environmental benefit analysis (“NEBA”). This technique is widely used to evaluate the advantages and disadvantages of available response options in order to minimize additional habitat damage. The response option that is considered to have the greatest net environmental benefit is selected. General river bank clean-up or treatment techniques are outlined in Section 10.6 (Treatment Recommendations) of the GOSRP and, as noted above, if and when the “Field Guide for Oil Spill Response in Freshwater Environments” is published by Environment Canada this would provide information directly relevant for the NEBA process.

Once the initial response is complete, continued monitoring for recovery or for continued natural attenuation may be part of a longer-term plan. In the event of a pipeline spill incident, Northern Gateway will implement a comprehensive environmental monitoring program that is commensurate to the site-specific conditions. The program would employ industry best practices for environmental monitoring, and be developed in consultation with relevant regulators, First Nations, and
stakeholders as appropriate. The objectives of the program would be to monitor containment effectiveness, clean-up progress, and clean-up effects, and to guide the development of further response and remediation plans.

c) Field work by the project team has identified numerous access locations on Hunter Creek and the Kitimat River between the pipeline crossing on Hunter Creek and the estuary. Several of these locations, identified at K2, K3 and K9 as Control Points (“TIPs”) and are described in Appendix C of the River Control Points for Oil Spill Response Technical Data Report (Polaris 2010, referenced below).

CP K2 on the Kitimat River has direct access to the river from Highway 37. This location is approximately 25 km downstream from the Hunter Creek pipeline crossing and the estimated travel times to the location from the crossing are:

- Low flow (0.8 m/s) – 9 hours
- Moderate flow (1.7 m/s) – 4 hours
- High flow (4.0 m/s) – 2 hours.

CP K2 would be approximately 27 km from the Kitimat Terminal, which would be an Oil Spill Response (“OSR”) base, and would involve an estimated <1 hour response travel time to this site.

CP K3 on the Kitimat River has direct access to the river from Highway 37. This location is approximately 32 km downstream from the Hunter Creek pipeline crossing and the estimated travel times to the location from the crossing are:

- Low flow (0.8 m/s) – 13 hours
- Moderate flow (1.7 m/s) – 5 hours
- High flow (4.0 m/s) – 2 hours.

CP K3 would be approximately 21 km from the Kitimat Terminal OSR base, and would involve an estimated <1 hour response travel time to this site.

The most downstream CP on the Kitimat River before the estuary at K9 is at Radley Park adjacent to the Haisla Boulevard bridge in Kitimat. This location is approximately 54 km downstream from the pipeline crossing on Hunter Creek and the estimated travel times to the location from a spill entering the water at the crossing are:

- Low flow (0.8 m/s) – 23 hours
- Moderate flow (1.7 m/s) – 9 hours
• High flow (4.0 m/s) – 4 hours.

CP K9 would be approximately 10 km from the Kitimat Terminal OSR base. Deployment of OSR equipment to this site could take place in under an hour.

**Reference:**

1.55 Mitigation of Oil That Becomes Entrained In Sediments

Reference:

i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)

ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)

iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)

iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)

v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble: "PAH levels may remain above sediment quality guidelines, unless remediated." (p. 7-10). If oil is entrained in bed sediments, how will the extent (depth, distance, volume) of sediment contamination be measured and cleaned up? Overall, there are few details about how sediment contamination would be measured and dealt with. The residual oil in Prince William Sound, Alaska after the Exxon Valdez oil spill has persisted for more than 20 years. There is no discussion about the persistence of stranded oil in the Kitimat River that is not detected and, thus, not cleaned up.

Request:

a) Please provide details on how sediments are remediated. Please provide information on how long it will take to remediate sediments, and on the extent (distance downstream) and depth of sediments remediation.

b) Please provide information on who makes the decision about the extent of remediation required.

Response:

a) Sediment remediation can be carried out by a range of treatment tactics which are outlined in Section 10.6 of the General Oil Spill Response Plan ("GOSRP") and described in more detail in the “Field Guide for Oil Spill Response on Marine Shorelines” published by Environment Canada in March 2010.

The length of time to remediate oiled sediments and the extent and depth of remediation are a function of many factors that include: sediment sizes, oil character, oil distribution, oil concentration, depth of oil burial or penetration, water levels and current speeds (both the present and future); and the desired treatment end points. Typically, a treatment plan time-line considers the size and number of the area(s) to be treated. Depending on size and the oiling conditions, the actual length of time for treatment of an individual oiled site may be a matter of hours or days.

b) Decisions regarding the extent of remediation required are generated by the spill management team, which evaluates information and input from a variety of sources, including the Regional Environmental Emergencies...
Team ("REET"). Typically, areas to be treated and shoreline treatment end points are defined for different environments or habitats and different oiling conditions, based on information provided by an interagency Shoreline Clean-up Assessment Team (“SCAT”) survey. End points can be developed using the Environment Canada “Guidelines for Selecting Shoreline Treatment Endpoints for Oil Spill Response”.
1.56 Recovery of Fish and Fish Habitat

Reference:
1. Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-25 (A1T0F6)
2. Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)
3. Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)
4. Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)
5. Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble:
The Application states that fish restocking would occur if mitigation is not effective and ecological effects of a spill occur. Restocking may not be the most suitable method for recovery of fish populations and the Application needs more details on fish habitat recovery (removal and/or cleaning of spawning substrates - i.e. gravel/cobble). A "Habitat Compensation Program" (reference i) is briefly mentioned, but the report has not been released. The importance of fish habitat recovery is paramount considering that not only did residual oil in Prince William Sound, Alaska after the EVOS persist for at least 20 years, but the actual clean-up operations, including dispersant use and high pressure washing of contaminated shorelines, further damaged fish habitat and, thus, the ecological effects were compounded. Given similarities in climate, damaged fish habitat from residual oil could be extensive.

Request:
a) Please indicate when the "Habitat Compensation Program" will be completed and whether it will be reviewed before construction begins.
b) Please provide a literature review of past experience demonstrating whether habitat compensation is effective and covers the range of fish habitat, especially spawning and incubation habitats, that occur in sediments where residual oil can persist.
c) Please discuss how mitigation measures and clean-up may damage fish habitat and refer to lessons learned from the EVOS.

Response:
a) Habitat compensation plans relating to construction effects will be filed with the application for DFO authorization prior to the start of construction. (see Application (Volume 6B, Section 11)). Prior to filing, the applications and compensation plans will be reviewed by DFO and participating Aboriginal groups in the area involved.
b) Northern Gateway is committed to prevention, detection and mitigation measures to prevent incidents from occurring and would take action so that any potential effects are reduced or remediated. Application (Volume 7B, Section 5) outlines the proposed responses but more detailed oil spill response plans will be developed.
In an instance where DFO deems it appropriate to compensate for fish habitat that has been affected by an oil spill, Northern Gateway will work closely with DFO to develop a habitat compensation plan that meets DFO’s policy of “net gain” and the guiding principle of “no net loss” of the productive capacity of fish habitat.

c) The Information Request contains some major misperceptions. Firstly, dispersants were not used in the EVOS response, they were specifically excluded from use and were applied only as a test application far out to sea and away from any fish spawning habitat. All contemporary dispersant use guidelines specifically exclude dispersant applications in nearshore, shallow areas or areas where residual dispersant could potentially wash into spawning streams. Furthermore, shoreline clean-up activities were specifically excluded from stream banks and stream beds as recognized sensitive habitat. As a result there were no "further damaged fish habitats" nor "compounded ecological effects" from the EVOS response. Fortunately, the net outflow of freshwater from spawning streams provided a natural barrier with the result that spilled oil was pushed away from the stream mouths and the sediments were kept clean from any oil deposition.

Actual GC/MS measurements of petroleum hydrocarbons from spawning stream sediments in 1989 and 1990 following the EVOS showed that trends in PAH concentrations for the majority of oiled streams show a general decline from 1989 to background levels by 1990. The measured PAH concentrations indicate low-level exposure to residual hydrocarbons that have not produced detectable differences in spawning behavior or escapement between streams from oiled areas compared with unoiled streams. (Maki, et al, 1995).

Reference:

1.57 Objectives for Post-Spill Monitoring

Reference:  
i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)  
ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)  
iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)  
iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)  
v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble: Should there be an oil spill into the Kitimat River, it is essential to initiate a thorough monitoring and assessment of impacts on fish and the fisheries that they sustain. This includes factors that affect the production and abundance of fish, including the health and abundance of prey (invertebrates and forage fish), access to suitable habitat for spawning, and water and sediment quality as they affect embryo development, growth, reproduction, and migration. Monitoring must also assess the quality of the fish as indicated by the occurrence of external lesions, the extent of parasite infections, and tainting by petroleum hydrocarbons. Damage to the local economy, including impacts on sports and native fisheries and tourism, and damage to First Nations cultural practices must also be assessed.

Request:  
a) Please provide a clear definition of Enbridge's objectives for post-spill monitoring, including what would be measured to achieve those objectives, where it would be measured, and for how long.

b) Please provide an indication of whether monitoring would be weighted towards chemical measures of oil contamination or to an assessment of fish species presence/absence, abundance, productivity, and economic and cultural loss.

Response:  
a) In the event of a spill, Northern Gateway would implement a comprehensive environmental monitoring program that is commensurate with the site-specific conditions of the incident. The objectives of the program would be to characterize the extent of contamination arising from the incident, monitor containment effectiveness and clean-up progress, and guide the development of further response and remediation plan and to verify and refine predictions of longer-term oil fate, behaviour, effects, and rates of biological recovery. The actual sampling techniques, monitoring locations, and the duration of the program would be based on industry best practices for environmental monitoring. The design of the program would be developed in consultation with relevant regulators, Aboriginal groups and stakeholders, as appropriate.
b) Program design, scope and scale would be defined by the objectives of the program. Typically, the design of a monitoring program takes into account the character of the contamination, the environmental setting, and the resources, both human and ecological, that may be affected. The actual data that may be collected and the selection of measurement tools would be site and incident-specific. The monitoring design would focus on actual or potential effects and may involve, but not necessarily include nor be limited to, physical measurements (water character), chemical analyses, and species data.
1.58 Management of Post-Spill Monitoring

Reference:

i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)

ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)

iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)

iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)

v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble: Plans for monitoring should be in place prior to a spill, with clear agreement among stakeholders about who will design, direct, and interpret the monitoring, how it will be done, and who will pay for it. The current proposal provides few useful details about post-spill monitoring.

Request:

a) Please provide information on local/federal/provincial agencies that are responsible for fisheries and environmental management and protection in the Kitimat watershed, and their anticipated role in post-spill monitoring.

b) Please provide information on existing contingency plans, remediation, oversight, monitoring, and enforcement plans by these agencies and compare them to the Enbridge plans for monitoring.

c) Please provide information on who would pay for creating and sustaining a monitoring and response capability.

d) Please indicate how the spatial and temporal scale for monitoring would be established following a spill.

e) Please indicate which agency or agencies would report and interpret monitoring data.

f) Please provide information on how monitoring data would be used to trigger action regarding additional remediation, additional monitoring, and who would make the decision whether additional remediation or additional monitoring is required.

g) Please provide information on how long post-spill monitoring would be sustained, and on the criteria or triggers that would be used to support a decision to cease monitoring.

Response:

a) The primary federal agencies responsible for fisheries and environmental management and protection include: Environment Canada, Canadian Wildlife Service (Environment Canada), Fisheries
and Oceans Canada, and the Canadian Coast Guard (Fisheries and Oceans Canada). The primary British Columbia provincial agencies responsible for fisheries and environmental management and protection include: the Ministry of Environment and the Ministry of Forests, Lands, and Natural Resource Operations.

Appropriate Aboriginal groups would be involved in the post-spill monitoring program development.

In the event of a pipeline incident (spill), Northern Gateway would implement a comprehensive environmental monitoring program that is commensurate to the site-specific conditions. The program would employ industry best practices for environmental monitoring, and be developed in consultation with relevant regulators, Aboriginal groups, and stakeholders as appropriate. The objectives of the program would be to characterize the extent of contamination arising from the incident, to monitor containment effectiveness and clean-up progress, and to guide the development of further response and remediation plans.

The scope of the program would be scalable to the risk, and would be determined based on considerations of the local environmental setting, the presence of potential receptors, the status of the spill (contained, uncontained) and the magnitude of the incident. The program would identify the specific contaminants of concern, and be designed to assess how these contaminants have dispersed in the environment. It would typically include monitoring of all relevant environmental media, which may include air, surface water, groundwater, soils and sediments. In circumstances where the spill is in highly sensitive environmental settings, the monitoring program may also include monitoring of fish and wildlife, marine mammals, vegetation, and other potential biological receptors.

Results from the monitoring program would be reviewed relevant to applicable Federal and Provincial environmental quality guidelines. The monitoring program would be implemented immediately following an incident. The duration of the program would be site- and circumstance-specific, and developed in consultation with the appropriate regulatory and stakeholder groups, including the aforementioned local groups.

b) The primary plans within the Kitimat watershed, which define the roles and responsibilities regarding remediation, oversight, monitoring, and enforcement, are the BC Ministry of Environment Inland Oil Spill Response Plan and the Environment Canada National Environmental Emergencies Contingency Plan (which includes the Regional Environmental Emergencies Plan). The Northern Gateway plans for monitoring are to be in full compliance with the terms of the Federal
and Provincial plans.

c) Costs associated with post-spill monitoring and response in respect to pipeline incidents would be the responsibility of Northern Gateway.

d) The design of the spatial and temporal scale for monitoring would be established in consultation with relevant regulators, Aboriginal groups, and stakeholders as appropriate. Typically, the design of a monitoring program takes into account the character of the contamination, the environmental setting, and the resources, both human and ecological, that may be affected. The actual time frame and geographic extent would be site- and incident-specific and would include information provided by an interagency Shoreline Clean-up Assessment Team ("SCAT") survey.

e) It is anticipated that Environment Canada, Fisheries and Oceans Canada, and British Columbia Ministry of Environment would review, interpret and report on the monitoring data, even if these agencies themselves would not be the originators.

f) Reviews of monitoring data by Environment Canada, Fisheries and Oceans Canada, and British Columbia Ministry of Environment would be the basis for recommendations on additional remediation or additional monitoring in light of the agreed target end points established for the treatment program.

g) The duration of post-spill monitoring would depend on the extent and degree of any impacts, on the treatment and mitigation actions, and on the recovery of the affected resources or habitats. Criteria and decisions regarding the length and completion of a monitoring program would be site- and incident-specific.
1.59 Delayed and Cumulative Effects

Reference:

i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)

ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)

iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)

iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)

v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble:

Pink salmon were among the species of fish most affected by the EVOS. In addition to direct mortality of fish embryos in oil-contaminated spawning shoals, there was experimental evidence of low rates of survival of pink salmon at sea.⁶ Salmon that survived exposure to oil under controlled conditions, and that appeared normal as juvenile fish, were tagged and released with tagged salmon that had not been exposed to oil during early development. Compared to the control group, 20 to 40% fewer exposed salmon returned to spawn, indicating that low level exposures to oil-derived PAH (about 5 to 19 µg/L total PAH) during embryonic development impaired some aspect of migration, swimming, feeding, or predator-avoidance ability of adult pink salmon. Given the similarity in physiology and life history among salmonids and other species of anadromous fish, the returns of anadromous species and the success of fisheries are likely to decrease in the years following a spill, corresponding to the expected number of years at sea for each species. Lower returns of spawning adults will also have reverberating effects of lower production in subsequent generations.


Request:

a) Please provide information on plans to monitor oil and PAH concentrations in sediments, gravel and interstitial waters of spawning beds where various fish species deposit eggs.

b) Please provide information on the extent to which anadromous fish species (salmon, sea-run trout, eulachon, Pacific lamprey, etc.) will be monitored following an oil spill.

c) Please provide information on whether post-spill monitoring will include assessment of the emergence of fry from spawning beds, escapement of juveniles to the sea, and the return success of adults.

d) Please provide information on the availability of baseline information describing current rates of emergence of fry from spawning beds,
escapement of juveniles to the sea, and the return success of adults.

e) Please provide information on plans to establish current baseline rates of emergence of fry from spawning beds, escapement of juveniles to the sea, and the return success of adults.

Response:  

The preamble provided with this information request contains some misconceptions about the EVOS effects to pink salmon which must be addressed before answering the specific information requests.

First, is the misconception that the pink salmon population in Prince William Sound suffered a long-term, major effect from the EVOS. Researchers from the Alaska Dept of Fish and Game synthesized all of the data from numerous studies of spill effects on salmon and concluded from modeling estimates (Geiger et al, 1996) that only about 2 million fewer wild pink salmon returned to PWS in 1990 because of EVOS, even though they also reported that 1990 was a record catch year for pink salmon with a catch of over 44 million fish, and the 1991 catch the second largest at over 37 million (Templin et al 1996; Brannon and Maki 1996).

Second, is the misconception that spawning habitat was heavily oiled causing further effects on pink salmon. Brannon et al. (1995) examined water and sediment concentrations for PAHs from Prince William Sound spawning stream sediments in 1989, and found low hydrocarbon concentrations in spawning sediments. Through regression analyses, they concluded that there would have been no substantial toxicological effects on the critical early life stages of pink salmon in PWS attributable to the spill. This was confirmed by chemical analysis of pink salmon embryo tissue sampled from oiled streams. In 1990 and 1991, embryos showed mean tissue-PAH concentrations that were at least 80 times lower than tissue concentrations reported toxic to pink salmon embryos (Brannon et al. 2001). These data and the sediment-PAH concentrations measured in oiled streams indicate that toxic levels of petroleum hydrocarbons were not present in the incubation environment (Brannon et al. 2001).

(a) If a hydrocarbon spill occurred that affected salmon spawning beds, specific environmental monitoring programs would be developed, and adapted to the specific location and conditions of the affected spawning habitat. It is therefore not realistic to outline a specific program at this time.

Based on past experience for spills in British Columbia (e.g., pipeline puncture near the Westridge Marine Terminal and the subsequent movement of oil into Burrard Inlet in 2007, a spill of oil from a pipeline
near Abbotsford to a stream and wetland in 2005), monitoring programs are typically designed by the environmental consultants, who work with the company involved, the spill responders, and a “stakeholder” committee. The “stakeholder” committee is coordinated by NEB and typically consists of Federal (Environment Canada, Fisheries and Oceans Canada) and provincial (Ministry of Environment) regulatory agencies, First Nations governments, and local governments. This format ensures that technical issues and locally relevant concerns are addressed in the monitoring programs, both for the short term (effect assessment) and long term (recovery assessment) programs. Additionally, the agencies involved with the spill response and biological effects assessment may also conduct monitoring programs of the potentially contaminated environment.

All relevant environmental components (sediment, water, biota contaminant levels), as applicable, would be included, and studies of individual species may be designed at that time. For example, in an area where a life stage of salmon is affected or suspected to be affected, recovery of that population would be monitored. If spawning habitat was oiled, then PAH levels in the spawning substrates would be included in the monitoring program.

(b) Decisions to monitor anadromous fish species would also be made following a similar process as described in Northern Gateway’s response to Haisla Nation IR 1.59a). The decision to monitor anadromous fish would be made based on the area affected by the spill, the presence of those species in the affected area, the life cycle phase involved, and the time needed for remediation to accepted endpoints (i.e., a reasonable link between the species and exposure to the spill). Decisions on the specific focus of the monitoring program, sampling methods and study design would need to be approved by regulatory agencies.

(c) Information from Northern Gateway’s response to Haisla Nation IR 1.59a) and 1.59b) is also applicable to this response. It is not possible to say at this time if post-spill monitoring would include assessment of individual phases of salmonids. As noted in Northern Gateway’s response to Haisla Nation IR 1.59b), this would be based on a number of parameters that establish a reasonable link between a spill and effects on specific life phases of salmonids. If a spill occurred in the Kitimat River and oil traveled downstream to spawning or other fish habitat, assessing the effects of the spill on specific and appropriate life phases and the recovery of fish populations will be an important component of the monitoring program.

(d) Baseline data on specific life cycle aspects of pink salmon and other
species are generally available from existing literature and agency/academic field surveys. The timing of emergence of fry from spawning beds, timing of escapement and adult return data are relatively well-known for salmonids. Further site-specific information for local spawning stocks would be developed if priorities associated with a spill event warranted such data.

(e) Northern Gateway currently does not plan to undertake the types of surveys outlined in this Information Request. However, Northern Gateway has committed to developing and implementing a Marine Environmental Effects Monitoring Program (“MEEMP”) for the marine terminal and marine transportation (see response Haisla IR 1.70). The specific scope and approach for the MEEMPs would be based on discussions with government agencies, Aboriginal groups and certain public stakeholders. Northern Gateway has offered coastal First Nations the opportunity to help develop and undertake appropriate MEEMPs and would extend this offer to the Haisla Nation. If there were valid reasons to include the parameters described in this Information Request, these parameters would be considered during the development of the MEEMPs.

References:


Geiger, Harold J., Brian G. Bue, Sam Sharr, Alex C. Wertheimer, and T. Mark Willette. 1996. A life history approach to estimating damage to Prince William Sound pink salmon caused by the Exxon Valdez oil

1.60 Other Delayed and Cumulative Effects

Reference: 

i) Exhibit B 3-6 Volume 6A - Application dated May 2010, Section 11, p. 11-1 (A1T0F6)

ii) Exhibit B 19-29 Volume 6A Application Update December 2010 (A1W9C1)

iii) Exhibit B 3-20 Volume 7B - Application dated May 2010 (A1T0H0)

iv) Exhibit B 3-21 Volume 7B - Application dated May 2010 (A1T0H1)

v) Terms of Reference, Joint Review Panel Agreement (A1R4D5)

Preamble: 

Delayed effects can also result from an increased susceptibility to infection and disease, corresponding to impairment of immune function after exposure to PAH. Other environmental stressors, such as sudden changes or extremes of temperature, salinity, or oxygen concentration can also aggravate or potentiate toxicity. Some of these stressors can represent the cumulative impacts of a variety of human activities, including changes in annual run-off, flood patterns, and water quality due to forestry, agriculture, construction, or urban development, as well as fishing pressure. While no one factor in itself may be harmful, their effects combined with an oil spill could have significant impacts.

Request: 

a) Please provide information on natural and human-caused stressors on the Kitimat River, including physical changes to terrestrial habitats adjacent to the river (e.g. forestry, agricultural, roads, urban or industrial development), alterations of stream or river channels, flow control structures, and sources and amounts of nutrients, effluents or chemical inputs to the river.

b) Please provide a review and analysis of the current impacts of natural and human-induced stressors on the Kitimat River ecosystem, and the resources most affected by these stressors.

c) Please provide an analysis of which of the current stressors are most likely to interact with and aggravate the impacts of oil on the Kitimat River ecosystem.

d) Please provide information on whether post-spill monitoring will include interactions between the impacts of spilled oil and other natural or human-induced stressors in the Kitimat River watershed.

e) Please provide information on the current rates of fish disease in the Kitimat River, including the prevalence and incidence of bacterial and viral diseases, parasite infestations, and external and internal signs of cancer.

f) Please provide information on plans for post oil-spill monitoring and
assessment of the prevalence and incidence of diseases and pathology in fish from the Kitimat River.

**Response:**

a) The methodology for conducting the cumulative effects assessment is described in the Application (Volume 6A, Section 3.2), additional information on the assessment of specific Project effects and the associated cumulative effects are presented in each of the environmental assessments for each biological discipline.

The list of project and activities considered in the cumulative effects assessment for the pipeline component of the Project is included in the Application (Volume 6A, Appendix 3A. This includes project and activities in the vicinity of Hunter Creek and the lower portion of the Kitimat River valley.

b) The Application (Volume 6A) includes a description of the baseline conditions for each environmental component (Section 4 through 13). The baseline case (i.e., the conditions that exist prior to the start of construction of the Project already take into account existing environmental effects (e.g., what is referred to in the IR as stressors) from past and current projects. Given this, Northern Gateway does not agree with this request and has not provided such a review.

c) The analysis suggested is in fact an assessment of the cumulative effects of a hydrocarbon spill in combination with the effects of other past present and future projects and human activities. An assessment of the potential cumulative effects of a hydrocarbon spill in combination with existing and current stressors was not conducted.

Under the *CEA Act* and associated guidance documents, cumulative effects assessments are not typically completed for the assessment of potential accidents and malfunctions. Cumulative effects are assessed for the routine activities of a project. Since these activities are certain to occur, there is a high likelihood that the identified adverse environmental effects will also occur.

In contrast, accidents and malfunctions are, by definition, unlikely. Therefore, while the environmental effects (consequences) of accidents and malfunctions could be adverse and significant, the likelihood that these effects will occur is directly related to probability that an accident or malfunction will occur. Other factors (see below) will determine the geographic scope, duration, and magnitude of the environmental effect.

In the Application (Volume 7C, Section 9.5.4), the assessment of a hypothetical pipeline spill into Hunter Creek concludes that adverse environmental effects would affect freshwater ecosystems, some
terrestrial biota, some land uses and possibly the Kitimat estuary. Specifically “A diluted bitumen release at KP 1098.8 into Hunter Creek and its spread into Kitimat River and into the estuary would have adverse effects on water quality, fish and fish habitat, terrestrial vegetation, wildlife (especially birds), non-traditional land use and community well being. Effects could extend to the estuary and could be noted for marine vegetation and birds.” The assessment also notes that with appropriate spill response and clean-up measures, recovery of these environmental components will occur.

While these adverse environmental effects could be significant, depending on a number of factors (see below), the likelihood that they will occur is directly linked to whether a pipeline break will occur. As noted in the Application (Volume 7C), the probability of a pipeline spill is low. Additional information on the probability of a full bore pipeline break is provided in the Response to the Request for Additional Information (March 2011).

The environmental effects of a hydrocarbon spill on freshwater, terrestrial and marine ecosystems will depend on many factors including the type of hydrocarbon spilled, where a spill occurred, the volume of hydrocarbons spilled, the weather and hydrological conditions, the time of year, the proximity of the spill to sensitive areas and the response and restoration actions taken and their success. Given these complexities, it is not possible to accurately predict the environmental effects of a hydrocarbon spill from the pipeline.

d) Pipeline spill response planning and a discussion of possible measures is provided in the Application (Volume 7B). The detailed Pipeline Oil Spill Response Plan and accompanying plans and assessments (e.g., control point mapping, identification and mapping of environmental consequence areas) would occur following project approval and would be completed at least 6 months prior to the commencement of operations. During the development of control point mapping and mapping of environmental consequence areas, additional information would be obtained on environmentally sensitive areas and biota, over and above that already collected by Northern Gateway. Additional information on environmentally sensitive areas would be obtained during the finalization of the pipeline centerline and associated centerline surveys.

In the event of a pipeline spill that affected the Kitimat River, this information, as well as baseline information from other sources and traditional knowledge would be used to assess the environmental effects of the spill. The same information would be used to establish spill clean-up end points and objectives. If other natural or human-induced
stressors in the Kitimat River watershed are or could affect the recovery of specific species or ecosystem components, Northern Gateway would take this into consideration and adapt the spill clean-up and habitat restoration programs appropriately.

As part of the response, Northern Gateway would also be willing to work with government agencies, Aboriginal groups and public stakeholders to maximize the benefits of its response and restoration activities to better address the natural and human stresses of specific environmental components. For example, habitat restoration measures planned for spill effects might better be applied in another area where greater environmental benefits might be achieved. However, any such actions would need to be approved by the relevant Federal or Provincial government authority.

e) Northern Gateway has not completed any studies regarding the current rates of fish disease in the Kitimat River.

f) In the event of a spill in the Kitimat River, Northern Gateway would implement a comprehensive environmental monitoring program that is commensurate to the site specific conditions. The program would employ industry best practices for environmental monitoring, and be developed in consultation with relevant regulators, Aboriginal groups, and stakeholders as appropriate. The objectives of the program would be to characterize the extent of contamination arising from the incident, to monitor containment effectiveness and clean-up progress, and to guide the development of further response and remediation plans.

The scope of the program would be scalable to the risk, and would be determined based on considerations of the local environmental setting, the presence of potential receptors, the status of the spill (contained, uncontained) and the magnitude of the incident. The program would identify the specific contaminants of concern, and be designed to assess how these contaminants have dispersed in the environment. It would typically include monitoring of all relevant environmental media, which may include air, surface water, groundwater, soils and sediments. In circumstances where the spill is in highly sensitive environmental settings, the monitoring program may also include monitoring of fish and wildlife, marine mammals, vegetation, and other potential biological receptors.

Results from the monitoring program would be reviewed relevant to applicable Federal and Provincial environmental quality guidelines. The monitoring program would be implemented immediately following an incident. The duration of the program would be site- and circumstance-specific, and developed in consultation with the
appropriate regulatory, Aboriginal and stakeholder groups.
EFFECTS OF HYDROCARBONS ON THE BIOPHYSICAL ENVIRONMENT

1.61 Approach to Assessing Effects of Hydrocarbon on Biophysical Environment

Reference: i) Exhibit B3-39 Volume 8C - Application dated May 2010, Section 8.1, p. 8-1 to 8-3 and Table 8.1 (A1T0I9)

Preamble: In Volume 8C of the risk assessment (RA), the treatment of the possible effects of oil or diluent (called condensate in much of the RA) spills is incomplete, with only very general references given, and without a focus on the area of the proposed project, e.g. Kitimat Arm and Kitimat River. There has been much work done and published on the effects of petrogenic PAHs on marine fish and invertebrates from northern temperate waters, but little of that work is referenced in the RA. These works should be considered in the RA. Without this information, assessing the risks, and determining the potential for mitigating risks, is not possible.

The RA fails to display a clear understanding of the toxicology of oil-derived compounds, especially PAHs. The RA should describe how certain PAHs are known to cause cancer, both in fish as well as humans, and should also describe the wide complexity of structures associated with this class of organic compounds. The RA should review the differences in metabolism of PAHs between fish, crustacea, and molluscs, which has implications both for biological effects as well as transfer though the food chain.

The RA purports to, in Table 8.1, "provide a brief overview of documented effects of hydrocarbons on marine biota". The table, however, is inadequate for the task, leaving out many important effects, and thus initially minimizing the apparent risk of spilled hydrocarbons to the flora and fauna of the region. Further, while the RA states that the assessment was conducted by focusing on key components of the ecosystem and vulnerable species and life history stages, it does not include information on the process used for identification of these key components and species.

Request: a) Please update and expand Table 8.1 by providing information concerning a number of other effects which are known or likely to occur in the event of an oil or condensate spill. At a minimum the following information should be included:

i. For invertebrates, provide information from the peer-reviewed literature, because the citations listed here consist of a two page handout from the US Fish and Wildlife Service and a general textbook on ecotoxicology. Examples which should have been examined by the authors of this RA include Neff et al (1976),\textsuperscript{7} Barata et al (2005),\textsuperscript{8} Jensen and Carroll (2010),\textsuperscript{9} and many more.
ii. For fish, include information concerning the effects of very low levels of dissolved petrogenic polycyclic aromatic hydrocarbons (PAHs) on the developing fish heart, and include information on other routes of exposure that can cause injury, including direct contact, ingestion of oiled prey, and uptake across gills and integument.

iii. For marine mammals, provide information on studies showing that effects have been seen in cetacean populations for almost two decades following the EVOS.

iv. For terrestrial wildlife, please advise what studies have been conducted to determine whether the consumption of oiled prey as a significant route of exposure is of concern, and what such studies have concluded. If no such studies have been conducted, why not?

b) Please provide a narrative as well as a graphic description of the process used to identify key ecosystem components, vulnerable and sensitive species and life history stages, and explain how the reliance on evaluating risk to this limited group of indicators will provide a reliable risk assessment for the ecosystems that will be affected by the Project.

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Response: a) Table 8.1 provides a brief summary of the main effects of oil spills (particularly PAHs) on marine and terrestrial biota that have been documented in the literature. The reference to pages 8-1 to 8-3 and Table 8.1 of this information request refers only to this summary of available information. More detailed information on specific effects of oil and its constituents at a species-level are available in subsequent sections, namely:

- Application (Volume 8C, Section 8.6.2) for effects to invertebrates such as Dungeness crab and blue mussel;
- Application (Volume 8C, Section 8.7.2) for effects to fish including eulachon, Pacific herring, rockfish, and Pacific salmon;
- Application (Volume 8C, Section 8.8.2) for effects to birds
including marbled murrelet, surf scoter, bald eagle, and black oystercatcher;

- Application (Volume 8B, Section 8.9.2) for effects on marine mammals including toothed whales, baleen whales, pinnipeds, and mustelids; and
- Application (Volume 8C, Section 8.10.2) for effects to terrestrial mammals, including river otters, and grizzly and black bears.

Consumption of oiled prey is a significant route of exposure to hydrocarbons, particularly because some hydrocarbons, due to their physico-chemical properties, are persistent and bio-accumulative, and can be trophically transferred up the food web. For invertebrates, “Many invertebrates are filter feeders or scavengers, so they can be exposed to hydrocarbon contaminants through ingestion or uptake from the water column” (Application (Volume 8C, Section 8.6.2)) and for filter feeders like the mussel they filter “large volumes of water and can concentrate PAH and other lipophilic contaminants...” (Application (Volume 8C, Section 8.6.2.2)).

Specific reference in the Application to consumption of other contaminated prey include:

- Application (Volume 8C, Section 8.6.2) it states “Some invertebrates can survive exposure, but might accumulate elevated levels of contaminants in their bodies that can be passed on to predators”
- Application (Volume 8C, Section 8.6.2.2), it states “Because mussels are a prominent source of food for marine mammals, coastal birds, macro-invertebrates and fishes, contaminants can be transferred into important intertidal food chains (Peterson 2000)”
- Application (Volume 8C, Section 8.7.2.1), it states “The larval stage is generally the most vulnerable (Carls 1987), so a spill during spring would likely have the greatest effect on the overall population, through toxicity or ingestion of contaminated prey, and...”
- Application (Volume 8C, Section 8.7.2.2), the third paragraph discusses effects to herring following consumption of contaminated prey.
- Application (Volume 8C, Section 8.7.2.5), discusses hydrocarbons in commercial fish, and thus provides information on availability of hydrocarbons from fish prey to humans and other high trophic level species, such as marine mammals
- Application (Volume 8C, Section 8.8.2) the last paragraph is in regards to consumption of contaminated prey by birds, it states “Ingestion of contaminated prey from the intertidal zone can lead to mortality for raptors....”
• Application (Volume 8C, Section 8.8.2.3) states “ingestion of oil from contaminated prey and feather preening can lead to reproductive effects such as reduced hatchability of eggs and breeding success...” and further down “In addition, bald eagles have been observed to avoid oiled areas and might avoid eating contaminated prey if non-contaminated prey is available....”

• Application (Volume 8C, Section 8.8.2.4), states “The oystercatcher prey base is comprised almost exclusively of filter-feeding invertebrates (e.g., mussels) such that contaminant biomagnification would quickly occur in oystercatchers foraging in contaminated intertidal zones. Contaminated mussel beds could provide a chronic source of exposure”

• Application (Volume 8C, Section 8.8.5) discusses follow-up and monitoring for birds, specifically “assess effects of hydrocarbons on feeding habitat and prey....” and “determine contaminant levels (e.g., PAHs) in preferred prey species....” and “the follow-up program should continue until recovery of the populations has been documented and contaminant levels in prey and key habitats are reduced to baseline levels”

• Application (Volume 8C, Section 8.10.2), states “Species such as grizzly and black bear – including Kermode bear (Ursus americanus kermodei) – could ingest scavenged prey along contaminated shorelines; ingestion would, at most, lead to mortality for a limited number of individuals”

• Application (Volume 8C, Section 8.11), states “Environmental effects could occur through both short-term mechanisms (acute toxicity from ingestion of oil and oiled prey, oiling of animals, inhalation of vapour) and long-term mechanisms (chronic effects from loss of habitat or uptake of contaminants).”

b) As described in the methods section for the environmental and socio-economic assessment (“ESA”) (Application, Volume 8B, Section 4.2), Valued Environmental Components (“VECs”) are defined as components of the biophysical and human environments, which, if altered by the Project, may be of concern to regulators, participating Aboriginal groups, resource managers, scientists and the public.

The selection of VECs for biological disciplines is closely linked to (1) the identification of interactions between the Project and specific types of biota and (2) the types of effects that the Project may have on these biota as a result of these interactions. The VECs chosen for the assessment of project and cumulative effects on the biophysical environment typically represent major components or aspects of the biological environment (e.g., groups of related species, vegetation communities) that might be altered by the Project. Criteria used to select species biological component or species include:
• They represent a broad environmental or ecological component that may be affected by the Project;
• They may be vulnerable to the environmental effects of the Project, or to those effects and effects of other activities in the region;
• They have been identified as important issues or concerns by participating Aboriginal groups or public stakeholders, or in other effects assessments in the region;
• They were identified by responsible authorities or other Federal agencies.

Justification for the selection of each VEC is provided in the scoping sections of the environmental assessment (typically in the VEC-specific scoping section).

Other criteria that might be used in VEC selection include the availability of baseline information, the availability of information on how a project effect may change the VEC and the ability to measure that change. In relation to measuring effects, in assessing specific environmental effects for each VEC for the Project, one or more measurable parameters were selected for quantitative or qualitative measurement of potential project environmental effects and cumulative environmental effects. These parameters and the justification for use of these parameters are described in the assessment for the VEC.

The degree of change in these measurable parameters is used to characterize project-related and cumulative environmental effects, and evaluate the significance of the potential environmental effects. If available and applicable, thresholds or standards are identified for each measurable parameter to assist to the extent possible in determining the significance of a predicted environmental effect.

For some complex project assessments (e.g., where the study area has high ecosystem diversity or the project may result in a broad range of potential interactions with different components of the VEC), Key Indicators (“KIs”) for the VEC may be selected. This is often the case for the wildlife, vegetation and marine VECs. KIs for these VECs are typically species or species groups (e.g., caribou, amphibians, killer whale) and specific vegetation components (e.g., rare plants, old forest). The criteria for selection of KIs are similar to those described above for VECs but also include conservation status and local abundance and distribution. The assessment approach for KIs is consistent with the approach described above for VECs but with a last step that considers the effect on all KIs collectively in making a final significance determination for that VEC.
1.62 Exposure Through Air

Reference: i) Exhibit B3-39 Volume 8C - Application dated May 2010, Section 8.2, p. 8-5 (A1T0I9)

Preamble: The RA downplays the seriousness of exposure to volatile organic compounds (VOCs) after a release of diluted bitumen or condensate, with statements like the last paragraph in this section, which begins "Most VOCs have relatively low toxicity...". Contrary to this, the website of the company (DNV) contracted to conduct this risk assessment for Northern Gateway, contains a link to a concept for a new type of oil tanker (http://www.dnv.com/press_area/press_releases/2010/Amajorsteptowardsthenevironmentalerafortankershipping.asp) that they believe will cause "less harm to the environment" because it will "eliminate entirely the venting of cargo vapours (VOCs)". No quantitative information is provided on the VOCs that would be released as part of the ongoing operations of the proposed project, or on the levels and risks of VOCs that would be released in the event of spills of either the diluted bitumen or the condensate.

Request: a) Please provide information on the specific VOCs and their amounts that are projected to be released into the air masses of Upper Kitimat Arm in the course of normal operations of the project, and include information for both the condensate as well as the diluted bitumen.  

b) Please provide information on the specific VOCs and their amounts that are projected to be released into the air masses of Upper Kitimat Arm in the event of spills of either condensate or the diluted bitumen.  

c) Please provide recent toxicological information on the effects of prolonged inhalation of VOCs on the health of humans and air-breathing biota, as well as the effects of acute inhalation of very high levels of VOCs in humans and biota.

Response: a) During normal operations, VOC emissions will result from the marine vessel engine exhaust and from evaporative emissions associated with the storage tanks. Fugitive VOC emissions from marine vessels are assumed to be not significant owing to vapour recovery on-board some vessels and a vapour recovery unit (VRU) at the marine terminal.

The main VOCs of concern are Benzene, Toluene, Ethylbenzene, and Xylenes ("BTEX"). These emissions are detailed in the Atmospheric Environment Technical Data Report (Table 4-5). These tables are attached as Attachment Haisla Nation IR 1.62a).

b) Northern Gateway has detailed the operational measures to prevent hydrocarbon spills and incident prevention and emergency response procedures in the event of spill in the Application (Volume 7C).
Monitoring and mitigation procedures have been detailed in the Environmental Protection and Management Plan ("EPMP") to allow for a quick response to any accidental releases which will help minimize the effects. Since the probability of occurrence of such an event is low, the air quality emissions were not characterized.

c) See Northern Gateway’s response to Haisla Nation IR 1.62b) above.
1.63 Effects of Hydrocarbons on Plankton

Reference: i) Exhibit B3-39 Volume 8C - Application dated May 2010, Section 8.4, p. 8-6 to 8.7 (A1T0I9)

Preamble: The subsection on plankton says that on the one hand, plankton may be at high risk because of their inability to move away from spills, and their proximity to the water surface. On the other hand, the RA suggests that there is little information on the effects of oil or hydrocarbons on plankton. However, there is a considerable amount of recent information on the effects of petroleum on temperate and sub-Arctic plankton, especially on copepods and other zooplankton, which does not appear to have been considered during the RA. Further, in the event of a significant spill near the proposed terminal, the narrowness of the channel raises the probability that the entire channel would be affected, potentially cutting off recruitment of planktonic species from other areas for an unknown period of time.

Request: a) Was existing recent information on the effects of oil and hydrocarbons on plankton considered? If yes, please provide reference and synthesis of that information. If no, why not?

b) Was the specific case of a significant spill near the proposed terminal considered? If yes, please provide information about the impacts of such a spill. If no, why not?

Response: a) Existing information on the potential effects of hydrocarbons on plankton were considered in the Application (Volume 8C, Section 8.4.1). References for this discussion are provided in the Application (Volume 8C, Section 13). Additional literature is summarized below.

Laboratory and mesocosm studies have documented a number of lethal and sublethal effects of oil spill hydrocarbons on species of phytoplankton and zooplankton. Recent review literature includes AMAP (2008). However, it appears that these reported effects are of limited relevance to natural populations; possibly because they are too transitory or effect a very small proportion of the natural populations or because those studies have not adequately simulated natural environmental and oil concentration conditions.

Post-spill studies on plankton have consistently found no, or very transitory, effects. Notable examples in the last two decades include Exxon Valdez (see below), Sea Empress (Batten et al 1998) and Prestige (Varela et al 2006).

Plankton was studied in great detail in Prince William Sound following
the EVOS. Zooplankton is the main food source of juvenile pink salmon and assessing the effect of the oil spill on zooplankton biomass provides a straightforward approach to ascertaining potential effects of the spill on the food.

Data on zooplankton have been collected by the Prince William Sound Aquaculture Corporation ("PWSAC") since the late 1970s for use in synchronizing hatchery fry releases in the Sound with the plankton bloom (Cooney et al., 1981) and provides a relative index for year-to-year comparisons. The sites monitored are Port Ashton and Elrington Passage, both within the oil spill impact area. Large calanoid copepods, dominated by Pseudocalanus spp. and Calanus spp., are the primary prey of young salmon, and crucial to marine productivity. Data from monitoring sites, representing the top 20 m of the water column, indicate that zooplankton biomass in 1989 was among the highest recorded in western Prince William Sound (two times the previous eight year mean), and ostensibly was responsible for exceptional growth among juvenile salmon for that year. These data also correspond with the data on plankton biomass gathered by Celewycz and Wertheimer (1996), showing no differences between oiled and non-oiled areas in any of the eight sample sites except for greater abundance of some species in oiled areas.

The distribution and density of epibenthic harpacticoid copepods was also monitored in heavily and lightly oiled bays by Wertheimer et al. (1996). They found that copepod mean densities on heavily oiled shorelines were higher than on lightly oiled shorelines. Moreover, the percentage of egg-bearing copepods were similar in the oiled and non-oiled sample sites. Wertheimer et al. (1996) concluded that copepod abundance appeared to increase from higher nutrients in the oiled areas.

Thus there is no field evidence that either the zooplankton biomass and in turn the phytoplankton biomass were negatively affected in 1989 following the EVOS.

b) Ecological risk assessment studies for marine oil spills are described in a Technical Data Report (Stantec 2010). The toxicological model used for quantitative assessments of aquatic biota exposed to hydrocarbons in the water column and in sediments is the Target Lipid Model ("TLM") of DiToro and co-workers (2000a, 2000b). The TLM, which focuses on the non-polar narcosis mechanism of hydrocarbon toxicity, has a broad and well validated range of application to a large suite of aquatic receptor classes, life stages and environmental media (water and sediment), and in addition is best able to address hydrocarbon mixture toxicity (as opposed to focusing on responses to single chemicals). Therefore, the assessment addresses "fish" as defined under the
Fisheries Act. The generic receptor in the TLM represents a sensitive (5’th percentile) species on a species sensitivity distribution that represents 33 species, including fish, amphibians, arthropods, mollusks, polychaetes, coelenterates, and protozoans. Effects on plankton are included within the assessment for aquatic biota exposed to hydrocarbons in the water column.

The modeled spill scenarios included two small spills (a 250 m$^3$ spill of condensate and a 250 m$^3$ spill of diluted bitumen near the Kitimat Terminal, and a 36,000 m$^3$ spill of diluted bitumen in Wright Sound. See the Technical Data Report (Stantec 2010) for full details regarding effects of the accidental spill scenario assessments. However, it was concluded that localized acute effects on the water column community (including plankton) might be seen for a condensate spill, due to the relatively high solubility of many of the individual chemical constituents of condensate. The risks of effects on the water column community due to spills of diluted bitumen were found to be much lower, due in part to the lower aqueous solubility of many of the constituents of the diluted bitumen.

References:


Stantec. 2010. Technical Data Report. Ecological and Human Health Risk Assessment of Accidental Spills at the Kitimat Terminal and in the Confined Channel Assessment Area. Enbridge Northern Gateway
1.64 Effects of Hydrocarbons on Marine Vegetation

Reference:  i) Exhibit B3-39 Volume 8C - Application dated May 2010, Section 8.5, pp. 8-7 to 8.12 (A1T0I9)

Preamble: This section purports to be about marine vegetation, but also includes discussion of benthic and infaunal communities associated with, for example, eelgrass habitat. Information should be provided showing that disturbances of these communities have persisted much longer than the 6 years described in the RA. Sites in Buzzards Bay, Massachusetts oiled over 40 years ago, still show impacts to infaunal organisms in low energy, soft substrate, sheltered habitats.\(^1\)


Request:  a) Were the long term effects of an oil spill in sheltered habitats such as Minette Bay and the Kitimat River estuary considered in light of the available literature, especially recent studies in Buzzards Bay, Massachusetts? If no, why not?

Response:  a) Experiences from the Buzzards Bay spill and other spills around the world were used in developing the overall RA.

The Buzzards Bay, Massachusetts area is relatively atypical of the marine habitats encountered in the project area. The barge Florida ran ashore there in 1969 and oil washed ashore in several net depositional, marsh areas of the bay. Researchers at the Woods Hole Oceanographic Institute have continued to study the area (Teal, et al 1992) While it is still possible to find deposits of oil about 15 inches below the surface in these muddy marsh areas, a fully functional salt marsh has reestablished on the surface and the small remnant oil lens remains undisturbed well below the surface sediments.

There are relatively few of these muddy salt marsh areas in the Confined Channel Assessment Area (“CCAA”) and the planned oil spill response measures would include exclusion booming to prevent oil from entering these salt marsh habitats. These and other environmentally sensitive habitats would be identified during the preparation of Geographic Response Plans (“GRP”).

GRP will be developed for specific sensitive areas of the CCAA and shoreline areas of the Open Water Area. As part of the spill response planning, government agencies, coastal Aboriginal communities and directly affected public stakeholders will be engaged in determining local sensitivities that are candidate sites for GRPs. These plans will
identify and describe environmentally-sensitive areas, including harvesting areas and cultural sites, as well as priorities for emergency response measures. The plans would be completed at least 6 months prior to the commencement of operations.

Reference:

1.65 Effects of Hydrocarbons on Marine Invertebrates

Reference:  
i) Exhibit B3-39 Volume 8C - Application dated May 2010, Section 8.6.2, pp. 8-18 to 8-19 (A1T019)

Preamble:  
Here, the RA uses a general textbook and a 2-page handout from the US Fish and Wildlife Service to make broad statements about a range of biological effects of oil on invertebrates. This section also states that subtidal invertebrates "are not expected to be vulnerable to direct effects of oiling". This section also notes that oil from the EVOS remained "at least" until 1996 in the sediments below and among the mats of mussel byssus, cobbles, and fine sediments. This section also states that "it is unlikely that condensate will reach the shoreline."

It is the responsibility of the project proponents to provide a systematic assessment of possible effects, especially in the region of concern, in order to determine if, and how, effects of spills can be mitigated.

Request:  
a) Was a more thorough literature review conducted and considered than is suggested in the RA? If not, why not? Has the possibility that diluted bitumen might sink, especially if it is mixed with sand or mud after reaching the shoreline, and then leaves the shoreline and sinks on an outgoing tide, been considered? If yes, please provide information on the effects from diluted bitumen that sinks. If no, what are the reasons for not making such a consideration?

b) Have recently published accounts of EVOS oil remaining in mussel beds, along with recent estimates that it will take 3 decades for oil in these strata to decline to background, or pre-spill, levels\textsuperscript{11} been considered in the RA? If yes, please provide information on the effects of oil persisting in mussel beds. If no, what are the reasons for not making such a consideration?

Response:  
a) As described in the Application (Volume 8C, Section 8.1), “[t]he assessment addresses effects on the marine ecosystem by selecting and evaluating key components to characterize potential effects, highlight potentially vulnerable species (e.g., key life stages like breeding, feeding, spawning or migratory corridors) and identify sensitive habitat. Air, water and sediment, plankton, vegetation, invertebrates, fish, terrestrial mammals, marine birds and marine mammals are discussed. For some components, representative species are selected to represent responses of groups of organisms or species of conservation concern.”

The assessment includes a discussion of the effects of hydrocarbon spills based on literature for past spills, mitigation specific to each component and recommended follow-up studies to document recovery.”

The assessment of potential effects of hydrocarbons on marine invertebrates includes reference to specific literature on potential effects on Dungeness crab (Application (Volume 8C, Section 8.6.2.1)) and blue mussel (Application (Volume 8C, Section 8.6.2.2)). These two species are considered representative of invertebrate organisms that inhabit the types of habitat that would most likely be affected by exposure to hydrocarbons.

In addition, the risk assessment (Application (Volume 8C, Section 11)) characterizes the nature and magnitude of health risks to ecological receptors from hydrocarbons. The potential environmental effects on marine water quality and subtidal sediment quality, including its potential effects on phytoplankton, zooplankton, marine plants, benthic invertebrates, and fish, are addressed in Application (Volume 8C, Section 11.2.4.2).

Petroleum hydrocarbons from marine oil spills can interact with suspended solids and particulates in the water column. They have been shown to be readily absorbed to these particulates and form a floc within the water column. (Dickson et al. 1984). This sorbed complex is then subject to biodegradation leading to the ultimate loss of these hydrocarbons from the environment. During extensive sampling of the subtidal sediments within Prince William Sound during 1989-1991, Page et al. (1995) analyzed 1936 sediment samples by gas chromatography–mass spectrometry (“GCMS”) fingerprinting. Results show that most of the seafloor in PWS contains no detectable hydrocarbons from the EVOS, although elevated concentrations of PAH from seep sources were widespread. In those areas where they were detected, spill hydrocarbons were generally a small increment to the natural petroleum hydrocarbon background. Low levels of EVOS crude were present in 1989 and again in 1990 in nearshore subtidal sediments off some shorelines that had been heavily oiled. By 1991 these crude residues were heavily degraded and sporadically distributed.

References:


William Sound and the Gulf of Alaska following the EVO in Exxon Valdez Oil Spill, Fate and Effects in Alaskan waters, ASTM STP 1219, Philad.

b) The answer to this query is one of context. While it is possible to locate a few small isolated subsurface areas within Prince William Sound where oil deposits from the EVOS still remain after 22 years, these amount to very small and localized areas of substrate among the over 3,300 miles of shoreline within the spill area. Extensive sampling of the intertidal shoreline sediments and biota were made during the 1989, 1990, and 19991 field season (Gilfillan et al. 1995). Species richness, density and diversity were measured as was the PAH content and composition of the sediments. Overall, the results of this study indicate that between 73% and 91% of the oiled shorelines in PWS were ecologically recovered, (i.e., indistinguishable from unoiled reference areas) in the summer of 1990. These results reflect rapid recovery of the biological communities and are consistent with chemical and toxicological studies which found that hydrocarbon related toxicity was virtually absent in the shoreline sediments by 1991 (Stubblefield et al. 1995).

References:


1.66 Effects of Condensate on Marine Invertebrates

Reference: i) Exhibit B3-39 Volume 8C - Application dated May 2010, Section 8.6.3, pp. 8-18 to 8-19 (A1T0I9)

Preamble: The RA states that it is unlikely a spill of condensate would reach the shoreline, but acknowledges that condensate would rapidly become entrained in the water column. Given the narrowness of Kitimat Arm, in the event of a major spill of condensate near the terminal, condensate could reach the shoreline.

Request:  

a) Has the possibility of condensate reaching the shoreline been considered. If no, why not?

b) Has the effect of condensate that reaches the shoreline been considered? If no, why not?

c) Has the possibility that a great deal of any spilled condensate will rapidly entrain into the water column, where it cannot be contained or cleaned up, been considered? If no, why not?

d) Has the long term effect of condensate entrained in the water column been considered? If no, why not?

Response:  

a) Yes. Please see Northern Gateway’s response to Gitxaala Nation IR 1.12.1.5.

b) Yes. The effects of hydrocarbons, including those of condensate, on the biophysical environment along the marine transportation routes are described in the Application (Volume 8C, Section 8). The effects of hydrocarbons, including condensate on the Human Environment are described in the Application (Volume 8C, Section 9). Please refer, within the aforementioned Sections of the Application, to the specific measures Northern Gateway proposes to put in place to mitigate these effects.

c) Yes. The mass balance scenario provided in Section 4.2.1.1 of the Hay & Co. Technical Data Report, describes the persistence of condensate following a 250 m³ spill at the Kitimat Terminal, in Kitimat Arm.

Reference:

d) Yes. Typically a condensate spill would be subject to rapid evaporation and dispersal. In the event of a large condensate spill, the in-water condensate concentrations near the spill source would be high and may be of concern to near fisheries in the short term. Please refer to the Application (Volume 8C, Section 12) for the summary and conclusions of the risk assessment related to hydrocarbons in the marine environment.

Also see Northern Gateway’s response to Federal Government IR 116.
1.67 Effects of Hydrocarbons on Fish, Fish Habitat and Marine Fisheries Management

Reference: i) Exhibit B3-39 Volume 8C - Application dated May 2010, Section 8.7, pp. 8-21 to 8-38 and Table 8.3 (A1T019)

Preamble: Here the RA states that egg and larval stages are generally the most vulnerable because they inhabit the upper water column and cannot swim away. This is a gross oversimplification of the diverse life history strategies of fishes. Some fish have adhesive eggs, deposited either along the shoreline, or sometimes at depth. Some fish larvae stay at depth, while others stay near the surface. Eulachon are of very high importance for the Haisla Nation, but are absent from Table 8.3 in the OWA and CCAA. The RA states that only a few species of flatfish, such as English sole, are found at moderate to shallow depths. It is noted that while eulachon spawn in rivers, the larvae immediately move to nearshore marine and estuarine habitats, where they rear and feed for several weeks, and it is also noted here that there is a distinct non-migratory population of Pacific herring in upper Kitimat Arm, that does not appear to mix with other populations.

In discussing the potential effects of spilled bitumen or condensate on fish, fish habitat, and fisheries, this section omits a growing body of work showing that low levels of petrogenic PAHs cause severe defects in fish larvae, by targeting the developing heart.\(^{12}\) We now know that very low concentrations (low parts per billion) of low molecular weight PAHs dissolved in water cause cardiac arrhythmia, heart malformations, and loss of vascular circulation in fish embryos, and these effects lead to the suite of larval deformations seen in fish exposed to oil or oil-derived compounds. These same compounds are associated with bitumen derived from the Alberta oil sands,\(^{13}\) and are suspected of impacting human health in people living downstream of the Alberta oil sands development activities.

This section also states that the Kitimat River has a low probability of being affected by any spills of bitumen or condensate.

Regarding rockfish, this section states that only small number of adults in a spill area might die, then goes on to state that "rockfish was the only fish found dead in large numbers following the EVOS".

In the subsection concerning commercial fisheries, tainting is defined as the presence of abnormal odour or flavor, and the statement is made that wild fish are rarely tainted, and if so, for only a short period of time (one to two months).


Request:

a) Please identify all the potential exposure pathways for spilled oil or condensate to affect fish and other species, and provide a complete description of these pathways for exposure and injury.

b) Please provide information concerning eulachon in Table 8.3, including their spawning habitats.

c) Has information that many flatfish species, especially young and juveniles, live in shallower waters been considered, and if so, how? If such information has not been considered, why not?

d) Has information showing that pelagic fish species can show evidence of exposure to oil at sites located several hundred miles away from a spill been considered, and if so, how? If such information has not been considered, why not?

e) Has the information on nearshore habitat use by larval eulachon been used to consider the potential severe impacts of spilled oil or condensate on this species, if any spills were to occur while these larvae inhabit nearshore habitats? If this analysis has not been done, why not?

f) Has the susceptibility of the distinct population of herring in Kitimat Arm been considered, especially in the event of a significant spill in the area of the proposed marine terminal, and if so, how? If such information has not been considered, why not?

g) Has the intertidal spawning strategy of herring been considered as a risk factor for this species in the event of oil or condensate spills and if so, how? If such information has not been considered, why not?

h) Has information been collected and incorporated concerning the mortalities of pink salmon eggs and larvae following the EVOS, and if so, how was it used in the RA? If not, why not?

i) Please provide more information on species, timing, and locations of
j) Has recent scientific literature concerning the cardiotoxic nature of petrogenic hydrocarbons to larval fish been reviewed and used in this RA? If such information has not been considered, why not?

k) Have the cardiotoxic effects of petrogenic hydrocarbons on fish that spawn in freshwater, such as salmon and eulachon been considered, and if so, how? If such information has not been considered, why not?

l) Have the strong up-channel winds that are common in Kitimat Arm been considered as a factor that could push spilled bitumen or condensate into the lower Kitimat River? If no, why not?

m) How have the impacts of the EVOS on herring been considered in assessing risks to Pacific herring from the proposed Project? Most notably, it is generally agreed that there has been a large and long-lasting impact to Pacific herring in Prince William Sound following the EVOS, such that a once thriving and highly valuable commercial fishery has been virtually shut down for over two decades.

n) How has the high mortality of rockfish following the EVOS been considered in assessing risk to this species assemblage? If such information has not been considered, why not?

o) Please provide information describing how fish harvested from an oiled area are considered by some agencies, such as the US Food and Drug Administration, to be adulterated, even in the absence of tainting.

p) Please provide information on the extent of and costs associated with the testing that is required before allowing areas to be opened for harvest following an oil spill.

q) Have the potential economic and social impacts of long-term closures and onerous testing requirements been considered? If not, why not? Please review and consider information from a study showing that caged salmon were shown to be tainted for seven months following the T/V Braer spill. Please explain whether this study supports a conclusion that that wild fish could be tainted for a significantly longer period of time than one to two months.

r) Please provide a review and synthesis of the scientific peer-reviewed literature concerning the potential effects of condensate and condensate constituents on fish and their habitats, that goes beyond the non-peer reviewed book published more than a decade ago which appears to
have been largely relied on in the RA (Patin, 1999).

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**Response:**

a) Potential exposure pathways for hydrocarbons to affect marine fish and a discussion of effects of hydrocarbons on marine fish are discussed in the Application (Volume 8C, Section 8.7.2 and 8.7.3). In addition, the risk assessment (Section 11) characterizes the nature and magnitude of health risks to ecological receptors from hydrocarbons. The potential environmental effects on marine water quality and subtidal sediment quality, including its potential effects on phytoplankton, zooplankton, marine plants, benthic invertebrates, and fish, are addressed in Section 11.2.4.2.

b) Information on the distribution and spawning habitats of eulachon is provided in the Application (Volume 6B, Section 10.5.1). As discussed in the application, “Spawning locations vary from year to year, but various locations in the Kitimat area are known to be eulachon runs. The Kildala River, the Kitimat River and possibly other small channels off Gardner Canal (e.g., Kemano, Kowesas and Kitlope Rivers) support consistent eulachon spawning (Hay and McCarter 2000). Gilttoyees Inlet and Foch Lagoon are also used occasionally (Hay and McCarter 2000). Adult eulachon have been confirmed in Bish Creek, indicating occasional spawning activity in the area (British Columbia Forest Service 1998). Adults likely spend most of their at-sea life in Hecate Strait and Queen Charlotte Sound (British Columbia Forest Service 1998; Hay and McCarter 2000).”

c) Flatfish (e.g., sole, flounder, halibut) were identified as fish species that inhabit the CCAA (Application (Volume 8C, Section 8.7)). For the assessment of effects of hydrocarbons on the biophysical environment, four fish species were used to assess the effects of hydrocarbons on fish and fish habitat. As discussed, “Given the wide range of fish species in the OWA, and their diverse habitat requirements, species representative of a range of habitat uses, differing vulnerabilities and different socio-economic as well as ecological importance are discussed.” Flatfish were not chosen for this assessment because rockfish were selected as a species representative of the demersal fish assemblage. Although rockfish mortalities were reported following the EVOS, no pathway for oil exposure was confirmed and no forensic data links the dead rockfish to oil exposure. Mortalities were likely due to sport fishing hooking mortality from crews aboard spill response vessels. Both rockfish and flatfish occupy benthic habitats and have pelagic larvae. As a result, exposure pathways for flatfish will be similar to those of demersal rockfish.
The exposure and possible adverse effects of the EVOS at depth were studied between 1989 and 1991 on several species of crustaceans, molluscs and finfish that are characterized by benthic or demersal juveniles and adults. These included tanner crabs, several species of pandalid shrimp, flathead sole and several species of bivalve molluscs and scallops. Virtually no evidence of significant adverse effects was detected at either the individual or population levels across all the life history stages sampled, for these species.

In contrast to lack of adverse effects caused by the EVOS on these study species, substantial declines in fishery landings of several crabs and shrimp species had occurred prior to the EVOS. Long-term trends in abundance of populations of these species due to natural environmental causes or fishing pressures are likely to be far more important than any effects from the EVOS. (Armstrong et al. (1995) Status of selected bottomfish and crustacean species in Prince William Sound following the Exxon Valdez spill. In: Exxon Valdez Oil Spill: Fate and Effects in Alaskan Waters ASTM STP 1219. Philad.)

As with many marine fish species, the habitat requirements of flatfish include shallow nearshore areas. This was considered in the identification of marine receptors for the Ecological Risk Assessment (Application (Volume 8C, Section 11, Section 11.2 and Section 11.2.4)). Identified marine receptors include: marine water quality, subtidal sediment quality, and intertidal sediment quality. These receptors are habitats used by flatfish.

d) There are several factors to be considered when addressing the question of whether contaminants related to a spill have an effect on pelagic fish hundreds of kilometers away:

- The concentrations of contaminants (e.g., PAH) in water or sediment following a spill would be very small, spread over a large area
- While biomarkers (e.g., PAH compounds or induction of cytochrome P450 enzyme system) related to hydrocarbons may be detected in fish tissue, they indicate exposure but do not necessarily indicate a biological effect (i.e., chronic or acute toxicity) at an individual or population level.
- For species that range over large distances, it can be challenging to link the observed PAHs with a specific hydrocarbon source (i.e., there can be a variety of hydrocarbon sources unrelated to a released oil).

e) Baseline information on habitat use by eulachon (including larval
Northern Gateway has committed to the development and implementation of a Marine Environmental Effects Monitoring Program (“EEMP”) for the marine terminal and marine transportation (see Federal Government IR 79). As appropriate, information on eulachon and other fish species will be included in the EEMP.

Application (Volume 8C, Section 5) outlines the proposed responses designed to mitigate effects to sensitive nearshore habitat, but more detailed oil spill contingency plans will be developed if the Project is approved.

f) Potential effects of a hydrocarbon release at the Kitimat Terminal on Pacific herring are assessed in the Application (Volume 7C, Section 7.7). In this section the distinct population of herring in Kitimat Arm was specifically addressed: “A small resident population of Pacific herring, distinct from the larger, migratory stocks of Hecate Strait and coastal British Columbia, resides in the upper reaches of Kitimat Arm.”

An Ecological Risk Assessment for a hypothetical hydrocarbon release at the Kitimat Terminal was also conducted (Application (Volume 7C, Section 10, Section 10.2 and Section 10.2.4)). This assessment includes a consideration of potential effects to marine fish.

It should be noted that the ‘distinctiveness’ of the herring population in Kitimat Arm has not been characterized. In general, Pacific herring populations that spawn at the heads of major coastal inlets (e.g., Kitimat Arm) are less migratory than those spawning on the outer coast (DFO 2011). Herring do not show good fidelity to specific spawning areas and they have been known to move locations from year to year for no apparent reason. However, the migratory behavior of herring is complex and poorly understood (Hay et al. 2001, Hay and McKinnell 2002, DFO 2011). While it is possible that the Kitimat Arm herring population is strictly resident, it is more likely that some degree of connectivity is maintained with larger populations in Douglas Channel, Wright Sound, and the Central Coast via migration and/or larval dispersal.

g) The intertidal spawning strategy of Pacific herring has been considered in the assessment of potential effects of hydrocarbons on marine fish. As described in the application, “Herring generally spawn over a four-day period, typically in late March (Hay et al. 1989; Triton 1993). They
can spawn on a range of intertidal and subtidal vegetation, including rockweed, at depths between the high tide mark and -11 m (chart datum)" (Application (Volume 8C, Section 8.7.1.4)). Section 8.7.2.2 discusses effects of oil on Pacific herring and states that herring eggs are vulnerable to effects from an oil spill due to their presence in nearshore and shallow areas.

Please also see Northern Gateway’s response to Haisla Nation IR 1.67m

h) In the years after EVOS, returns of wild pink salmon ranged from about 2 million (1992) to almost 13 million (1990), leading Trustees (2002) to conclude that because of the tremendous natural variation in adult returns, the extent to which wild salmon returns were affected by the oil spill could not be measured directly. Maki et al. (1995) noted the high levels of pink salmon returns in PWS in 1990 and concluded there were no population-level effects from EVOS. Brannon et al. (1995) examined water and sediment concentrations for PAHs in 1989, and through regression concluded that there would have been no substantial toxicological effects on the critical early life stages of pink salmon in PWS attributable to the spill.

This was confirmed by chemical analysis of pink salmon embryo tissue sampled from oiled streams. In 1990 and 1991, embryos showed mean tissue-PAH concentrations that were at least 80 times lower than tissue concentrations reported toxic to pink salmon embryos (Brannon et al. 2001).

These data and the sediment-PAH concentrations measured in oiled streams indicate that toxic levels of petroleum hydrocarbons were not present in the incubation environment (Brannon et al. 2001). Geiger et al. (1996) derived modeled estimates that about 2 million fewer wild pink salmon returned to PWS in 1990 because of EVOS, even though they also reported that 1990 was a record catch year for pink salmon (with a catch of over 44 million fish, and the 1991 catch the second largest at over 37 million; Paine et al. 1996). Trustees (2002) estimated that returns in the Southwest District of the Sound may have been reduced by 11%, and Willette (1996) derived a model-based estimate of about 2% reduction in survival to the adult stage among pink salmon from hatcheries that were reared in oiled areas.

The Geiger model treated the egg mortality reported by Bue et al. (1996) as being oil-related to arrive at the estimated loss in returning adults. However, Brannon et al. (2001) concluded from reanalysis of the egg mortality data and field tests of the sampling protocol (Collins et al. 2000) that the egg mortality was not from oil, but from the effect of
samping the eggs too soon after spawning during the period of extreme embryo sensitivity to shock. The Alaska Department of Game and Fish also reanalyzed their egg mortality data and concluded that because of sampling problems, oil effects on eggs could not be determined (Craig et al. 2002). Both Maki et al. (1995) and Templin et al. (1996) noted that in 1990 and 1991, there was no obvious reduction in the numbers of returning salmon per spawner in the Southwestern District.

While egg mortality may have been reduced in unoiled versus oiled streams through 1993, reduced growth rates of juveniles in oiled areas occurred only in 1989 (Wertheimer and Celewycz 1996), and PAH concentrations were below 1 \( \text{ng l}^{-1} \) in initially oiled streams (i.e., well below any significant effects level). Moreover, Wertheimer and Celewycz (1996) attributed the higher abundance of juvenile pink salmon in unoiled areas compared to oiled areas in 1989 and 1990 to avoidance or habitat differences, rather than toxicity from the oil. They concluded from their study of zooplankton and epibenthic crustaceans in western PWS that the EVOS did not reduce the availability of the prey resources of juvenile salmon, indicating the absence of an EVOS-caused food chain effect.

Rice et al. (2002) argued that differences between published estimates of initial population loses of pink salmon effects were driven by differing experimental methods or interpretations between research groups, or by evaluation of differing sets of salmon streams, especially mixing oiled and unoiled streams; but the more relevant point is that even accepting the largest estimate of potential population reduction (2 million fewer returning adults) in the context of the natural inter-annual variability and occurring in what was a record-crop year, quite undermines the conclusion of ecologically significant population-level effects in the immediate years after the oil spill. In any event, Trustees (2002) concluded there are no continuing population effects from EVOS on pink salmon in PWS, and declared the population to be completely recovered.

**References:**


i) Potential effects of hydrocarbons on FSC fisheries are assessed in the Application (Volume 7C, Section 7.7.2 and Volume 8C, Section 8.7.2).

When the Application was filed, Traditional Land Use Studies (“TLUS”) containing information on Food, Social and Ceremonial (“FSC”) fisheries had not been completed. Therefore, the information used to assess potential effects of the Project on FSC fisheries was derived primarily from secondary sources (e.g., literature, websites, DFO statistical data). These sources, and the information gathered from them, are discussed in the Marine Fisheries Technical Data Report (Watson and Vaughan 2010, Marine Fisheries Technical Data Report, Section 4: Results of Baseline Investigations for Food, Social, and Ceremonial Fisheries). In addition to the information gathered on FSC fisheries, the baseline work conducted contributed to the identification and location of species that could be targeted by FSC fishers. The aggregate information collected and compiled from these sources is considered adequate and defensible for assessing potential effects of the Project on FSC fisheries.

Additional information on species, timing, and locations of FSC fisheries was not incorporated in the ESA and RA because it was not available. Northern Gateway has offered to engage with coastal Aboriginal groups and will continue with its efforts to engage and work with these groups. To date, engagement has varied depending on the level of interest and the preference of each individual community. In the coastal region, the Gitxaala Nation, has completed a comprehensive TLUS (Calliou Group, 2011), as has the Kitselas First Nation. Some communities have declined to participate; some have been interested in simply receiving information from Northern Gateway about the Project, while others have engaged in a more comprehensive way and talked about a variety of issues, including environmental study methodologies, shipping, and emergency response issues.

Northern Gateway continues to engage with participating Aboriginal groups and has offered to fund and/or assist in the completion of
TLUSs. These studies can provide valuable information on FSC fisheries. Northern Gateway would like to continue to work cooperatively with Aboriginal groups to identify means to minimize and/or avoid potential effects of the Project on FSC fisheries. This could include:

1) the establishment of a Fisheries Liaison Committee ("FLC") to minimize conflicts between Northern Gateway-associated vessels and FSC fisheries;
2) further refinement of environmental sensitivity atlases, using site-specific information on FSC fisheries (i.e. respecting fishing rights related to sacred and ceremonial locations; and,
3) the development of geographic response plans as part of a broader oil spill response plan, using site-specific information on FSC fisheries.

Northern Gateway has committed to participation in the development and establishment of a FLC, including Aboriginal groups, and recognizes the importance of FSC fisheries to Aboriginal groups. The framework for a FLC would have participating members contribute in good faith to discuss construction and operational schedules, identify sensitivities and concerns, and to seek mutually agreeable solutions to minimize and/or avoid conflicts and optimize communication among participants. It should be noted that there are no other industrial or vessel fleet operators on the North Central Coast that have proposed the concept of a FLC as a means of managing and addressing potential effects on fisheries.

j) The RA has integrated essentially all real and potential toxic effects of petrogenic hydrocarbons into the analyses. The ultimately important toxicity endpoints are survival, growth and reproduction of freshwater and marine fish since these three endpoints integrate all sublethal and developmental effects into the analysis. The question refers to the incidence of cardiotoxic effects seen in some laboratory exposures. This effect is a swelling of the pericardium (aka. ascites) seen in some individual laboratory exposures of fish to petroleum hydrocarbons (Incardonna et al. 2006). To date this effect has been mainly a laboratory artifact and has not been reported in the field following oil spill exposures. Many other conditions such as low oxygen concentration can also cause this effect and while it is generally fatal in the laboratory it's real world field significance remains uncertain. However, as the herring and pink salmon field studies following the EVOS have shown, neither direct fish mortality nor chronic effects from hydrocarbon exposure following an oil spill do not seem to be a major concern.
k) Please refer to Northern Gateway’s response to Haisla Nation IR 1.67j).

l) Yes. Wind is a smaller component of surface oil transport than the surface current and is not considered to be a significant factor to move oil upstream against the outflow from the Kitimat River.

m) An assessment of the potential effects of oil spills on Pacific herring is presented in Application (Volume 8C, Section 8.7.2.2). As stated in Application (Volume 8C, Section 8.1.1), the assessment focuses on the Confined Channel Assessment Area and the Open Water Area [which includes FMA 6] and areas where hydrocarbons could travel in the case of an oil spill. Application Volume 8C, Section 10 provides examples developed to understand the potential fate of hydrocarbons at various times of year and assist in response planning.

There has been much debate on the effects of the EVOS on Pacific herring, stemming from the notable collapse of the fishery stocks in 1993, four years after the spill, and their continued lack of recovery. However, while the timing suggests a causal link and effects on samples of eggs and juveniles were documented, many other environmental factors have been implicated, and ‘population level effects of the spill were never clearly established’ (EVOS Trustee Council 2010).

Eggs and juveniles of fish species that use very shallow spawning and nursery areas are very vulnerable and sensitive to dispersed oil from spills (National Academy of Sciences 1985); and that Pacific herring are such a species. It was therefore not surprising when egg mortalities, larval deformities and other sublethal effects on juvenile Pacific herring were documented from some oiled sites following the Exxon Valdez spill (McGurk 1990, Pearson et al. 1995, Hose et al. 1996). However, the extent to which the spill resulted in notable exposure of toxic oil to the herring eggs and larvae in Prince William Sound is not agreed. The
reproductive strategy of pacific herring involves the production of very large numbers of eggs (high fecundity) that allows for very high natural mortality. Spawning and nursery areas are also spread over a relatively large geographic area, which reduces the effects of site specific impacts. The large annual fluctuations in the strength of the herrings year classes is influenced by wide scale environmental factors during spawning and early development, so a spill would need to have a similar wide scale influence to cause a notable effect.

The proportion of 1989 herring spawn potentially affected by the Exxon Valdez oil were estimated as ~4% by Pearson et al. (1995) and more than 40% by Brown et al. (1996). Both estimates used similar data on shoreline receiving spawn in 1989, but the former was based on the overlap with physically oiled shoreline, while the latter was based on the overlap with the full extent of the oiled trajectory (including areas affected by elevated oil concentrations in the water). Critics of the former suggest that it underestimated the potential effects of dispersed oil on fish eggs and larvae, which have been documented in the laboratory (Kocan et al. 1996). Critics of the latter suggest that it overestimated those effects and point to studies that suggest significant effects are likely only in the presence of high concentrations (Pearson et al. 1995). Sampling of newly hatched larvae in oiled and unoiled areas suggested lower densities in oiled areas, but those data were confounded by many other site related environmental factors (Brown et al. 1996).

Other evidence that suggests the oil was not a major factor in the failure of the herring stock includes the presence of a widespread disease in herring in 1993, record high population levels of Prince William Sound herring in 1990 to 1992, the lack of change from the expected age-class distribution, and the lack of a workable mechanism to link the spill to the continued failure of the subsequent year classes (Pearson et al 1999).

Whether or not the spill had any notable effect on the herring stocks, it is now generally accepted by industry and government scientists that the 1993 collapse was likely caused by suboptimal nutrition, disease and high population size (Pearson et al 1999, Carls et al 2002).

Shallow spawning and nursery areas of herring and other species are sensitive and vulnerable to dispersed oil from spills, but the likelihood of population levels effects from such a situation appears to be small and no such effects have yet been documented from any marine spill worldwide (National Academy of Sciences 1985, AMAP 2008). To have a notable population level effect would require severe contamination of a high proportion of the spawning and nursery areas. Three of the five major spawning areas for Central Coast herring stocks in British Columbia are within the boundaries of the OWA (Clarke and
Jamieson 2006), but the spawning beds are widely distributed and even a very large spill would be very unlikely to affect a large proportion of those areas.

**References:**


n) An assessment of the potential effects of oil spills on rockfish species is presented in Application (Volume 8C, Section 8.7.2.3). Reports of rockfish mortality following EVOS are described and considered in the assessment. It is important to note that no meaningful pathway for exposure of rockfish to residual EVOS hydrocarbons has been demonstrated and reports of rockfish mortalities due to the spill have been highly suspect. It is likely that the reported mortalities were the result of mortality from the increased sport fishing done by boat-based spill response personnel during time-off periods (A.W. Maki, personnel observation). In the event of an oil spill, some individual rockfish in the immediate local of a spill may suffer acute effects, but it is not expected that there will be any long-term effects on rockfish populations in the region.

o) Yender et al (2002) distinguish between “adulteration” and “tainting.” According to the FDA, adulteration occurs if a food source contains any poisonous or deleterious substance that may render it injurious to health, if it contains filthy, putrid or decomposed substances, or if it is otherwise unfit as food. Taint is commonly defined as an odor or flavor that is foreign to a food product including seafood. According to the definition, the presence of a taint simply means the flavor or odor is altered and does not characterize any implied health hazard.

Spilled oil either on the surface or within the water column can impart a taste and/or odor impairment to fish tissue which is referred to as tainting. Since the determination of fish tainting usually involves lengthy and extensive testing including lab analyses and taste and odor testing panels, the US FDA and most state agencies will generally use conservative criteria to close commercial fishery operations following a
major oil spill event. The presence of oil on the water surface where commercial fishery operations are to occur can be used to close the fishery. The presence of oiled fishing gear such, as oiled ropes or nets aboard a fishing vessel, can also close a fishery or condemn a catch, as can the presence of oil in the general habitat of the target fish species. Alaska and other states have developed a hand-held UV lamp to scan the surface of recently caught fish and the presence of fluorescing reflections from fish can be used to condemn a particular catch.

Concerns over traditional food safety concerns were addressed during the M/V Selendang Ayu spill. Mauseth et al (2008) reports on the potential spill-related contamination of traditional food resources consumed by tribal members and others on Unalaska Island. The process of addressing the concern involved the Qawalangin Tribe, the State of Alaska Division of Public Health, the Responsible Party and the community. A subsistence core management team was formed, an advisory team representing technical specialists from NGOs, academia and subsistence users was also formed, and important resources were identified. Consumption surveys were conducted and samples (including shellfish and finfish) were tested. A risk-based public health evaluation of the analytical results and the communication of those results were shared with the public. Sample testing included polycyclic aromatic hydrocarbon ("PAH") analysis, organoleptic and paralytic shellfish poisoning ("PSP") testing. The State of Alaska Division of Public Health objectively evaluated the public health risks of subsistence foods consumption clearly discussing the various perceived and real risks.

Once a fishery has been closed due to an oil spill, the criteria to reopen fishing and declaring that the catch is safe for human consumption are highly variable and subjective. Agencies are generally conservative since they want to protect human safety as well as the reputation and image of the locally caught fish to help ensure enduring market value. As a result, the reopening of a fishery after a major oil spill requires extensive testing of marketable fish tissues using definitive extraction and analytical methods such as GC-MS analyses. Once these results have been made available and assuming that they consistently show no fish contamination by oil spill hydrocarbons, the fishery is reopened. The costs associated with the reopening effort involve catching the fish under controlled conditions, preparation and extraction of the edible portions, GC-MS analyses for definitive hydrocarbon presence and subsequent reporting of results to a wide public audience including the fishing community and consumer groups. Costs for such testing would be borne by the Responsible Party as part of the spill response and compensation costs.
q) The economic costs associated with an oil-spill-related fishery closure are a direct function of the area affected by the spill, the time of year relative to the commercial fishing season, and the annual value of that fishery. Obviously these variables are all subject to a wide range of values, and a projected loss from a fishery closure would necessarily have to be based on a specific case.

Knapp (2005) discussed the economic effects of the Selendang Ayu spill in the Aleutians. He stressed that the supply effect depends on the scale of the supply reduction relative to the total market supply. The crab fisheries closures during the Selendang Ayu spill were small compared to the total production, so the spill probably had a correspondingly small supply effect on crab prices.

Yender et al (2002) note that penned finfish have a greater risk of exposure than wild finfish because they cannot avoid oil in the water column and that “most cases of finfish contamination at oil spills have involved penned finfish at spills where a significant quantity of oil was mixed into the water column.”

Yender et al (2002) also contains extensive documentation of the process whereby US government agencies have conducted seafood risk assessments and communicated the results of those assessments publically.

The data cited from the T/V Braer spill are a worst case example where a number of salmon enclosed within a pen were exposed to spill hydrocarbons with no way to escape or avoid the exposure. With the exception of the spawning migration, adult salmon do not generally spend any time in close nearshore waters such as the location where this artificial pen was located. Adult salmon are voracious predators and spend their growing years offshore in pelagic waters where bait fish are abundant. The Braer spill data offer at best a very poor analogy with little or no extrapolation to a potential spill event within the project waters.

r) Effects of a condensate spill on various marine components were assessed in Application (Volume 7C, Section 7 and (Volume 8C, Section 8). In addition, the Ecological Risk Assessment and Human Health Risk Assessment (Application (Volume 7C, Section 10.2.4.1) also described chronic effects of condensate on a range of marine biophysical components. As a result, Northern Gateway does not agree with the need to conduct a synthesis of the literature concerning potential effects of condensate.

References:


1.68 Effects of Hydrocarbons on Marine Birds

Reference: i) Exhibit B3-40 Volume 8C - Application dated May 2010, Section 8.8.5, p. 8-51 (A1T0J0).

Preamble: This section states that part of a bird monitoring protocol could be to "determine contaminant levels (e.g. PAHs) in preferred prey species (e.g. non-lethal sampling of liver tissue from captured birds)".

Request: a) Please provide information showing how bird livers can be sampled non-lethally.

b) Please provide a rationale for how analysis of bird liver for PAHs can provide useful information about exposure of the bird’s prey.

Response: a) Bird livers can be sampled non-lethally using surgical biopsy techniques conducted by a veterinarian, as was done in Prince William Sound (Degernes et al. 2002) subsequent to the Exxon Valdez Oil Spill.

Reference:


b) The Application (Volume 8C, Section 8.8.5) states that in the event of a spill, the health and recovery of affected bird populations would be monitored, as appropriate, to potentially include efforts to “determine contaminant levels (e.g. polycyclic aromatic hydrocarbons “PAHs”) in preferred prey species (e.g., non-lethal sampling of liver tissue from captured birds)”. This statement refers to the assessment of bioaccumulation of PAHs in seabirds by measuring a combination of prey contaminant levels and subsequent bird concentrations. Specifically, this approach would include:

- determining contaminant levels (e.g. PAHs) in preferred prey species to assess potential dietary exposure of marine birds to contaminants; and
- characterizing biomagnification potential of contaminants (e.g. PAHs) by comparing prey concentrations/patterns to higher trophic-level marine bird concentrations/patterns (e.g., non-lethal sampling of liver tissue from captured birds).
By comparing PAH concentrations in marine bird prey to PAH concentrations in marine bird predators, a biomagnification factor ("BMF") can be calculated. The BMF characterizes the potential of a contaminant to increase in concentration (commonly lipid corrected) as it is transferred up the food chain. High BMF values (>1) in top predator species represent contaminants that are likely to reach high concentrations, which may be associated with adverse health effects.

Examination of PAH patterns between predator and prey allows for an examination of contaminant biotransformation capacity and/or contaminant excretion by the predator. Knowledge on the fate of contaminants following exposure allows for better characterization of overall health risk. Thus, examination of both prey and predator species allows for a better assessment of dietary exposure, biomagnification, contaminant biotransformation/elimination, and overall risk, compared to if only prey samples are examined.
1.69 Mitigation Measures

Reference: i) Exhibit B3-39 Volume 8C - Application dated May 2010, Section 8.5.4, pp. 8-11 (A1T0I9)
ii) Exhibit B3-39 Volume 8C - Application dated May 2010, Section 8.6.4, pp. 8-20 (A1T0I9)
iii) Exhibit B3-39 Volume 8C - Application dated May 2010, Section 8.8.4, pp. 8-50 (A1T0J0)

Preamble: These sections state that booming will be used to protect sensitive shoreline areas and skimmers and sorbents will be used to reduce the amounts of hydrocarbons in the environment, in the event of spills of diluted bitumen or condensate (even though other parts of the RA state that spilled condensate is not likely to reach the shore).

Request: a) Have the wave intensities in this specific geographic region been estimated and/or measured? If so please provide information on how those intensities have been considered in combination with the many published assessments of reduced boom efficacy in high winds and waves. See for example boom recommendations from the State of Alaska, USEPA, and NOAA.

b) If the wave intensities have not been estimated and/or measured, please explain why NGP anticipates booming will be effective, given the many published assessments of reduced boom efficacy in high winds and waves.

c) Similarly, please provide information on how skimming operations will be affected by wind and waves typical of Upper Kitimat Arm.

d) Please provide information to clarify whether or not booming strategies will be used in the event of a condensate spill, and if so, provide information on how to make them effective, especially in the event of up-channel winds during a condensate spill.

Response: a) Yes. Figure 2-6 of the filed Weather and Oceanographic Conditions Technical Data Report (ASL 2010) provides a summary of the percentage exceedences of significant wave heights observed at six stations covering the Confined Channel Assessment Area (“CCAA”), Queen Charlotte Sound, Hecate Strait and Dixon Entrance. The Nanakwa Shoal Buoy (C46181), located in the CCAA, observed exceedances of wave heights of 1 m less than 2% of total recorded period between November 1988 and March 2009.

Wave heights would be considered when selecting appropriate response...
equipment specific to the operating environments. Boom failure is a function of boom design and surface currents. Wave height is a secondary factor. Internal floatation “open water boom” typically can retain integrity with wave heights >2m (ExxonMobil 2008). Certain brands of offshore or ocean booms are in excess of 3m in height and are designed to retain integrity with wave heights of 2.5m or greater and even larger long period ocean swell waves.

References:


b) Please see Northern Gateway’s response to Haisla Nation IR 1.69a).

c) Wind is a minor factor in skimming operations relative to wave conditions. The Nanakwa Shoal Buoy (C46181), located in the CCAA, observed exceedances of wave heights of 1 m less than 2% of total recorded period between November 1988 and March 2009 (ASL 2010, Figure 2-6). A maximum wind speed of 28 m/s was recorded at the Nanakwa Shoal Buoy during the period between 1989 and 2009. The mean wind speed recorded at the Buoy for the same period was 4.55 m/s (ASL 2010, Table 2-2).

A range of oil skimmers have been designed for different surface water conditions. Please also refer to Northern Gateway’s response to Coastal FN IR 1.19g).

Reference:


d) A response to a condensate spill typically includes monitoring and tracking until the product naturally disperses and evaporates. Condensate has a high proportion of light ends and tends to disperse and evaporate rapidly following release making the use of booms unnecessary.

Containment and recovery strategies for condensate spills are governed
by safety as intentionally concentrating this product by booming could increase the risk of fire or explosion. Exclusion, diversion or deflection booming tactics to move condensate away from resources at risk in a projected pathway could be a viable strategy.
1.70 Follow-up and Monitoring

Reference:

i) Exhibit B3-39 Volume 8C - Application dated May 2010, Section 8.5.5, pp. 8-11 to 8-12 (A1T0I9)

ii) Exhibit B3-39 Volume 8C - Application dated May 2010, Section 8.6.5, p. 8-20 (A1T0I9)

iii) Exhibit B3-39 Volume 8C - Application dated May 2010, Section 8.7.5, p. 8-38 (A1T0I9)

iv) Exhibit B3-39 Volume 8C - Application dated May 2010, Section 8.8.5, p. 8-51 (A1T0J0)

v) Exhibit B3-42 Volume 8C - Application dated May 2010, Section 11.4, p. 11-29 (A1T0J2)

Preamble:
The discussions of follow-up and monitoring are generally worded to indicate that these efforts will be focused on determining how long it takes for conditions to return to 'normal' following spills or other releases of contaminants, for example "to determine the success of the response measures and the recovery of marine vegetation" (reference i), "until hydrocarbon concentrations have returned to baseline levels" (reference ii), "Monitoring would typically continue until specific ends are achieved and residual hydrocarbons reach acceptable background levels" (reference iii), "until it is confirmed that baseline conditions are restored" (reference v).

Request:
a) Please advise how a determination that baseline conditions have been restored will be made, given the lack of baseline studies on most marine species in Kitimat Arm.

b) Please specify what offers or discussions have been held with the Haisla Nation on the geographic, ecological and temporal scales of monitoring that would be needed to assess the complex ecology in this region, both before, during, and after construction of the Project.

c) Please provide information on the commitment that has been, or will be, made by NGP, to support such monitoring over the long time period which will be needed for an effective monitoring program, to include extensive monitoring prior to initiation of any project, and monitoring for the lifetime operation of the Project.

Response:
a) As discussed in Northern Gateway’s response to Federal Government IR 79, Northern Gateway has committed to the development and implementation of a marine environmental effects monitoring program (“EEMP”) for the marine terminal and a separate but integrated study of baseline conditions for marine transportation.

b) As of this writing Northern Gateway and the Haisla Nation have
recently renewed mutual engagement efforts. Northern Gateway looks forward to inclusion of the matters referred to in this information request in subsequent discussions. In particular, Northern Gateway would value participation by the Haisla Nation in the collection of additional Aboriginal traditional knowledge, emergency preparedness and response programs, ongoing environmental monitoring programs and field studies, and the Fisheries Liaison Committee, among other initiatives.

c) Northern Gateway’s commitment to undertake a Marine EEMP is described in the Northern Gateway’s response to Federal Government IR 79.
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<td>Construction Date</td>
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## Reportable Enbridge Liquids Pipeline Spills for Past 10 Years

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<td>Year</td>
<td>Month</td>
<td>State/Province</td>
<td>Location</td>
<td>Estimated Amount Spilled (m³)</td>
<td>Cause</td>
<td>Caused by Corrosion?</td>
<td>Construction Date</td>
<td>Pipeline Material - Pipe</td>
<td>Pipeline Material - Coating</td>
<td>Pipeline Material - Long Seam Weld</td>
<td>Material Transported</td>
<td>Amount recovered (m³)</td>
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</table>

1. Amount recovered as free product. Does not include material collected via other means (e.g. in soil, absorbent mats, booms etc.)

[Attachment Haisla Nation IR 1.7c) ]
### Selected Enbridge Liquid Pipeline Spills Over the Past Decade

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<tr>
<td></td>
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<td>Month</td>
<td>Location</td>
<td>Amount Spilled (L)</td>
<td>Product</td>
<td>Cause</td>
<td>Area Impacted</td>
<td>Nature of Product</td>
<td>Factors leading up to spill</td>
<td>Method of Discovery</td>
<td>Monitoring Type</td>
<td>Environmental Protection Procedures</td>
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<td>September</td>
<td>Buffalo, NY</td>
<td>unknown</td>
<td>crude</td>
<td>Puncture by rock</td>
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<td>Petroleum based product (did not come from an Enbridge pipeline)</td>
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<td>N/A</td>
<td>N/A</td>
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<td>September</td>
<td>Romeoville, IL</td>
<td>946,000</td>
<td>crude</td>
<td>Rupture</td>
<td>Storm water ditch and waste water treatment plant</td>
<td>Crude Oil</td>
<td>Under investigation</td>
<td>Under investigation</td>
<td>Soil, surface water, groundwater, drinking water, air quality, vegetation, wildlife</td>
<td>LP Emergency Response Plan implemented</td>
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<tr>
<td>3</td>
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<td>July</td>
<td>Marshall, MI</td>
<td>3,785,000</td>
<td>diluted bitumen</td>
<td>Corrosion (final report not complete)</td>
<td>Talmadge Creek, Kalamazoo River system and floodplain</td>
<td>Crude Oil</td>
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<td>Under investigation</td>
<td>Soil, surface water, groundwater, drinking water, air quality, vegetation, wildlife</td>
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<td>Virden, MB</td>
<td>2,500</td>
<td>crude</td>
<td>Leak</td>
<td>Creek bed of Bosshill Creek</td>
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<td>Third Party</td>
<td>Soil, surface water, groundwater, air quality, vegetation, wildlife</td>
<td>LP Emergency Response Plan implemented</td>
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1: Unavailable regulatory infractions
2: Unavailable fines
3: Not available

Attachment Haisla Nation IR 1.9(a-c)
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<td>Location</td>
<td>Amount Spilled (L)</td>
<td>Product</td>
<td>Cause</td>
<td>Area Impacted</td>
<td>Nature of Product</td>
<td>Factors leading up to spill</td>
<td>Method of Discovery</td>
<td>Monitoring Type</td>
<td>Environmental Protection Procedures</td>
<td>Response and Cleanup Efforts</td>
</tr>
<tr>
<td>6</td>
<td>April</td>
<td>Leech Lake, MN</td>
<td>unknown</td>
<td>crude</td>
<td>Small leak</td>
<td>Leech Lake Reservation</td>
<td>Crude Oil</td>
<td>Inspection after brush fire</td>
<td>Contractor</td>
<td>Soil</td>
<td>LP Emergency Response Plan implemented</td>
<td>LP Emergency Response Plan implemented, excavation and landfill disposal</td>
</tr>
<tr>
<td>7</td>
<td>January</td>
<td>Neche, ND</td>
<td>500,000</td>
<td>SCO(^2)</td>
<td>Pressure</td>
<td>Agricultural land</td>
<td>Crude Oil</td>
<td>Sudden drop in pressure</td>
<td>SCADA</td>
<td>Soil, groundwater, air quality</td>
<td>LP Emergency Response Plan implemented</td>
<td>LP Emergency Response Plan implemented, excavation and landfill disposal of contaminated soil &amp; debris, ex-situ bioremediation, snow/dirt separation and treatment</td>
</tr>
<tr>
<td>8</td>
<td>September</td>
<td>Odessa, SK</td>
<td>175,000</td>
<td>crude</td>
<td>Rupture downstream of pump station</td>
<td>Surrounding land</td>
<td>Crude Oil</td>
<td>Physical Damage to Pipe</td>
<td>Third Party</td>
<td>Soil, surface water, groundwater, air quality, vegetation, wildlife</td>
<td>LP Emergency Response Plan implemented</td>
<td>LP Emergency Response Plan implemented, excavation and landfill disposal of contaminated soil &amp; debris</td>
</tr>
<tr>
<td>9</td>
<td>June</td>
<td>Floodwood, MN</td>
<td>19</td>
<td>crude</td>
<td>Not known</td>
<td></td>
<td>Crude Oil</td>
<td>Old Repair - cracked weld</td>
<td>Operator</td>
<td>Soil, groundwater</td>
<td>LP Emergency Response Plan implemented</td>
<td>LP Emergency Response Plan implemented, excavation and landfill disposal of contaminated soil &amp; debris</td>
</tr>
</tbody>
</table>

**2010 reported spills:** 1
**Unavailable regulatory infractions:** 2
**2009 reported spills:** 89
**Regulatory infractions:** 25
**Fines:** $1,159,300
<table>
<thead>
<tr>
<th>Month</th>
<th>Location</th>
<th>Amount Spilled (L)</th>
<th>Product</th>
<th>Cause</th>
<th>Area Impacted</th>
<th>Nature of Product</th>
<th>Factors leading up to spill</th>
<th>Method of Discovery</th>
<th>Monitoring Type</th>
<th>Environmental Protection Procedures</th>
<th>Response and Cleanup Efforts</th>
</tr>
</thead>
<tbody>
<tr>
<td>March</td>
<td>Clearbrook, MN</td>
<td>190</td>
<td>crude</td>
<td></td>
<td>Crude Oil</td>
<td>Pump seal failure</td>
<td>Soil, groundwater, surface water</td>
<td>LP Emergency Response Plan implemented</td>
<td>SCADA</td>
<td>Soil, drinking water</td>
<td>LP Emergency Response Plan implemented, excavation and landfill disposal of contaminated soil &amp; debris</td>
</tr>
<tr>
<td>February</td>
<td>Kisbey, SK</td>
<td>112,000</td>
<td>“oil”</td>
<td>Rupture</td>
<td>Hay field</td>
<td>Light Crude</td>
<td>Historical Third Party Damage</td>
<td>LP Emergency Response Plan implemented</td>
<td>SCADA</td>
<td>Soil, drinking water</td>
<td>LP Emergency Response Plan implemented, excavation and landfill disposal of contaminated soil &amp; debris</td>
</tr>
<tr>
<td>January</td>
<td>Cheecham, AB</td>
<td>914,000</td>
<td>“oil”</td>
<td>Failed vent valve at unmanned facility</td>
<td>Downwind area contaminated by oil mist</td>
<td>Crude Oil</td>
<td>Ball valve fitting failure causing fatigue and failure</td>
<td>LP Emergency Response Plan implemented</td>
<td>SCADA</td>
<td>Soil, surface water, groundwater, vegetation, wildlife</td>
<td>LP Emergency Response Plan implemented, excavation and landfill disposal of contaminated soil &amp; debris</td>
</tr>
<tr>
<td>July</td>
<td>Edmonton, AB</td>
<td>40,000</td>
<td>crude</td>
<td>Feeder pipe spill</td>
<td>Edmonton Terminal</td>
<td>Crude Oil</td>
<td>Third Party Nitrogen Purge</td>
<td>SCADA</td>
<td>None</td>
<td>None</td>
<td>LP Emergency Response Plan implemented, product recovery and steam cleaning (contained in secondary containment)</td>
</tr>
</tbody>
</table>

2009 reported spills: 89
regulatory infractions: 25
fines: $1,159,300

2008 reported spills: 80
regulatory infractions: 12
fines: $56,214
## Selected Enbridge Liquid Pipeline Spills Over the Past Decade

<table>
<thead>
<tr>
<th>Month</th>
<th>Location</th>
<th>Amount Spilled (L)</th>
<th>Product</th>
<th>Cause</th>
<th>Area Impacted</th>
<th>Nature of Product</th>
<th>Factors leading up to spill</th>
<th>Method of Discovery</th>
<th>Monitoring Type</th>
<th>Environmental Protection Procedures</th>
<th>Response and Cleanup Efforts</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>Eldorado, KS</td>
<td>87,400</td>
<td>crude</td>
<td>Storage tank corrosion hole</td>
<td>Eldorado Terminal</td>
<td>Crude Oil</td>
<td>Corrosion</td>
<td>Operator</td>
<td>Soil, groundwater</td>
<td>LP Emergency Response Plan implemented</td>
<td>product recovery and steam cleaning (contained in secondary containment)</td>
</tr>
<tr>
<td>April</td>
<td>Griffith, IN</td>
<td>41,300</td>
<td>crude</td>
<td>Broken thermal relief line</td>
<td>Griffith Terminal</td>
<td>Crude Oil</td>
<td>Tank Painting</td>
<td>Contractor</td>
<td>Soil, groundwater, air quality, worker exposure</td>
<td>LP Emergency Response Plan implemented</td>
<td>excavation and landfill disposal of contaminated soil &amp; debris</td>
</tr>
<tr>
<td>March</td>
<td>Fort McMurray, AB</td>
<td>40,000</td>
<td>oil sands crude</td>
<td>Drain line failure</td>
<td>Terminal</td>
<td>Crude Oil</td>
<td>Broken Drain Line - Filled with water, froze then cracked</td>
<td>Operator</td>
<td>Soil, groundwater</td>
<td>LP Emergency Response Plan implemented</td>
<td>excavation and landfill disposal of contaminated soil &amp; debris</td>
</tr>
<tr>
<td>February</td>
<td>Weyburn, SK</td>
<td>25,000</td>
<td>crude</td>
<td>Human error</td>
<td>Truck Facility</td>
<td>Crude Oil</td>
<td>Attempting to drain Plugged Sump Line, line left open, Operator Error</td>
<td>Operator</td>
<td>Soil, vegetation</td>
<td>LP Emergency Response Plan implemented</td>
<td>excavation and landfill disposal</td>
</tr>
</tbody>
</table>

2008 reported spills: 80  
regulatory infractions: 12  
fines: $56,214

Attachment Haisla Nation IR 1.9(a-c)
<table>
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<tr>
<th>Month</th>
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<th>Monitoring Type</th>
<th>Environmental Protection Procedures</th>
<th>Response and Cleanup Efforts</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>Cromer, MB</td>
<td>100,000</td>
<td>crude</td>
<td>Gasket failure</td>
<td>Cromer Terminal</td>
<td>Crude Oil</td>
<td>N/A</td>
<td>Operator</td>
<td>None</td>
<td>LP Emergency Response Plan implemented</td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>Clearbrook, MN</td>
<td>51,700</td>
<td>crude</td>
<td>Pinhole leak</td>
<td></td>
<td>Crude Oil</td>
<td>Replacing a section of pipe</td>
<td>Operator</td>
<td>Soil, surface water, groundwater, drinking water, air quality, vegetation, wildlife</td>
<td>LP Emergency Response Plan implemented, excavation and landfill disposal of contaminated soil &amp; debris</td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>Glenavon, SK</td>
<td>990,000</td>
<td>crude</td>
<td>Rupture due to cracking from fatigue</td>
<td>Unclear</td>
<td>Crude Oil</td>
<td>Corrosion</td>
<td>SCADA</td>
<td>Soil, surface water, groundwater, drinking water, air quality, vegetation, wildlife</td>
<td>LP Emergency Response Plan implemented, excavation and landfill disposal of contaminated soil &amp; debris</td>
<td></td>
</tr>
<tr>
<td>February</td>
<td>Rusk County, WI</td>
<td>477,000</td>
<td>crude</td>
<td>Construction</td>
<td></td>
<td>Crude Oil</td>
<td>Construction of New Pipeline, Contractor Error</td>
<td>Contractor</td>
<td>Soil, surface water, groundwater, drinking water, air quality, vegetation, wildlife</td>
<td>LP Emergency Response Plan implemented, excavation and landfill disposal of contaminated soil &amp; debris</td>
<td></td>
</tr>
</tbody>
</table>

2007 reported spills: 65
regulatory infractions: 14
fines: $4,050

2008 reported spills: 80
regulatory infractions: 12
fines: $56,214
## Selected Enbridge Liquid Pipeline Spills Over the Past Decade

### 2006 Spills

<table>
<thead>
<tr>
<th>Month</th>
<th>Location</th>
<th>Amount Spilled (L)</th>
<th>Product</th>
<th>Cause</th>
<th>Area Impacted</th>
<th>Nature of Product</th>
<th>Factors leading up to spill</th>
<th>Method of Discovery</th>
<th>Monitoring Type</th>
<th>Environmental Protection Procedures</th>
<th>Response and Cleanup Efforts</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>Clark County, WI</td>
<td>187,000</td>
<td>crude</td>
<td>Crack rupture</td>
<td>Farmland and drainage ditches</td>
<td>Crude Oil</td>
<td>N/A</td>
<td>SCADA</td>
<td>Soil, surface water, groundwater, drinking water, air quality, vegetation, wildlife</td>
<td>LP Emergency Response Plan implemented, excavation and landfill disposal of contaminated soil &amp; debris</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>Sheridan County, MT</td>
<td>318,000</td>
<td>crude</td>
<td>Failed nipple downstream of pump</td>
<td>Pasture (most recovered)</td>
<td>Crude Oil</td>
<td>N/A</td>
<td>Third Party</td>
<td>Soil, surface water, groundwater, drinking water, vegetation</td>
<td>LP Emergency Response Plan implemented</td>
<td></td>
</tr>
<tr>
<td>March</td>
<td>Willmar, SK</td>
<td>97,500</td>
<td>crude</td>
<td>Pump failure</td>
<td>Terminal with off-site impact</td>
<td>Crude Oil</td>
<td>N/A</td>
<td>Operator</td>
<td>Soil, vegetation</td>
<td>LP Emergency Response Plan implemented, excavation and landfill disposal of contaminated soil &amp; debris</td>
<td></td>
</tr>
</tbody>
</table>

### 2005 Spills

No specific spill reports were found through Enbridge reports or other sources. It is known through its 2005 Report, however, that Enbridge spilled a total of 1,562,000 L of liquid petroleum products during the year.

### 2007 Spills

No specific spill reports were found through Enbridge reports or other sources. It is known through its 2007 Report, however, that Enbridge spilled 318,000 L of liquid petroleum products during the year.
# Selected Enbridge Liquid Pipeline Spills Over the Past Decade

<table>
<thead>
<tr>
<th>Month</th>
<th>Location</th>
<th>Amount Spilled (L)</th>
<th>Product</th>
<th>Cause</th>
<th>Area Impacted</th>
<th>Nature of Product</th>
<th>Factors leading up to spill</th>
<th>Method of Discovery</th>
<th>Monitoring Type</th>
<th>Environmental Protection Procedures</th>
<th>Response and Cleanup Efforts</th>
</tr>
</thead>
<tbody>
<tr>
<td>March</td>
<td>Parker County, TX</td>
<td>1,750</td>
<td>condensate</td>
<td>Pipeline seam failure</td>
<td>Cattle stock pond</td>
<td>Crude Oil</td>
<td>N/A - GAS TRANSPORATION INCIDENT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>February</td>
<td>Fort McMurray, AB</td>
<td>260,000</td>
<td>oil sands crude</td>
<td>Valve failure</td>
<td>Along pipeline (uncontained)</td>
<td>Crude Oil</td>
<td>N/A</td>
<td>Soil, surface water, groundwater</td>
<td>LP Emergency Response Plan implemented</td>
<td></td>
<td></td>
</tr>
<tr>
<td>February</td>
<td>Grand Rapids, MI</td>
<td>159,000</td>
<td>crude</td>
<td>Leak caused by dent from pipeline resting on a rock</td>
<td>Area soil and groundwater</td>
<td>Crude Oil</td>
<td>Dent caused by rock</td>
<td>Contractor</td>
<td>Soil, drinking water, groundwater, air quality</td>
<td>LP Emergency Response Plan implemented</td>
<td></td>
</tr>
</tbody>
</table>

2004 reported spills: 69
regulatory infractions: 28
fines: $207,278
<table>
<thead>
<tr>
<th>A/B/C/D</th>
<th>E/F/G/H/I/J/K/L/M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td></td>
</tr>
<tr>
<td>January</td>
<td>Superior, WI</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Product</td>
<td>Cause</td>
</tr>
<tr>
<td>Nature of Product</td>
<td>Factors leading up to spill</td>
</tr>
<tr>
<td>Monitoring Type</td>
<td>Environmental Protection Procedures</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>Cohasset, MN</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>Glenboro, MB</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Selected Enbridge Liquid Pipeline Spills Over the Past Decade

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>January</td>
<td>Kerrobert, SK</td>
<td>975,000</td>
<td>crude</td>
<td>Leaking gasket</td>
<td>Industrial site</td>
<td>Mixed Batch</td>
<td>N/A</td>
<td>N/A</td>
<td>Soil, groundwater</td>
<td>LP Emergency Response Plan implemented, ex situ bioremediation, road maintenance</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>September</td>
<td>Binbrook, ON</td>
<td>95,000</td>
<td>crude</td>
<td>Valve failure</td>
<td>Surrounding land</td>
<td>Mixed sweet blend</td>
<td>External metal loss</td>
<td>N/A</td>
<td>Soil, groundwater, drinking water, air quality, vegetation</td>
<td>LP Emergency Response Plan implemented, excavation and landfill disposal of contaminated soil &amp; debris</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>September</td>
<td>Fairbanks, LA</td>
<td>68,000 (plus natural gas)</td>
<td>“oily mixture”</td>
<td>Unspecified</td>
<td>Land and creek</td>
<td>N/A - GAS TRANSPORATION INCIDENTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>February</td>
<td>Satartia, MS</td>
<td>16,000</td>
<td>crude</td>
<td>Accident (struck by farm implement)</td>
<td>Farmland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>January</td>
<td>Hardisty, AB</td>
<td>3,800,000</td>
<td>crude</td>
<td>Pipeline seam failure (cracking from fatigue)</td>
<td>Surrounding land and nearby slough</td>
<td>Crude Oil</td>
<td>Longitudinal weld failure</td>
<td>N/A</td>
<td>Soil, surface water, groundwater, drinking water, vegetation</td>
<td>LP Emergency Response Plan implemented, thermal desorption, natural attenuation</td>
<td></td>
</tr>
</tbody>
</table>

### Notes:

1. Source: National Energy Board - Pipeline Spill Record; all other incidents were sourced from Enbridge Corporate Social Reports, 2002-2010.
2. Liquid (hydrocarbon) spills only (number may be higher if natural gas spills are included).
3. In US Dollars; fines represents payments to regulatory agencies and do not include clean-up or compensation costs.
4. Enbridge, in its 2010 Report, states “crude oil” as having spilled from its Michigan Line 6B spill. It is known and documented that this was diluted bitumen, and it is misleading to list it as crude oil. Similarly, the Line 6A spill was product diverted from 6B and therefore also diluted bitumen.
5. SCO is synthetic crude oil, a refined product of bitumen.
6. “oil” = normally Enbridge specifies crude oil when it is conventional crude; sometimes the company simply mentions “oil” as the product spilled, and it is open to interpretation whether it is synthetic oil, bitumen, or conventional crude.

### Table 1:

<table>
<thead>
<tr>
<th>Month</th>
<th>Location</th>
<th>Amount Spilled (L)</th>
<th>Product</th>
<th>Cause</th>
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</thead>
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<tr>
<td>January</td>
<td>Kerrobert, SK</td>
<td>975,000</td>
<td>crude</td>
<td>Leaking gasket</td>
<td>Industrial site</td>
<td>Mixed Batch</td>
<td>N/A</td>
<td>N/A</td>
<td>Soil, groundwater</td>
<td>LP Emergency Response Plan implemented, ex situ bioremediation, road maintenance</td>
<td></td>
</tr>
<tr>
<td>September</td>
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<td>95,000</td>
<td>crude</td>
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<td>Surrounding land</td>
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<td>External metal loss</td>
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<td>LP Emergency Response Plan implemented, excavation and landfill disposal of contaminated soil &amp; debris</td>
<td></td>
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<tr>
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<td>68,000 (plus natural gas)</td>
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<td>Unspecified</td>
<td>Land and creek</td>
<td>N/A - GAS TRANSPORATION INCIDENTS</td>
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<td></td>
<td></td>
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<td>16,000</td>
<td>crude</td>
<td>Accident (struck by farm implement)</td>
<td>Farmland</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>Hardisty, AB</td>
<td>3,800,000</td>
<td>crude</td>
<td>Pipeline seam failure (cracking from fatigue)</td>
<td>Surrounding land and nearby slough</td>
<td>Crude Oil</td>
<td>Longitudinal weld failure</td>
<td>N/A</td>
<td>Soil, surface water, groundwater, drinking water, vegetation</td>
<td>LP Emergency Response Plan implemented, thermal desorption, natural attenuation</td>
<td></td>
</tr>
</tbody>
</table>
### Selected Enbridge Liquid Pipeline Spills Over the Past Decade

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<tbody>
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<td></td>
<td></td>
<td></td>
<td></td>
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WARNING LETTER

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

January 21, 2010

Mr. Terry McGill, President
Enbridge Energy Partners, L.P.
1100 Louisiana, Suite 3300
Houston, Texas 77002

Dear Mr. McGill:


As a result of the inspection, it appears that you have committed a probable violation of the Pipeline Safety Regulations, Title 49, Code of Federal Regulations. The items inspected and the probable violation(s) are:

1. 195.579 What must I do to mitigate internal corrosion?

   (b) Inhibitors. If you use corrosion inhibitors to mitigate internal corrosion, you must--
(1) Use inhibitors in sufficient quantity to protect the entire part of the pipeline system that the inhibitors are designed to protect;
(2) Use coupons or other monitoring equipment to determine the effectiveness of the inhibitors in mitigating internal corrosion; and
(3) Examine the coupons or other monitoring equipment at least twice each calendar year, but with intervals not exceeding 7 1/2 months.

Internal corrosion monitoring was discontinued on the five hydrogen permeation monitors (Beta Foils) installed on Line 6B. Two manually-interrogated monitors were discontinued in May 2006. One remotely-interrogated monitor was discontinued in January 2006, and the other two remotely-interrogated monitors were discontinued in October 2007. Enbridge representatives stated the monitoring was discontinued due to “communication/instrumentation problems.”

Enbridge is in the process of implementing an alternative method of internal corrosion monitoring on Line 6B utilizing a technology referred to as Electrical Resistance Tomography (FSM-IT), however, it is not expected to be implemented on Line 6B until sometime during the first half of 2010. In the interim, Enbridge provided the following information as demonstration that the internal corrosion threat is being properly managed:

- a comprehensive report related to the internal corrosion mitigation and monitoring program for their heavy oil pipeline system
- repair sleeve installations (which require circumferential non-destructive testing)
- inspection of the Line 6B Pig Sending Trap at Griffith Station (which included ultrasonic inspection of the trap floor between the 5:00 and 7:00 positions)
- detailed pipe examinations at in-line inspection indications
- records for a weight loss coupon at the Stockbridge Pumping Station (Line 17), which sees only fluid flow from Line 6B

The information provided does not demonstrate compliance with the above regulation. Line 6B has been subject to a batch chemical treatment program to inhibit internal corrosion for several years. As required by 195.579(b), Line 6B must have coupons or other monitoring equipment to determine the effectiveness of the inhibitor program, and the coupons or other monitoring equipment must be examined at least twice each calendar year, at intervals not to exceed 7-1/2 months. PHMSA acknowledges the positive steps being taken to improve Enbridge’s internal corrosion mitigation and monitoring program. However, the transition from one technology to another must be implemented in a manner that ensures continued compliance with the regulations.

Under 49 United States Code, § 60122, you are subject to a civil penalty not to exceed $100,000 for each violation for each day the violation persists up to a maximum of $1,000,000 for any related series of violations. We have reviewed the circumstances and supporting documents involved in this case, and have decided not to conduct additional enforcement
action or penalty assessment proceedings at this time. We advise you to correct the item identified in this letter. Failure to do so will result in Enbridge being subject to additional enforcement action.

No reply to this letter is required. If you choose to reply, in your correspondence please refer to CPF 3-2010-5002W. Be advised that all material you submit in response to this enforcement action is subject to being made publicly available. If you believe that any portion of your responsive material qualifies for confidential treatment under 5 U.S.C. 552(b), along with the complete original document you must provide a second copy of the document with the portions you believe qualify for confidential treatment redacted and an explanation of why you believe the redacted information qualifies for confidential treatment under 5 U.S.C. 552(b).

Sincerely,

Ivan A. Huntsoon  
Director, Central Region  
Pipeline and Hazardous Materials Safety Administration
February 2009 (note incorrect title – should read February 2010)
Enbridge’s Liquids Pipeline Network
Overview

• Enbridge Pipeline Systems
• System Integrity Philosophy and Policies
• Pipeline Integrity Update
  – Organizational Structure
  – Primary Threats
  – Integrity Management Overview
  – Commitment to Addressing Integrity Issues
  – Current Integrity Issues
Pipeline Systems

- **Corporate headquarters in Calgary**
  - Houston – U.S. Gas Transportation and Administrative headquarters
- **Three operating businesses**
  - Liquids Pipelines
  - Natural Gas Transportation
  - Gas Distribution
- **Liquids Pipelines U.S. highlights**
  - 5,000 miles liquid pipelines
  - Superior, Wisc. operating center
  - Lakehead System transports over 11% of US imports
  - >2 million bpd on systems operated by Enbridge in U.S.
  - Joint Venture ownership:
    - Olympic
    - Frontier
    - Chicap
    - Mustang
Major growth underway

- Projects completed or underway in United States:
  - New 42” pipeline Superior to Flanagan (Southern Access)
  - New 20” pipeline Chicago to Clearbrook, MN (Southern Lights - diluent)
    - Reversal of existing Clearbrook to Edmonton
  - New 20” pipeline Cromer to Clearbrook
  - New 36” pipeline Hardisty to Superior
  - Pumping expansion of ND System
  - Tankage added at key terminals
- Liquids Projects in development:
  - Additional expansion in ND
  - Tankage additions
  - Others under consideration
  - Numerous in Oil Sands region
  - Northern Gateway
Environmental, Health and Safety

Environmental, Health and Safety management is integral in the conduct of our business to ensure the protection of the environment, our employees and the public. Enbridge will comply with government regulation and standards, ensure a safe and healthy working environment for our employees and enhancing our safety culture and performance.

Integrity Management

The Company has an extensive program to manage system integrity, which includes the development and use of predictive models and in-line inspection tools. Maintenance, excavation and repair programs are directed to the areas of greatest impact and pipe is replaced or repaired as required.
System Integrity Organizational Structure

System Integrity
(81 Full-time staff)

Pipeline Integrity
- 47 Full Time Staff
- 10 Contract Staff

Compliance
- 18 Full Time Staff
  (11 US based)
- 1 Contract Staff

Facilities Integrity
- 16 Full Time Staff
- 4 Contract Staff
Primary Integrity Threats

- **Corrosion**
  - external
  - internal

- **Cracks**
  - growth due to metal fatigue
  - environmentally assisted

- **Dents & Gouges**
  - rock dents
  - construction damage
  - third party strikes
Integrity Management

• Damage Prevention
  – proactive excavator and public awareness program
  – right-of-way surveillance
  – depth of cover surveys
  – corrosion inhibitor
  – pressure cycle monitoring

• Mitigation Measures
  – high resolution in-line inspections (ILI)
  – analysis of strength and remaining life
  – excavation and remediation/repair
Integrity Management Plans

- Different ILI technologies for different threats
  - corrosion – magnetic and ultrasonic
  - cracking – ultrasonic
  - mechanical damage – caliper, magnetic, inertial
- Continuous development of ILI tools and assessment methods
- All pipeline segments subject to high resolution ILI for corrosion and mechanical damage
- Pipeline analysis methods and assessment criteria continuously being reviewed and updated
- Reassessment intervals established by analysis and regulations
Commitment to Addressing Integrity Issues - 2009

U.S. Liquids Pipelines

- 51 in-line inspections, 8200 miles of pipe
- 279 excavation and repair sites
- $60 MM in expenditures
Commitment to Pipeline Integrity Research

• PRCI International Research Projects
  – Pipe Quality Issues
  – Improved ILI Tools
  – ILI Measurement Uncertainties
  – Improved Strength & Fatigue Models

• Enbridge Research Projects
  – New ILI Tool Developments
  – Full-scale Fatigue Tests
Current Integrity Issues

• Line 3 Operations
  – Mixed light-heavy crude service
  – Conversion to light crude service

• Line 6B Integrity Maintenance
  – Significant corrosion rehabilitation program

• Line 2 Rupture in North Dakota
  – Failure investigation update
Planned Changes to Line 3 Operations

- Currently in mixed (light-heavy crude) service, at 83% of max. design pressure
- New 36-inch pipeline (Alberta Clipper) comes on stream in 2010, taking heavy crude volumes off Line 3
- Plan to convert Line 3 to long haul, light crude service (options still being assessed)
- In light service, required operating pressure is 60% of max. design pressure
- Return to 100% of max. design pressure is possible, but no plan to do so in the near future
- Integrity to be managed taking account of lower operating pressures, as appropriate
Line 6B – Integrity Update

- Griffith, Indiana to Sarnia, Ontario (293 miles)
- 30-inch OD
- Constructed in 1969
- Polyethylene tape coating
- Ships mainly heavy crudes
- Throughput
  - 124,000 bbls/d ex. Griffith
  - 50,000 bbls/d ex. Stockbridge
- Corrosion growth studies indicate large repair programs required in next 10 years
Immediate Actions

- Temporary pressure restrictions to restore safety margin
  - 80% of recent high pressure (80% of failure pressure for Gretna Station)
- Pipe joint cut out for metallurgical investigation to determine cause (on-going)
- Expedited review of data from crack inspection conducted in late 2009
- ILI verification program currently underway
- Excavation and repair program underway
September 4, 2008

Shaun Kavajecz
Manager – Compliance
Enbridge Pipelines (Lakehead) LLC
119 N. 25th Street E
Superior, WI 54880

RE: Line 14 – Resumption of normal operation

Dear Mr. Kavajecz:

The Central Region Office of the Pipeline and Hazardous Materials Safety Administration (PHMSA) has received Enbridge’s request to resume normal operation of its 24-inch diameter Line 14 pipeline. Following the pipeline failure near the Owen pump station in Wisconsin on January 1, 2007, Enbridge reduced the operating pressure on Line 14 from Superior, Wisconsin to Mokena, Illinois. Metallurgical examination of the failed pipe specimen was performed, and the cause of the failure was determined to be a defect in the pipe seam. Therefore, in 2007 an in-line inspection (ILI) was completed using an ultrasonic crack detection tool to assess seamed pipe in Line 14. Enbridge reviewed the ILI results and established an excavation and repair program for the pipeline.

Enbridge has completed the program and analyzed the results to ensure that critical anomalies have been repaired. Additionally, a fatigue growth analysis based on the pipeline’s operating pressure spectrum was performed to confirm that safety is maintained until the next scheduled ILI of the seam in 2012. Until the next scheduled seam assessment Enbridge will be monitoring pressure cycles on Line 14, and would shorten the assessment interval as necessary to maintain safety. Based on the Central Region Office’s review of the information provided, we do not object to Enbridge’s request to remove the pressure restrictions placed on Line 14 as a result of the January 1, 2007 accident. We understand that the pump station discharge pressure setpoints will be returned to the values in place prior to the accident, consistent with the §195.406 requirements for maximum operating pressure.

Thank you for your cooperation in this matter.

Sincerely,

Ivan A. Huntoon
Director, Central Region
Pipeline and Hazardous Materials Safety Administration
June 4, 2007

Mr. Thomas Kendzierski
Hazardous Substance Spill Coordinator / Hydrogeologist
Remediation and Redevelopment, West Central Region
Wisconsin Department of Natural Resources
P.O. Box 4001, 1300 West Clairemont Ave.
Eau Claire, WI 54702-4001

RE: Case Closure Request and Letter of Compliance: MP 149.5 (Owen, Wisconsin)

Dear Mr. Kendzierski:

Enclosed is the Case Closure Request MP 149.5 prepared on behalf of Enbridge Energy, Limited Partnership. The report serves to capture environmental remediation and monitoring activities conducted at the Site as well as set forth a request for case closure under NR 708. A check in the amount of $250 is attached that covers the No Further Action determination under NR 708. Per NR 708.09(1), this letter also serves as the letter of compliance since immediate response action is complete and it is requested that no further action status be granted.

If you have any questions or comments, please do not hesitate to call me – I can be reached at (715) 399-3250.

Sincerely,

Barry F. Power, P.E.
President

Enclosures

cc: Enbridge Energy – Joe McGaver: Superior Region

bc: Law
CASE CLOSURE REQUEST
MP 149.5
OWEN, WISCONSIN

Prepared for:
Enbridge Energy, Limited Partnership
June 2007

Prepared by:
Natural Resources Engineering Co.
1409 Hammond Ave—Suite 110
Superior, WI 54880
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4B. SURFACE WATER ANALYTICAL RESULTS (PAH)

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1. SITE LOCATION MAP
2. OVERLAND FLOW PATH
3. WATER SUPPLY WELLS MAP
4. EXCAVATION EXTENT MAP
5. SPRAY ZONE MAP
6. OVERLAND FLOW MAP
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8. SURFACE WATER SAMPLE LOCATIONS MAP

## APPENDICES

A. CASE SUMMARY AND CLOSE OUT REQUEST FORM
B. PHOTOGRAPHS (MARCH 2007)
C. LABORATORY ANALYTICAL REPORT (MARCH 2007)
I. INTRODUCTION

A. Background

The morning of January 1, 2007, a crude oil release occurred as the result of a pipeline failure from Enbridge’s 24-inch diameter crude oil transmission pipeline approximately ½-mile downstream (southeast) of Enbridge’s Owen pumping station near the town of Owen in central Wisconsin (approximate milepost 149.5, refer to Figure 1). The location is west of Sparrow Avenue in the Southeast Quarter (SE ¼) of the Northwest Quarter (NW ¼) of section twenty-seven (27), Township twenty-eight North (28N), Range one West (1W) in Clark County. The 24-inch diameter pipeline is referred to as Line 14 and serves to transport crude oil from Superior, Wisconsin to Mokena, Illinois.

The release occurred in a rural agricultural area characterized by gently rolling topography and clayey near surface soils. The crude oil took an overland flow path to the south, following a drainage swale for approximately ½-mile. At the time of the release, the ground was frozen with six to eight inches of frost present, which served to constrain the vertical extent of oil to the near surface soils. The overland flow path was mostly visible. However, in a few areas, the crude oil overflowed the drainage swale and spread laterally underneath the snow, requiring closer inspection to determine the horizontal extent of the release. The areas impacted by the release are shown on Figure 2, and will hereon be collectively referred to as the “Site.” The Site is approximately 2.5 acres in area.

Enbridge’s Control Center noticed a pressure anomaly on Line 14 south of the Owen Station at 0930 CST on January 1, 2007, and proceeded to shutdown Line 14. Enbridge’s pipeline maintenance crews mobilized and provided field verification of the release. At that time, efforts to contact the appropriate regulatory authorities commenced. Containment and recovery activities were initiated on January 1, 2007, and completed on January 6, 2007.
B. Purpose/Content

This report serves to capture environmental remediation and monitoring activities conducted at the Site as well as set forth a request for case closure under NR 708.

Including this section, this report is divided into eight parts. Section I provides a brief introduction to the Site. Section II summarizes nearby potential receptors. Section III details emergency response activities conducted at the Site. Section IV describes initial confirmation sampling activities and results. Sections V discusses site inspection and sampling activities conducted in March 2007. Section VI discusses plans for site restoration. Section VII contains conclusions and recommendations, and Section VIII lists references.
II. RECEPTOR SURVEY

Utilizing the WDNR’s private water supply well database, ten (10) private water supply wells were identified within one mile of the release location. Well construction reports for these ten wells were previously included in the March 2007 submittal to the WDNR. Nine of the ten (10) wells were found to be hydraulically up-gradient of the Site with one hydraulically down-gradient well located over ¾-mile from the Site. The nearest well is approximately 1,200 feet north of the Site, and is owned by the Town of Green Grove. This well serves one home and the Green Grove Shop.

In addition to the water supply wells identified above, there are also farm buildings located at the Site, as well as three residences south of the Site. Two residences are located on the east side of Sparrow Avenue, while the other residence is located west of the culvert near surface water sample location DSW-2 on Cloverdale Road. The WDNR private water supply well database does not contain records of potable wells at these locations. Therefore, the WDNR was consulted to determine if potable wells are present at these locations as well as determine information regarding ownership, construction and status. Information regarding these potential water supply wells was not available. Figure 3 depicts the locations of known private water supply wells within one mile of the Site, including the locations thought to have potable water supply wells that are not included on the WDNR private water supply well database.
III. EMERGENCY RESPONSE ACTIVITIES

For an all inclusive discussion regarding emergency response activities conducted at the Site, refer to the Site Monitoring and Closure Plan Report MP 149.5 Owen, Wisconsin that was submitted to the Wisconsin Department of Natural Resources (WDNR) in March 2007. Emergency response activities included the excavation of oily soils via heavy equipment and the recovery of crude oil using sorbent booms and pads, pneumatic barrel skimmers, and vacuum trucks. The crude oil was contained via a series of five interception trenches and two inverted flume ponds located approximately 0.5-mile from the location of the release (refer to Figure 4).

The total volume of crude oil released was estimated to be approximately 1,500 barrels (refer to Table 1). The majority was recovered by vacuum truck and injected back into the pipeline system. The remainder was hauled off-site as oily soil. A total of approximately 7,428 tons of crude oil impacted soils were excavated and disposed of at Veolia ES Cranberry Creek Landfill (a WDNR certified solid waste disposal facility) in Wisconsin Rapids, Wisconsin. Soil disposal documentation was previously provided to the WDNR.

Although not mandatory for a case closure request under NR 708, relevant specifics of the incident are provided on the Case Summary and Closeout Request Form included in Appendix A.
IV. INITIAL CONFIRMATION SAMPLING ACTIVITIES AND RESULTS

A. Soil Quality

To quantify near surface soil quality and confirm remedial activities were effective, a network of samples were collected from four general areas (spray zone, pipe excavation, overland flow, and interception trenches). A soil sampling summary including headspace screening and sample collection depth is found in Table 2. Figures 5, 6 and 7 depict the sample locations. After the initial round of soil sampling, seven samples were above respective Residual Contaminant Levels (RCLs). Six of the seven locations were further excavated and resampled. These samples included one from the spray zone (SZ-2, Figure 5), three from the overland flow area (OF-7, OF-8, and OF-11, Figure 6), and two from the interception trench area (IT-7 and IT-8, Figure 7).

Results from each of the six resampled areas were below laboratory detection limits. Analytical results for the remaining sample (PE-2), indicated 83 ug/kg for benzo(a)pyrene and 14 ug/kg for dibenzo(a,h)anthracene. Although these concentrations exceed non-industrial direct contact criteria, the soil protective of groundwater RCLs were not exceeded. It should be noted that the sample was collected at a depth greater than four feet below grade, and the sample location is in Enbridge’s right-of-way. As an institutional control, Enbridge’s Environment Department must provide approval and guidance before excavation activities may commence in this area. Therefore, the soil at this location was left in place. A comprehensive summary of soil analytical results are in Tables 3A and 3B. The complete laboratory analytical reports were previously submitted to the WDNR in March 2007.
B. **Surface Water Quality**

Immediately following the release, a surface water sample (DSW-2) was collected on two occasions approximately ½-mile downstream of the oil collection area (refer to Figure 8). The surface water samples were submitted for laboratory analysis of PVOC and PAH concentrations. No exceedences of Aquatic Life Criteria were detected (refer to Tables 4A and 4B).

C. **Groundwater Quality**

A groundwater investigation was not conducted, nor is one proposed for the Site. The six to eight inches of frost found throughout the Site, deep clay soils, and a quick response and removal of impacted soils prevented oil from infiltrating through the soil to the water table. Therefore, the potential for groundwater quality impacts due to this release is remote. Groundwater was not encountered during excavation activities (including the interception trench area, which was excavated to approximately nine feet below grade). Nearby well logs indicate groundwater is greater than 20 feet below grade in this area. In addition, soil confirmation samples collected at the Site met the standards for protection of groundwater (refer to Tables 3A and 3B).
V. MARCH 2007 SITE INSPECTION /SURFACE WATER SAMPLING ACTIVITIES

In March 2007, a visual site inspection was conducted. There was no evidence of oil, emulsion, or sheen at the Site. Areas inspected included the spray zone, overland flow area, former interception trench area, and flume pond. A series of photographs collected in March 2007, after remedial activities, is included in Appendix B. Photographs collected at the Site prior to and during remedial activities were included in the March 2007 submittal to the WDNR.

On March 26, 2007, additional surface water samples were collected at the Site. Figure 8 depicts the sample locations. Samples were collected at the outfall of the second flume pond where the surface water leaves the Site (DSW-1), at the culvert south of Cloverdale Road (DSW-2, where surface water samples were previously collected), at the tributary to Nelson Creek along Cardinal Avenue (DSW-3, about 4 ½-miles downstream of the outfall), and where the tributary and Nelson Creek cross Capital Road (DSW-4, about 7 ½-miles downstream of the outfall). DSW-4 was initially proposed to be sampled where the tributary and Nelson Creek meet; however, flood conditions only allowed for a sample to be collected near Capital Road.

Surface water samples were submitted for laboratory analysis of PVOC and PAH concentrations. Naphthalene was the only compound detected above analytical detection limits and the level detected was below the Aquatic Life Criteria (refer to Tables 4A and 4B). The complete laboratory analytical report is included in Appendix C. As expected, the surface water analytical results collected in March 2007 verified the success of the diligent response activities.
VI. SITE RESTORATION

The primary objectives of the remediation activities were to mitigate the risk posed by the release, and to a degree feasible, return the affected area to pre-spill conditions. Restoration actions have been tailored to best address Site conditions, and satisfy landowner requirements.

Enbridge has discussed the best strategy for restoration of the Site with the landowner. One foot of topsoil will be placed over the excavated areas. Later this Summer, the excavated areas will be seeded in accordance with the agreement set forth with the landowner.
VII. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations have been drawn based on remedial activities at the Site.

A. CONCLUSIONS

The following is a summary of conclusions drawn upon the findings during remediation and monitoring activities conducted at the Site:

- Due to a longitudinal weld failure, a release of approximately 1,500 barrels of crude oil occurred from Enbridge’s 24” Line 14 on January 1, 2007 near Owen, Wisconsin (approximate milepost 149.5);
- The majority of the oil was recovered via vacuum trucks and injected back into the pipeline transmission system. The remainder was hauled off-site as oily soil. Approximately 7,428 tons of crude oil impacted soil and vegetation was removed from the Site and hauled to a Wisconsin licensed disposal facility for proper disposal;
- Crude oil was recovered from the open excavations (interception trenches and flume pond) via skimmers and vacuum trucks. Absorbent boom and pads were also used to contain and recover oil;
- The remedial excavation minimized potential risks associated with the Site, which included ingestion/inhalation of crude oil impacted soil as well as ingestion of crude oil impacted groundwater;
- Soil confirmation sampling indicates the Site has been effectively remediated;
- The incident does not pose a threat to private water supply wells in the immediate vicinity of the Site. The nearest private drinking water well is hydraulically remote, being approximately 1,200 feet to the north (up-gradient) of the former release;
Surface water samples collected during and after remedial activities did not exceed surface water Aquatic Life Criteria;

Visual inspection of the Site in March 2007 indicated no evidence of oil/sheen in the spray area, overland flow area or flume pond. In addition, there was no evidence of sheen/emulsion in pooled water along the overland flow area, in the flume pond or at the downstream surface water sample locations;

Site inspection and surface water sampling in March 2007 verified impact from the release has been removed;

Backfilling of the remaining flume pond and grading/seeding activities at the Site are to be conducted in early Summer 2007; and

Enbridge works to prevent future releases through its intensive pipeline maintenance program.

B. RECOMMENDATIONS

The Site meets the criteria for a No Further Action status under NR 708. Immediate action was taken to halt the discharge of crude oil, which minimized the environmental impact to air, lands, and waters of the state. In addition, the necessary emergency actions were conducted to restore the Site to the extent practicable. Therefore, the criteria of NR 708.05 (1) and (2) have been achieved.

In order to obtain No Further Action status, criteria under NR 708.09 were addressed. These criteria are listed in italics below, followed by a response.

- **The type, volume and mobility of the substance discharged**
  - Approximately 1,500 barrels of crude oil was released, some of which traveled surficially via a drainage swale and was contained approximately ¼-mile from the release location;
The duration of the discharge
- Enbridge Control Center noticed an anomaly on Line 14 south of the Owen Station at 0930 CST on January 1, 2007, and proceeded to shutdown Line 14;

Time until the discharge was responded to and properly contained/eliminated
- The release was detected the morning of January 1, 2007 at which time containment/recovery was initiated. Recovery and remediation efforts were completed on January 6, 2007;

Mitigation efforts that may have accelerated the migration of the contamination
- Not applicable;

Weather conditions that may have accelerated migration of the contamination
- The crude oil was contained via a series of interception trenches and flume ponds located approximately ½-mile from the release. Thawing conditions did accelerate movement of oil from the upper reaches of the drainage swale to the interception trenches and flume ponds; however, the oil was contained in this area;

Migration potential of the contaminant, including proximity to surface water, locations of drains, depth to groundwater and the integrity of any containment area
- As previously mentioned, crude oil traveled surficially via a drainage swale and was containment via a series of interception trenches and flume ponds. Surface water, which was free of oil, migrated off-site through the constructed flumes into a tributary that eventually discharges into Nelson Creek. There are no drains or storm sewers in the area. Based on WDNR well construction reports, depth to groundwater in the area is approximately 20 feet below grade;
The nature and scope of immediate actions conducted
- Discussed in Section III;

The results of any sampling conducted to confirm the success of the response
- Discussed in Section IV;

Visual and olfactory evidence of contamination
- In March 2007, there was no evidence of oil/sheen in the spray area, overland flow area or flume pond. In addition, there was no evidence of sheen/emulsion in pooled water along the overland flow area, in the flume pond or at the downstream surface water sample locations;

Actual or potential environmental impacts
- Given the success of the response activities, potential environmental impacts are essentially nonexistent;

Proximity of contamination to receptors
- The nearest well is approximately 1,200 feet north of the Site. It is owned by the Town of Green Grove, supplying one home and the Green Grove Shop;

Present and anticipated future land use
- The present and future land use is agricultural; and

Whether or not routes of exposure are protective and the environment has been restored to the extent practicable
- The remedial excavation minimized potential risks associated with the Site, which included ingestion/inhalation of crude oil impacted soil as well as ingestion of crude oil impacted groundwater. The environment has been restored to the extent practicable based on no evidence of oil at the Site in March 2007 and also the clean surface water analytical results.
Under NR 708.09(2), the following conditions were evaluated to determine if the Site would trigger an NR 716 Site Investigation:

- There is evidence that groundwater wells have been affected by the discharge;
- Free product is found and removal is warranted; and
- There is evidence that contaminated soil may be in contact with groundwater.

The Site does not meet any of these conditions; therefore, an NR 716 Site Investigation is not warranted.

Given the rapid response and successful remediation efforts, the primary objective was achieved, which was to ensure the protection of both human health and the environment. Based on a lack of oil, the clean surface water quality observed at the Site in March 2007, and the fact that the Site meets the conditions under NR 708, it is recommended that a No Further Action status be granted for this Site.
VIII. REFERENCES

(NCDC Owen, WI, Cooperative Station)
http://www.worldclimate.com/cgi-bin/data.pl?ref=N44W090+2200+476357C
Source: OWEN, CLARK COUNTY data derived from
NCDC Cooperative Stations. 45 complete years between 1946 and 1995

(WDNR)
http://dnr.wi.gov/org/caer/ce/eek/earth/groundwater/precip.htm

<table>
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Table 1: Estimated Oil Recovery
Enbridge Energy, Limited Partnership - Line 14 (24") MP 149.5 Release

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<td>1,353 to 1,411</td>
<td>All Oil (OW Skimmer)</td>
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<td></td>
</tr>
<tr>
<td>1/4/2007</td>
<td>3</td>
<td>37 to 74</td>
<td>1,390 to 1,485</td>
<td>90-95% Water</td>
<td></td>
<td></td>
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<tr>
<td>1/5/2007</td>
<td>1</td>
<td>35</td>
<td>1,425 to 1,520</td>
<td>Enbridge All Oil, OSI Oily Water</td>
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</tbody>
</table>

Total Recovered = 1,425 to 1,520 (bbls)
### Table 2: Soil Sample Summary

**Enbridge Energy, Limited Partnership - Line 14 (24") MP 149.5 Release**

<table>
<thead>
<tr>
<th>Location:</th>
<th>Collection Date</th>
<th>Depth (feet below grade)</th>
<th>Headspace Screening (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Figure 5 - Pipe Excavation Sample Locations</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE-1</td>
<td>1/4/2007</td>
<td>4</td>
<td>&lt;5</td>
</tr>
<tr>
<td>PE-2</td>
<td>1/4/2007</td>
<td>5</td>
<td>10.5</td>
</tr>
<tr>
<td>PE-3</td>
<td>1/4/2007</td>
<td>4</td>
<td>&lt;5</td>
</tr>
<tr>
<td>PE-4</td>
<td>1/4/2007</td>
<td>3</td>
<td>&lt;5</td>
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<td>6</td>
<td>&lt;5</td>
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<tr>
<td><strong>Figure 5 - Spray Zone Sample Locations</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SZ-1</td>
<td>1/5/2007</td>
<td>1</td>
<td>&lt;5</td>
</tr>
<tr>
<td>SZ-2</td>
<td>1/5/2007</td>
<td>1</td>
<td>37.3</td>
</tr>
<tr>
<td>SZ-3</td>
<td>1/5/2007</td>
<td>1</td>
<td>&lt;5</td>
</tr>
<tr>
<td>SZ-4</td>
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<td>&lt;5</td>
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<td>&lt;5</td>
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<td>SZ-6</td>
<td>1/5/2007</td>
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<td>&lt;5</td>
</tr>
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<td>SZ-7</td>
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<td>1</td>
<td>0.9</td>
</tr>
<tr>
<td>SZ-10</td>
<td>1/5/2007</td>
<td>1</td>
<td>&lt;5</td>
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<td>SZ-2-R</td>
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<td>1.5</td>
<td>&lt;5</td>
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<tr>
<td><strong>Figure 6 - Overland Flow Sample Locations</strong></td>
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</tr>
<tr>
<td>OF-1</td>
<td>1/5/2007</td>
<td>1</td>
<td>&lt;5</td>
</tr>
<tr>
<td>OF-2</td>
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<td>&lt;5</td>
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<td>&lt;5</td>
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<tr>
<td>OF-10</td>
<td>1/8/2007</td>
<td>1.5</td>
<td>&lt;5</td>
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<tr>
<td>OF-11</td>
<td>1/8/2007</td>
<td>1.5</td>
<td>&lt;5</td>
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<td>1.5</td>
<td>&lt;5</td>
</tr>
<tr>
<td>OF-7-2</td>
<td>1/12/2007</td>
<td>3</td>
<td>&lt;5</td>
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<tr>
<td>OF-8-2</td>
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<td>&lt;5</td>
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<td><strong>Figure 7 - Interception Trench Sample Locations</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>IT-1</td>
<td>1/5/2007</td>
<td>4</td>
<td>0.4</td>
</tr>
<tr>
<td>IT-2</td>
<td>1/5/2007</td>
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<td>IT-3</td>
<td>1/5/2007</td>
<td>4</td>
<td>&lt;5</td>
</tr>
<tr>
<td>IT-4</td>
<td>1/5/2007</td>
<td>3</td>
<td>&lt;5</td>
</tr>
<tr>
<td>IT-5</td>
<td>1/5/2007</td>
<td>3</td>
<td>&lt;5</td>
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<td>&lt;5</td>
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<td>IT-8</td>
<td>1/5/2007</td>
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<td>5</td>
<td>&lt;5</td>
</tr>
<tr>
<td>IT-10</td>
<td>1/5/2007</td>
<td>3</td>
<td>&lt;5</td>
</tr>
<tr>
<td>IT-7-2</td>
<td>1/12/2007</td>
<td>3</td>
<td>&lt;5</td>
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<tr>
<td>IT-8-2</td>
<td>1/12/2007</td>
<td>3</td>
<td>&lt;5</td>
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<tr>
<td><strong>Impacted Soil Stockpile Sample</strong></td>
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<td>CSP-1</td>
<td>1/5/2007</td>
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<td>Not Collected</td>
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<tr>
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<tr>
<td>Clean Soil</td>
<td>1/12/2007</td>
<td>N/A</td>
<td>&lt;5</td>
</tr>
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</table>
### Table 3A: Soil Analytical Results (PVOC)

<table>
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<tr>
<th>Location</th>
<th>Collection Date</th>
<th>1,2,4-Trimethylbenzene</th>
<th>1,3,5-Trimethylbenzene</th>
<th>Benzene</th>
<th>Ethylbenzene</th>
<th>MTBE</th>
<th>Toluene</th>
<th>Xylenes, m,p</th>
<th>Xylene, o</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Protection of Groundwater</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RCL (ug/Kg) *</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figure 5 - Pipe Excavation Sample Locations</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Figure 5 - Spray Zone Sample Locations</td>
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<td>410</td>
<td>82</td>
<td>220</td>
<td>&lt;25</td>
<td>390</td>
<td>980</td>
<td>340</td>
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<td><strong>Figure 6 - Overland Flow Sample Locations</strong></td>
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<td></td>
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</tr>
<tr>
<td>OF-1</td>
<td>1/5/2007</td>
<td>260</td>
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<td>90</td>
<td>&lt;25</td>
<td>200</td>
<td>400</td>
<td>150</td>
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<tr>
<td>OF-7</td>
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<td>240</td>
<td>200</td>
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<td>98</td>
<td>&lt;25</td>
<td>170</td>
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<td>150</td>
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<td>OF-8</td>
<td>1/8/2007</td>
<td>970</td>
<td>710</td>
<td>170</td>
<td>430</td>
<td>&lt;25</td>
<td>920</td>
<td>1,600</td>
<td>820</td>
</tr>
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<td><strong>Figure 7 - Interception Trench Sample Locations</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IT-1</td>
<td>1/5/2007</td>
<td>&lt;25</td>
<td>&lt;25</td>
<td>&lt;25</td>
<td>&lt;25</td>
<td>&lt;25</td>
<td>&lt;50</td>
<td>&lt;25</td>
<td></td>
</tr>
<tr>
<td><strong>Contaminated Soil Stock Pile</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSP-1</td>
<td>1/5/2007</td>
<td>15,000</td>
<td>6,500</td>
<td>9,900</td>
<td>11,000</td>
<td>630</td>
<td>35,000</td>
<td>40,000</td>
<td>14,000</td>
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<tr>
<td><strong>Clean Soil Stock Pile</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Direct Contact Criteria were calculated using USEPA’s IRIS Toxicology data and NR 720.19 assumptions.
Groundwater Criteria are from NR 720.09 Table 1.
Red indicates exceedance of Protection of Groundwater RCL.
Blue indicates exceedance of Direct Contact RCL (soil was hauled off-site for disposal).
Green indicates subsequent excavation and resampling.
### Table 3B: Soil Analytical Results (PAHs)

<table>
<thead>
<tr>
<th>Location</th>
<th>Collection Date</th>
<th>Protection of Groundwater RCL (ug/kg)*</th>
<th>Direct Contact Non-Industrial RCL (ug/kg)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2.3 x 10^4 g/kg</td>
<td>1.1 x 10^4 g/kg</td>
</tr>
<tr>
<td>PE-1</td>
<td>1/15/2007</td>
<td>&lt;3.5</td>
<td>&lt;3.5</td>
</tr>
<tr>
<td>PE-2</td>
<td>1/14/2007</td>
<td>500.0</td>
<td>94.0</td>
</tr>
<tr>
<td>PE-3</td>
<td>1/14/2007</td>
<td>5.6</td>
<td>1.5</td>
</tr>
<tr>
<td>PE-4</td>
<td>1/14/2007</td>
<td>3.7</td>
<td>3.7</td>
</tr>
<tr>
<td>PE-5</td>
<td>1/14/2007</td>
<td>3.7</td>
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<td>PE-6</td>
<td>1/14/2007</td>
<td>3.7</td>
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<td>PE-7</td>
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<td>3.7</td>
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<td>PE-8</td>
<td>1/14/2007</td>
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<tr>
<td>PE-10</td>
<td>1/14/2007</td>
<td>3.7</td>
<td>3.7</td>
</tr>
</tbody>
</table>

*Soil Criteria from WQNR Publication RR-519.07: "Soil Cleanup Levels for Polycyclic Aromatic Hydrocarbons (PAHs) Interim Guidance."

Blue indicates exceedance of Guidance Direct Contact RCL.

Red indicates Direct Contact exceedance, but the sample was collected below 4 depth.

Green indicates subsequent excavation and resampling.
Table 4A: Surface Water Analytical Results (PVOC)
Enbridge Energy, Limited Partnership - Line 14 (24”) MP 149.5 Release
(units are ug/L)

<table>
<thead>
<tr>
<th>Location</th>
<th>1,2,4-Trimethylbenzene</th>
<th>1,3,5-Trimethylbenzene</th>
<th>Benzene</th>
<th>Ethylbenzene</th>
<th>Methyl-tert-butyl ether</th>
<th>Toluene</th>
<th>Xylenes, m,p</th>
<th>Xylene, o</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquatic Life Criteria*</td>
<td>140</td>
<td>230</td>
<td>4,487</td>
<td>150</td>
<td>6,500</td>
<td>1,352</td>
<td>240</td>
<td></td>
</tr>
</tbody>
</table>

Figure 8 - Downstream Surface Water Sample Locations

<table>
<thead>
<tr>
<th>Location</th>
<th>Collection Date</th>
<th>1,2,4-Trimethylbenzene</th>
<th>1,3,5-Trimethylbenzene</th>
<th>Benzene</th>
<th>Ethylbenzene</th>
<th>Methyl-tert-butyl ether</th>
<th>Toluene</th>
<th>Xylenes, m,p</th>
<th>Xylene, o</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSW-1</td>
<td>3/26/07</td>
<td>&lt;0.39</td>
<td>&lt;0.40</td>
<td>&lt;0.14</td>
<td>&lt;0.40</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
<td>&lt;0.74</td>
<td>&lt;0.36</td>
</tr>
<tr>
<td>DSW-2</td>
<td>1/4/07</td>
<td>18</td>
<td>5.9</td>
<td>200</td>
<td>28</td>
<td>&lt;0.36</td>
<td>250</td>
<td>94</td>
<td>44</td>
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<tr>
<td>DSW-2</td>
<td>1/5/07</td>
<td>5</td>
<td>1.7</td>
<td>76</td>
<td>10</td>
<td>&lt;0.36</td>
<td>100</td>
<td>31</td>
<td>16</td>
</tr>
<tr>
<td>DSW-2</td>
<td>3/26/07</td>
<td>&lt;0.39</td>
<td>&lt;0.40</td>
<td>&lt;0.14</td>
<td>&lt;0.40</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
<td>&lt;0.74</td>
<td>&lt;0.36</td>
</tr>
<tr>
<td>DSW-3</td>
<td>3/26/07</td>
<td>&lt;0.39</td>
<td>&lt;0.40</td>
<td>&lt;0.14</td>
<td>&lt;0.40</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
<td>&lt;0.74</td>
<td>&lt;0.36</td>
</tr>
<tr>
<td>DSW-4</td>
<td>3/26/07</td>
<td>&lt;0.39</td>
<td>&lt;0.40</td>
<td>&lt;0.14</td>
<td>&lt;0.40</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
<td>&lt;0.74</td>
<td>&lt;0.36</td>
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<tr>
<td>Field Blank</td>
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<td>&lt;0.39</td>
<td>&lt;0.40</td>
<td>&lt;0.14</td>
<td>&lt;0.40</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
<td>&lt;0.74</td>
<td>&lt;0.36</td>
</tr>
</tbody>
</table>

*Acute Toxicity Surface Water Criteria has not been fully developed, the criteria shown here are “secondary values” from USEPA’s Great Lakes Initiative Clearinghouse that was suggested by James Schmidt of the WDNR for water quality criteria.
### Table 4B: Surface Water Analytical Results: (PAH)
Enbridge Energy, Limited Partnership - Line 14 (24") MP 149.5 Release
(units are ug/l.)

<table>
<thead>
<tr>
<th>Location</th>
<th>Collection Date</th>
<th>1-Methylnaphthalene</th>
<th>2-Methylnaphthalene</th>
<th>Acenaphthene</th>
<th>Acenaphthylene</th>
<th>Anthracene</th>
<th>Benz(a)anthracene</th>
<th>Benz(a)pyrene</th>
<th>Benz(b)fluoranthene</th>
<th>Benzo(k)fluoranthene</th>
<th>Chromene</th>
<th>Dibenz(a,h)anthracene</th>
<th>Fluoranthene</th>
<th>Pyrene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquatic Life Criteria*</td>
<td></td>
<td>42</td>
<td>19</td>
<td>120</td>
<td>0.46</td>
<td>0.2300</td>
<td>0.3846</td>
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<td>3.7</td>
<td>5</td>
<td>344</td>
<td>8</td>
<td>42</td>
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</tbody>
</table>

*Acute Toxicity Surface Water Criteria has not been fully developed, the criteria shown here are "secondary values" from USEPA's Great Lakes Initiative Clearinghouse that was suggested by James Schenck of the WCNR for water quality criteria.

**Figure 8 - Downstream Surface Water Sample Locations**

<table>
<thead>
<tr>
<th>Location</th>
<th>Collection Date</th>
<th>1-Methylnaphthalene</th>
<th>2-Methylnaphthalene</th>
<th>Acenaphthene</th>
<th>Acenaphthylene</th>
<th>Anthracene</th>
<th>Benz(a)anthracene</th>
<th>Benz(a)pyrene</th>
<th>Benz(b)fluoranthene</th>
<th>Benzo(k)fluoranthene</th>
<th>Chromene</th>
<th>Dibenz(a,h)anthracene</th>
<th>Fluoranthene</th>
<th>Pyrene</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSW-1</td>
<td>32/07</td>
<td>&lt;0.011</td>
<td>&lt;0.012</td>
<td>&lt;0.0087</td>
<td>&lt;0.0087</td>
<td>&lt;0.012</td>
<td>&lt;0.017</td>
<td>&lt;0.020</td>
<td>&lt;0.017</td>
<td>&lt;0.021</td>
<td>&lt;0.007</td>
<td>&lt;0.020</td>
<td>0.14</td>
<td>&lt;0.016</td>
</tr>
<tr>
<td>DSW-2</td>
<td>14/07</td>
<td>1.7</td>
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<td>&lt;0.012</td>
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</table>
Spray Zone (see Figure 5)

Drainage Swale/Overland Flow (see Figure 6)

Interception Trenches (see Figure 7)
Figure 4: Excavation Extent Map

Legend
- Enbridge Lines 6A & 14
- Release Location
- Soil Berm
- Extent of Excavation
- Flume Ponds

- Spray Zone (see Figure 5)
- Pipe Excavation (see Figure 5)
- Drainage Swale/Overland Flow (see Figure 6)
- Interception Trenches (see Figure 7)
- Pond #1
- Pond #2
- Outfall

Enbridge Energy, Limited Partnership

Scale: 1 inch = 250 feet

Date Issued: 1/17/2007

Date Revised: 3/9/2007

Drawn by: MLD

SERIES: Clean MP 149.5
Figure 8: Surface Water Sample Locations Map

Legend:
- Extent of Oil
- Release Location
- Proposed Downstream Surface Water Sampling Location
- Downstream Surface Water Sampling Location
- Enbridge Lines 5A & 14

Enbridge Energy, Limited Partnership

Attachment 2 Haisla Nation IR 1.11b)
APPENDIX A –
CASE SUMMARY AND CLOSE OUT REQUEST FORM
This form is intended to provide instructions and a list of information that must be submitted for evaluation for case closure, each time a request is made. The closure of a case means that the Department has determined that no further response is required at that time based on the information that has been submitted to the Department.

NOTICE: Completion of this form is mandatory for applications for case closure pursuant to ch. 292, Wis. Stats. and ch. NR 726, Wis. Adm. Code, including cases closed under ch. NR 746 and ch. NR 726. The Department will not consider, or act upon your application, unless all applicable sections are completed on this form and the closure fee and any other applicable fees, required under ch. NR 749, Wis. Adm. Code, Table 1 are included. It is not the Department’s intention to use any personally identifiable information from this form for any purpose other than reviewing close-out requests and determining the need for additional response action. The Department may provide this information to requesters as required by Wisconsin’s Open Records law [ss. 19.31 - 19.39, Wis. Stats.].

In order to expedite the closure process, provide a complete and accurate closure package according to the following instructions, each time a closure decision is requested:

- Submit the Case Summary and Close Out Form and the required attachments as a stand-alone, unbound package. Include all information requested per section, as appropriate to the site, in the order shown. Include all attachments per section, as appropriate. Do not attach previously submitted reports. Correctly reference any reports in the case summary, as applicable.
- Include fees with this package at the time it is submitted to the department in order for the application to be considered complete.
- Specify your selected closure option.
- Include all GIS Registry Information (in Section I) as a stand-alone document (do not refer to materials in other attachments). Include copies of all off-source property and ROW notifications.
- Place a √ (attached) or NA (not applicable) in the blank next to each attachment, in each section.
- Include a draft of the deed document with the close out application, if a deed restriction or deed notice is required as a condition of closure of the selected remedy. Include a maintenance plan, if it is required in the deed instrument.
- Maps for the GIS Registry may not be larger than 8.5 x 14 inches, unless maps are submitted in electronic form in portable document format (pdf) readable by the Adobe Acrobat Reader. For electronic document submittal requirements, see http://www.dnr.wi.gov/org/aw/rr/archives/pubs/RR690.pdf.
- Prepare maps according to the applicable portions of ss. NR 716.15(2)(h)1 and 726.05(3)(a)4.d. Prepare visual aids, including maps, plans, drawings, cross sections, fence diagrams, tables and photographs according to s. NR 716.15(2)(h)1. – 4.
- Use a bold font on information of importance on tables, maps and figures. A bold font (for ES exceedances) and italics (for PALs) are preferred when differentiation is necessary. Please do not use shading or highlights on any of the analytical tables (per s. NR 726.05(3)) and maps as the shading obscures the information that is scanned for inclusion in the GIS Registry.
- Put multiple tables submitted for contaminated media data (eg. pre- and post-remedial data) in chronological order. Include the level of detection for results which are below the detection level (i.e. do not just list as no detect (ND)). Summaries of all data should include information collected by previous consultants. Do not submit lab data sheets unless these have not been submitted in a previous report. Tabulate all data required in s. NR 716.15(2)(g)3 in the format required in s. NR 716.15(2)(h)3.
- Document free product recovery estimates as required in s. NR 708.15, if applicable.
Section A: Case History and Closure Pathway Selected

ATTACHMENTS:

- A brief site summary including results of all investigative activities, interim and remedial actions taken, a description of any residual soil and/or groundwater contamination and their locations, a description of any other media affected, and a description of how actual and potential impacts to receptors have been addressed.
- Site location map on USGS topographic base map.
- Site map including buildings, utilities, property lines of source property and impacted non-source properties, ground cover and supply wells. These maps may be combined. A copy of the map(s) from Section I, #5 may be used.

INFORMATION NEEDED:

1. Site Name: Embudges (MP 149.5)
   Street Address: 547460
   City/Zip Code:

2. BRRTS #: NA

3. DNR FID #: NA
   PECFA Claim#: NA

4. Responsible Party Name: Embudges Energy Limited Partnership
   Mailing Address: 275 37th Street East
   City/Zip Code: Stillwater 55080
   Contact Person: Joe McGover
   Phone number:
   Date of Incident/Discovery: 10/1/96
   Contaminant Type(s): Grade Oil
   Quantity Released: 4500 Barrels

5. Land Use: Current: 
   Planned Post Remediation: 
   If other, specify: Residential Commercial Industrial Other

6. Is a zoning change required? Y N
   If so, has it been completed for post remedial land use? Y N

7. Acres ready for use (The total area in acres of all adjacent tax parcels owned by the same entity on the site where the contamination originated, rounding fractions to nearest .5 acre and noting >100 acres for acreages above 100 acres. For multiple discharges that are cleaned up concurrently, count the acres once.)(specify):
   Geographic Coordinates (meters/WTM83/91) E 489,577 N 489,930
   Method Used to Obtain Geographic Coordinates:
   Used RR GIS Registry web site to get WTM83/91 coordinates
   Other (specify):

8. Groundwater Contamination Remaining (>ES):
   On Source Property Y N
   Off Source Property Y N

9. Residual Soil Contamination > Generic or Site-Specific RCL:
   On Source Property Y N
   Off Source Property Y N

10. Contamination in Right of Way: Y N

15. Closure Pathway Selected: check all that apply

<table>
<thead>
<tr>
<th>CLOSURE via NR 726</th>
<th>Groundwater</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; s. NR 720.09/720.11 Generic RCLs</td>
<td>&lt; s. NR 140.10 Table 1 &amp; Table 2 Values</td>
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<td>s. NR 720.19(2) Soil Performance Standards</td>
<td>s. NR 140.28(2) PAL Exemption</td>
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<tr>
<td>s. NR 720.19(4) Groundwater Pathway</td>
<td>s. NR 726.05(2)(b), &gt; ES Natural Attenuation</td>
</tr>
<tr>
<td>s. NR 720.19(5) Direct Contact</td>
<td></td>
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<tr>
<td>s. NR 720.19(6) Other Pathways</td>
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</tbody>
</table>
# Case Summary and Close Out Request

**Form 4400-202 (R 5/04)**

**Section A: Notification**

**WDNR BRRTS CASE #** __________ — __________

**WDNR SITE NAME:** Embree (MR 1475)

<table>
<thead>
<tr>
<th>CLOSURE via NR 746 and NR 726</th>
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<tbody>
<tr>
<td>Petroleum Storage Tank Soil Options for Closure:</td>
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<tr>
<td>____ s. NR 746.07 Requirements Met - Post Investigation</td>
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<tr>
<td>____ s. NR 746.08 Requirements Met - Post Remed.</td>
</tr>
<tr>
<td>Petroleum Storage Tank GW Options for Closure:</td>
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<tr>
<td>Within Permeable Material:</td>
</tr>
<tr>
<td>____ s. NR 746.07(3) ≥ PAL, &lt; ES, Post Investigation</td>
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<tr>
<td>____ s. NR 746.07(4) &gt; ES, Post Investigation</td>
</tr>
<tr>
<td>____ s. NR 746.08(3) ≥ PAL, &lt; ES, Post Remediation</td>
</tr>
<tr>
<td>____ s. NR 746.08(4) &gt; ES, Post Remediation</td>
</tr>
<tr>
<td>Petroleum Storage Tank GW Options for Closure:</td>
</tr>
</tbody>
</table>

**Section B: Receptor Summary**

**ATTACHMENTS:**

- Notification(s) regarding contamination in ROW
- Notification(s) to off-source property owners regarding sampling results

**INFORMATION NEEDED:**

1. **Identify all pre-remedial actual receptors, the assessed risk and their locations (e.g., both on- and off-site utility corridors, basements or sumps of nearby buildings, direct contact threat from soil, water supplies, surface waters, sediments, vapors, etc.)**

2. **Have the remedial actions addressed the potential or actual impacts to these receptors?**
   - [ ] Y (Details in the case history summary (Section A)).
   - [ ] N If no, please identify the nature of the remaining risk and the receptor at risk, if any:

**Section C: Soil Investigation Information**

**ATTACHMENTS:**

- Complete soil data summary table of field screening and laboratory analytical results, including all detects, regardless of ch. NR 720 standards, with dates, sample locations, depths and detection limits.
- Identify exceedances.
- Map(s) of all pre-remedial soil sampling locations: depicting all soil sample locations relative to site facilities. Note in bold font those sample locations that exceed ch. NR 720 RCLs (including free product location) and delineate the extent of contamination.

**INFORMATION NEEDED:**

1. **Extent Defined?**
   - [ ] Y
   - [ ] N If not, explain why.

2. **Soil Type(s):** Clay
3. **Depth of Contamination:** Top: **Surface**  < 1 ft
4. **Type of Bedrock:** Upper Cambrian  Depth to Bedrock: **> 50 ft**

---

Note: The text contains a few symbols and abbreviations that are part of the form's standard language. The tables and sections are organized to facilitate the review and closure process of a site investigation by the Department of Natural Resources (WDNR).
State of Wisconsin  
Department of Natural Resources  
http://dnr.wi.gov  

Case Summary and Close Out Request  
Form 4400-202 (R 5/04)  
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WDNR BRRTS CASE # __________ WNR SITE NAME: Enbridge (MP 149.5)

5. Is Any Contaminated Soil (Unsaturated or Saturated) in Contact With the Bedrock? __ Y __ N

6. Measurable Free Product? __ Y __ N  
   Depth/Location: Crude oil was stained superficially along the drainage swale, in the containment trenches and flume ponds.

Section D: Soil Remediation Information

ATTACHMENTS:

Map showing remediated area (for example, excavation limits or area influenced by SVE) and locations of post-remediation soil samples (if any). This map should show the locations and extent of residual soil contamination exceeding ch. NR 720 RCLs. These samples should be noted in bold font. A copy of the map(s) from Section I, #10, may be used.

Soil disposal documentation

NR 720.19 analysis, assumptions and calculations for site specific RCLs (SSRCLs), with justification

Calculations and results of EPA Soil Screening Level Model.

Post-remedial cross-section(s) with post remedial soil sampling results, if soil removal or treatment has occurred. Identify sample results and depths. A copy of the cross-section(s) from Section I, #11, may be used or you may refer to the cross-section(s) in Section E, as appropriate.

INFORMATION NEEDED:

1. Remedial Action Completed? __ Y __ N

2. Were immediate or interim actions conducted? __ Y __ N  
   If yes, what action was taken?

3. Brief description of remedial action taken:

   See above.

4. Were soils excavated? __ Y __ N
   Quantity: __ 7428 tons
   Disposal Method: Landfill

5. Final Confirmation Sample Collection Methods:

   In accordance with the soil sampling plan following WDNR approval.

6. Final Soil/Drill Cuttings Disposal Location:

   Cranberry Goose Landfill (Wisconsin Rapids, WI)

7. Estimated volume and depth of in situ soils exceeding ch. NR 720 Table RCLs or Site Specific RCLs:

   NA

8. Estimated volume and depth of in situ soils exceeding ch. NR 746 Table 1 or Table 2 or Site Specific RCLs (underground petroleum tank systems, as defined in ch. NR 746 only):

   NA

9. s. NR 720.19 Analysis? __ Y __ N

   __ Performance Standard -NR 720.19(2)
   __ SSRCL - NR 720.19(3) and (4),(5) or (6)

10. If the remedy includes a Soil Performance Standard, what type? __ not applicable

   Cap ___ Soil ___ Building ___ Natural Attenuation of Groundwater ___Other

   Specify other:

11. Will the maintenance of the SPS be consistent with the planned post remediation land use? __ Y __ N  
    If No, please explain:

12. Is the EPA Soil Screening Level Model used as justification for closure of sites with residual contaminated soils? __ Y __ N

   Are the input numbers used: ___ Site Specific , or ___ WI Defaults?

Section E: Groundwater Information

ATTACHMENTS:

Table identifying all contaminants, summarizing all pre- and post-remediation groundwater analytical results, with sample collection dates (prepared in accordance with guidance document RR-628)

Groundwater sample location map showing the site facilities and all monitoring wells, sumps, extraction wells, and potable and non-potable wells.
Isoconcentration map(s) when included as part of the site investigation or map(s) of the horizontal extent of contamination based on most recent data. A copy of the map(s) from Section I, #7, may be used.

A map showing groundwater flow direction(s) and summarizing the maximum variation in flow direction. Multiple maps may be used. A copy of the map(s) from Section I, #9, may be used.

A table summarizing all groundwater elevations, with dates, and top and bottom elevations of well screens. (Wells are to be referenced to national geodetic survey datum, as per NR 141.065(2)).

Graphs and statistical analyses which demonstrate the dynamics of the groundwater plume, for sites requesting closure using natural attenuation that meet the criteria s. NR 726.05(2)(b) or s. NR 746 (permeable soils). Refer to WDNR publication RR-614 for guidance.

Geologic cross-sections showing extent of residual soil and/or groundwater contamination, as applicable. A copy of the cross-section(s) from Section I, #11 may be used.

**INFORMATION NEEDED:**

1. Extent of Contamination Defined? __ Y __ N __ N/A

2. Remedial Action Completed? __ Y __ N __ N/A

   **Brief Description of Remedial Action Taken:**

3. Depth(s) to Groundwater: __ 20 ft __ Flow Direction(s): __ South __

4. Field Analyses? __ Y __ N __

5. Lab Analyses? __ Y __ N __

   **# of Sample Rounds**
   - __
   - __
   - __
   - __
   - __

   **# of Sampling Points**
   - __
   - __
   - __
   - __
   - __

   **# NR 141 Monitoring Wells Sampled**
   - __
   - __
   - __
   - __
   - __

   **# Temporary GW Sampling Points Sampled**
   - __
   - __
   - __
   - __
   - __

   **# Recovery Sumps Sampled**
   - __
   - __
   - __
   - __
   - __

   **# Municipal Wells Sampled**
   - __
   - __
   - __
   - __
   - __

   **# Private Wells Sampled**
   - __
   - __
   - __
   - __
   - __

6. Was DNR notified of substances in groundwater without standards? __ Y __ N __ N/A

   If yes, how many? __ What substances? __

7. Preventive Action Limit currently exceeded? __ Y __ N __ If yes, identify location(s) __

8. Enforcement Standard currently exceeded? __ Y __ N __ If yes, identify location(s) __

9. Measurable free product detected? __ Y __ N __ Pre-remediation __

10. Was free product remediated? __ Y __ N __ Post-remediation __

   **Method:**
   - __
   - __

   Purge water or free product-groundwater mixture disposal method? __

11. Potable wells within 1200 feet of site? __ Y __ N __ (If well within 1200 ft ungraded)

   **Have they been sampled?**
   - __
   - __

   **Type (i.e. municipal, private, etc.):**
   - __
   - __

   **[NOTE: Include wells on groundwater well location map]**

12. Has DNR been provided with all results of private well sampling? __ Y __ N __

13. Have well owners/occupants been notified of results? (Sec. B Attachments) __ Y __ N __

   **(Results also need to be sent to the DNR Water Supply Specialist)**

**Section F. Other Contaminated Media Information:**

**ATTACHMENTS:**

- Table of analytical results for all contaminants for media other than soil or groundwater
INFORMATION NEEDED:
1. Have other media been impacted (either on-site or off-site e.g. sediment, utilities, air)?
   - Y / N
   Briefly describe type and extent of all contamination found in media other than soil or groundwater:
   
2. Remedial action completed? Y / N / N/A
   Brief description of remedial action taken:
   
3. # of Post Remedial Sample Rounds:
   - Y / N / N/A
   # of Sampling Points:
   
   Field Analyses? Y / N
   Lab Analyses? Y / N

Section G. Associated Site Closure Information:

ATTACHMENTS:
- Construction documentation or as-built report for any constructed remedial action or portion of, or
  interim action specified in s. NR 724.02(1), in accordance with s. NR 724.15.
- Maps and photos documenting the cap area, and/or integrity of the cap, with date.
- Description of any soil performance standard cover system used, including a description of how it meets
  the requirement to be protective until residual contaminant concentrations no longer pose a threat to
  public health, safety, welfare or the environment, per s. NR 720.19(2), s. NR 722.09(2) and (3).
- Maintenance plan with deed restriction for performance standard remedy. (per ss. NR 720.19(2) and
  724.13(2))

INFORMATION NEEDED:
1. Enforcement actions closed out? Y / N / N/A
2. Permits closed out? Y / N / N/A
3. Describe how the following pathways are protected:
   a) Direct Contact Pathway:
      Direct contact soil & surface water risk vectors were
      mitigated through soil excavation and recovery of crude oil
   b) Groundwater:
      Given the six to eight inches of least clay soils and
      rapid response, a potential threat to groundwater quality is relatively non-existent.
   c) Other:

H. Proposed Institutional Controls: (See Pub. RR-606)

ATTACHMENTS:
- RR GIS Registry of Closed Remediation Sites
  - Soil
  - Groundwater
  - Both

- Draft deed document (Contact your DNR project manager for a template or guidance.)
  Type:
  - Deed Restriction
  - Deed Notice
  - Maintenance Agreement
  - Other:
I. Required GIS Registry Information: Provide the following information, as a separate, stand-alone attachment, in the order specified.

1. Copy(s) of most recent deed, including legal description(s), for all affected properties within or partially within the contaminated site boundary. (NOTE: If a property has been purchased with a land contract and the purchaser has not yet received a deed, a copy of the land contract which includes the legal description shall be submitted instead of the most recent deed. If the property has been inherited, written documentation of the property transfer should be submitted along with the most recent deed.)

2. A copy of certified survey map(s), as required by s. NR 716.15(2)(g)2., or the relevant section of the recorded plat map for those properties where the legal description in the most recent deed refers to a certified survey map or a recorded plat map (lots on subdivided or platted property (e.g., lot 2 of xyz subdivision).

3. The parcel identification number (if county uses them) for each property within the contaminated site boundaries. Include the address of each property within the contaminated site boundary (regardless of whether parcel id # exists). Geographic position data for each property (meters in WTM83/92 projection) in compliance with the requirements of s. NR 716.15 (2)(k), unless this information was previously submitted to the agency with administrative authority for the site as part of the site investigation report, unless the agency with administrative authority has directed that the responsible party does not need to provide geographic position data for a specific site.

4. A site location map which outlines all properties within the contaminated site boundaries on a U.S.G.S. topographic map or plat map in sufficient detail to permit the easy location of all parcels. If groundwater standards are exceeded, the map must also include the location of all municipal and potable wells within 1200 feet of the site. (If only one property, combine with map required in next item #5.)

5. A map of contaminated properties within the site boundary showing buildings, roads, property boundaries, contaminant sources, utility lines, monitoring wells and potable wells. This map shall also show the location of all contaminated public streets, and highway and railroad rights-of-way in relation to the source property and in relation to the boundaries of groundwater contamination exceeding ch. NR 140 enforcement standards, and/or in relation to the boundaries of soil contamination exceeding generic or site-specific residual contaminant levels as determined under s. NR 720.09, 720.11 and 720.19.

6. A table of the most recent analytical results, with sample collection dates from all monitoring wells, and any potable wells for which samples have been collected for groundwater, and/or showing results for all contaminants found in pre-remedial sampling and in the most recent soil sampling event, for soils (without shading or crosshatching). Include the date measurements were made, is to be included. If present, note free product location(s).

7. A groundwater isoconcentration map, if required as part of the site investigation (SI), of the contaminated properties within the site boundaries. The map must include the areal extent of groundwater contamination exceeding PALS and the areal extent of groundwater contamination exceeding ESs, groundwater flow direction(s) based on the most recent data, and sample collection dates. If an isoconcentration map was not required as part of the SI, substitute a map showing the horizontal extent of contamination, based on the most recent data. Note free product location(s).

8. A table of the previous 4 water level elevation measurements from all monitoring wells, at a minimum, with the date measurements were made, is to be included. If present, note free product elevation and thickness on the table.

9. A groundwater flow direction map representative of groundwater movement at the site. If the flow direction varies by more than 20° over the history of the site, 2 groundwater flow maps showing the maximum variation in flow direction are to be submitted. Prepare maps according to the applicable portions of ss. NR 716.15(2)(g)5-8 and 716.15(2)(h)1-2.

10. For sites closing with residual soil contamination, include a map showing the location of all soil samples and a single contour showing the horizontal extent of each area of contiguous residual soil contamination that exceeds generic or site specific residual contaminant levels.

11. A geologic cross section, if required as part of the SI, showing vertical extent and location of residual soil contamination exceeding generic or site specific RCLs and residual groundwater contamination, source extent and location, isoconcentrations for all groundwater contaminants that exceed PALs that remain when closure is requested; water table and piezometric elevations, and the location and elevation of geologic units, bedrock, and confining units, if any.

12. A statement signed by the responsible party, which states that he or she believes that the legal description has been attached for each property that is within, or partially within, the contaminated site boundary. (The purpose of this requirement is that a legal description for each of the contaminated properties has been submitted. The RP is not required to attest to the accuracy of the attached legal descriptions.)
State of Wisconsin
Department of Natural Resources
http://dnr.wi.gov

Case Summary and Close Out Request
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WDNR BRRTS CASE # _______ _______ _______ WDNR SITE NAME: Edgudge (MP 149.5)

13. A copy of the letters sent by the RP to all owners of properties with groundwater exceeding ESs as required by s. NR 726.05(3)(a)4g. Letters sent to off-source properties must contain standard provisions in Appendix A of ch. NR 726. (Off source properties are listed separately on the GIS Registry with a link to the source property.) If the source property is owned by someone other than the person who is applying for case closure, a copy of the letter notifying the current owner of the source property that case closure has been requested should also be included.

14. A copy of all written notifications provided to the city/village/municipal/state agency or other entity responsible for maintenance of a public street or highway or railroad right-of-way, within or partially within the boundaries of the contaminated site, for contamination exceeding groundwater ESs and/or soil exceeding generic or site specific RCLs.

15. A list of addresses for all off-source properties affected by residual soil or groundwater contamination exceeding applicable standards.

I certify that, to the best of my knowledge, the information presented on and attached to this form is true and accurate. This recommendation for case closure is based upon all available data as of 5/3/02 (date). I have read the Case Summary and Close Out Form instructions and all required information has been included.

Form Completed By: ___________ (Signature) ___________ (Date)

_____ $750.00 Closeout Review Fee Attached
_____ $250.00 GIS Registry Maintenance Fee Attached (GW)
_____ $200.00 GIS Registry Maintenance Fee Attached (Soil)

Printed Name: Barry F. Power
Company Name: NREC

Email address: bpower@arecompany.com
If not site owner, relationship to site owner: consultant
Address: 1409 Hammond Ave - Suite 110 City/Zip Code: Superior, 54880
Telephone Number: (715) 395-5650 FAX Number: (715) 395-5681

Environmental Consultant (if different than above):
Address: ___________________________ City/Zip Code: ___________________________
Telephone Number: (____) ____________ FAX Number: (____) ____________
FOR DEPARTMENT USE ONLY

PROJECT MANAGER: __________________________ Date Reviewed: __________________________

( ) Approved ( ) Denied ( ) Sent to Committee

CLOSURE COMMITTEE DECISION ON CLOSURE:

FIRST COMMITTEE REVIEW DATE: ________________ ( ) Approved ( ) Denied

(Signature) (Signature) (Signature) (Signature)

COMMITTEE RECOMMENDATION:

Closure Approved With:

- No Restrictions
- Listing on GIS Registry due to Groundwater impacts
- Listing on GIS Registry due to Soil impacts
- Zoning Verification
- Deed Restriction
- Deed Notice
- Site Specific Close Out Letter
- Well Abandonment Documentation
- Soil Disposal Documentation
- NR 140 Exemption For:
- VPLE Insurance needed
- Other Conditions/Comments: __________________________

________________________

________________________

________________________

________________________

Closure Denied, Needs More:

- Investigation
- Groundwater Monitoring
- Soil Remediation
- Groundwater Remediation
- Documentation of Soil Landspreading or Biopile Destiny
- Specific Comments: __________________________

________________________

________________________

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________________________
FOR DEPARTMENT USE ONLY

PROJECT MANAGER: ____________________ Date Reviewed: ____________________

( ) Approved ( ) Denied ( ) Sent to Committee

CLOSURE COMMITTEE DECISION ON CLOSURE:

SECOND COMMITTEE REVIEW DATE: ________________ ( ) Approved ( ) Denied

(Signature) (Signature) (Signature)

COMMITTEE RECOMMENDATION:

_____ Closure Approved With:

- No Restrictions
- Listing on GIS Registry due to Groundwater impacts
- Listing on GIS Registry due to Soil Impacts
- Zoning Verification
- Deed Restriction
- Deed Notice
- Site Specific Close Out Letter
- Well Abandonment Documentation
- Soil Disposal Documentation
- NR 140 Exemption For: __________________________________________
- VPLE Insurance needed
- Other Conditions/Comments: ______________________________________

Closure Denied, Needs More:

- Investigation
- Groundwater Monitoring
- Soil Remediation
- Groundwater Remediation
- Documentation of Soil Landspreading or Biopile Destiny
- Specific Comments: ______________________________________________

________________________________

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APPENDIX B – PHOTOGRAPHS (MARCH 2007)
Spray zone looking southwest.

Pooled water near the spray zone (no evidence of sheen).
Overland flow area looking southwest.

Overland flow area looking north.
Flume pond and DSW-1 sample location (no evidence of sheen).

Area between DSW-1 and DSW-2 (no evidence of sheen).
Aerial Photographs of Owen Leak Site Before and After Remedial Activities

Owen Leak Site near MP 149.5 the day of the release looking south.

Owen Leak Site near MP 149.5 three months after the release looking southwest.
**Analytical Report Number: 882003**

**Client:** NATURAL RESOURCES ENGINEERING CO.  
**Project Name:** ENBRIDGE M149.5  
**Lab Contact:** Eric Bullock

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I certify that the data contained in this Final Report has been generated and reviewed in accordance with approved methods and Laboratory Standard Operating Procedure. Exceptions, if any, are discussed in the accompanying sample comments. Release of this final report is authorized by Laboratory management, as is verified by the following signature. This report shall not be reproduced, except in full, without the written consent of Pace Analytical Services, Inc. The sample results relate only to the analytes of interest tested.

[Signature]  
4/3/07  
Approval Signature  
Date
### Pace Analytical Services, Inc.

**Analytical Report Number:** 882003

**Client:** NATURAL RESOURCES ENGINEERING CO.
**Project Name:** ENBRIDGE MP 149 S
**Project Number:**
**Field ID:** DSW-1

---

**Services, Inc.**
940-461-2436

**Matrix Type:** WATER
**Collection Date:** 03/26/07
**Report Date:** 04/02/07

**Lab Sample Number:** 882003-001

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**Surrogate**

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**Notes:**
- PVOC: Polycyclic Aromatic Compounds
- PAH: Polynuclear Aromatic Hydrocarbons
- PNA: Polynuclear Aromatic Hydrocarbons
- LOD: Limit of Detection
- LOQ: Limit of Quantification
- EQL: Equivalent Quantity Limit
- Dil.: Dilution Factor
- Units: ug/L
- Prep: Preparation Method
- Anl: Analysis Method

---

**Attachment 2:** Haisla Nation IR 1.11b)
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## Analytical Report Number: 882003

### Client: NATURAL RESOURCES ENGINEERING CO.

### Project Name: ENBRIDGE MP149.5

### Field ID: DSW-4

### Services, Inc.

1241 Bellevue Street  
Green Bay, WI 54302  
920-689-2439

**Matrix Type:** WATER  
**Collection Date:** 03/25/07  
**Report Date:** 04/02/07  
**Lab Sample Number:** 882003-004

### Project Number:

- **Ham.:** ENBRIDGE MP149.5  
- **Collection DN:** 03l26107  
- **Report One:** 04J02J07  
- **PfikIO:** OSW-4  
- **Lab Sample:** 88200J.004  
- **PVOC Prep ME:** 03l3Of07  
- **Analyte Result:** 08.10

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### Nitrobenzene-d5

| Nitrobenzene-d5            | 43     | 1    | 0.15 | 1   | ug/L |      |      | 03/30/07 | SW846 3510C | 8270C-SIM |

### 2-Fluorobiphenyl

| 2-Fluorobiphenyl           | 45     | 2    | 0.11 | 1   | ug/L |      |      | 03/30/07 | SW846 3510C | 8270C-SIM |

### Terphenyl-d14

| Terphenyl-d14             | 60     | 4    | 0.11 | 1   | ug/L |      |      | 03/30/07 | SW846 3510C | 8270C-SIM |
### Pace Analytical Services, Inc. Analytical Report Number: 882003

**Client:** NATURAL RESOURCES ENGINEERING CO  
**Project Name:** ENBRIDGE MP149.5  
**Project Number:**  
**Field ID:** FIELD BLANK

**Matrix Type:** WATER  
**Collection Date:** 03/26/07  
**Report Date:** 04/02/07  
**Lab Sample Number:** 882003-005

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**Surrogate:** LCL UCL

- a,a,a-Trifluorotoluene: 5.9%  
- p,p'-DDE: 80%  
- p,p'-DDT: 124%  
- 1%  

#### PAH/PNA

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**Surrogate:** LCL UCL

- Nitrobenzene-d5: 62%  
- 2-Fluorobiphenyl: 74%  
- Terphenyl-d14: 76%
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<td>SW846 8021B</td>
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<td>All Samples</td>
<td>Insufficient sample volume received to perform the method required MS/MSD.</td>
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<td>B - Naphthalene present in Extraction blank at 0.014ug/l.</td>
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Qualifier Codes

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<th>Explanation</th>
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<td>A</td>
<td>Inorganic</td>
<td>Analyte is detected in the method blank. Method blank criteria is evaluated to the laboratory method detection limit. Additionally, method blank acceptance may be based on project specific criteria or determined from analyte concentrations in the sample and are evaluated on a sample by sample basis.</td>
</tr>
<tr>
<td>B</td>
<td>Inorganic</td>
<td>The analyte has been detected between the method detection limit and the reporting limit.</td>
</tr>
<tr>
<td>B</td>
<td>Organic</td>
<td>Analyte is present in the method blank. Method blank criteria is evaluated to the laboratory method detection limit. Additionally, method blank acceptance may be based on project specific criteria or determined from analyte concentrations in the sample and are evaluated on a sample by sample basis.</td>
</tr>
<tr>
<td>C</td>
<td>All</td>
<td>Elevated detection limit.</td>
</tr>
<tr>
<td>D</td>
<td>All</td>
<td>Analyte value from diluted analysis or surrogate result not applicable due to sample dilution.</td>
</tr>
<tr>
<td>E</td>
<td>Inorganic</td>
<td>Estimated concentration due to matrix interferences. During the metals analysis the serial dilution failed to meet the established control limits of 0-10%. The sample concentration is greater than 50 times the IDL for analysis done on the ICP or 100 times the IDL for analysis done on the ICP-MS. The result was flagged with the E qualifier to indicate that a physical interference was observed.</td>
</tr>
<tr>
<td>E</td>
<td>Organic</td>
<td>Analyte concentration exceeds calibration range.</td>
</tr>
<tr>
<td>F</td>
<td>Inorganic</td>
<td>Due to potential interferences for this analysis by Inductively Coupled Plasma techniques (SW-846 Method 6010), this analyte has been confirmed by and reported from an alternate method.</td>
</tr>
<tr>
<td>F</td>
<td>Organic</td>
<td>Surrogate results outside control criteria.</td>
</tr>
<tr>
<td>G</td>
<td>All</td>
<td>The result is estimated because the concentration is less than the lowest calibration standard concentration utilized in the initial calibration. The method detection limit is less than the reporting limit specific for this project.</td>
</tr>
<tr>
<td>H</td>
<td>All</td>
<td>Preservation, extraction or analysis performed past holding time.</td>
</tr>
<tr>
<td>HF</td>
<td>Inorganic</td>
<td>This test is considered a field parameter, and the recommended holding time is 15 minutes from collection. The analysis was performed in the laboratory beyond the recommended holding time.</td>
</tr>
<tr>
<td>J</td>
<td>All</td>
<td>Concentration detected equal to or greater than the method detection limit but less than the reporting limit.</td>
</tr>
<tr>
<td>K</td>
<td>Organic</td>
<td>Detection limit may be elevated due to the presence of an unrequested analyte.</td>
</tr>
<tr>
<td>L</td>
<td>All</td>
<td>Elevated detection limit due to low sample volume.</td>
</tr>
<tr>
<td>M</td>
<td>Organic</td>
<td>Sample pH was greater than 2.</td>
</tr>
<tr>
<td>N</td>
<td>All</td>
<td>Spiked sample recovery not within control limits.</td>
</tr>
<tr>
<td>O</td>
<td>Organic</td>
<td>Sample received overweight.</td>
</tr>
<tr>
<td>P</td>
<td>Organic</td>
<td>The relative percent difference between the two columns for detected concentrations was greater than 40%.</td>
</tr>
<tr>
<td>Q</td>
<td>All</td>
<td>The analyte has been detected between the limit of detection (LOD) and limit of quantitation (LOQ). The results are qualified due to the uncertainty of analyte concentrations within this range.</td>
</tr>
<tr>
<td>S</td>
<td>Organic</td>
<td>The relative percent difference between quantitation and confirmation columns exceeds internal quality control criteria. Because the result is unconfirmed, it has been reported as a non-detect with an elevated detection limit.</td>
</tr>
<tr>
<td>U</td>
<td>All</td>
<td>The analyte was not detected at or above the reporting limit.</td>
</tr>
<tr>
<td>V</td>
<td>All</td>
<td>Sample received with headspace.</td>
</tr>
<tr>
<td>W</td>
<td>All</td>
<td>A second aliquot of sample was analyzed from a container with headspace.</td>
</tr>
<tr>
<td>X</td>
<td>All</td>
<td>See Sample Narrative.</td>
</tr>
<tr>
<td>Z</td>
<td>Organic</td>
<td>This compound was separated in the check standard but it did not meet the resolution criteria as set forth in SW846.</td>
</tr>
<tr>
<td>R</td>
<td>All</td>
<td>Laboratory Control Spike recovery not within control limits.</td>
</tr>
<tr>
<td>*</td>
<td>All</td>
<td>Precision not within control limits.</td>
</tr>
<tr>
<td>+</td>
<td>Inorganic</td>
<td>The sample result is greater than four times the spike level; therefore, the percent recovery is not evaluated.</td>
</tr>
<tr>
<td>&lt;</td>
<td>All</td>
<td>The analyte was not detected at or above the reporting limit.</td>
</tr>
<tr>
<td>1</td>
<td>Inorganic</td>
<td>Dissolved analyte or filtered analyte greater than total analyte; analyses passed QC based on precision criteria.</td>
</tr>
<tr>
<td>2</td>
<td>Inorganic</td>
<td>Dissolved analyte or filtered analyte greater than total analyte; analyses failed QC based on precision criteria.</td>
</tr>
<tr>
<td>3</td>
<td>Inorganic</td>
<td>BOD result is estimated due to the BOD blank exceeding the allowable oxygen depletion.</td>
</tr>
<tr>
<td>4</td>
<td>Inorganic</td>
<td>BOD duplicate precision not within control limits. Due to the 48 hour holding time for this test, it is not practical to reanalyze and try to correct the deficiency.</td>
</tr>
<tr>
<td>5</td>
<td>Inorganic</td>
<td>BOD result is estimated due to insufficient oxygen depletion. Due to the 48 hour holding time for this test, it is not practical to reanalyze and try to correct the deficiency.</td>
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<tr>
<td>6</td>
<td>Inorganic</td>
<td>BOD laboratory control sample not within control limits. Due to the 48 hour holding time for this test, it is not practical to reanalyze and try to correct the deficiency.</td>
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<tr>
<td>7</td>
<td>Inorganic</td>
<td>BOD result is estimated due to complete oxygen depletion. Due to the 48 hour holding time for this test, it is not practical to reanalyze and try to correct the deficiency.</td>
</tr>
<tr>
<td>8</td>
<td>Inorganic</td>
<td>Sample was received unpreserved. Sample was preserved either at the time of receipt or at the time of sample preparation.</td>
</tr>
<tr>
<td>9</td>
<td>Inorganic</td>
<td>Sample was received with insufficient preservation. Acid was added either at the time of receipt or at the time of sample preparation.</td>
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</table>
### Analysis Summary by Laboratory

**Test Group Name**

| PAH/ PNA | B | B | B | B | B |
| PVOC    |   |   |   |   |   |

**Code  WI Certification**

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<td>G</td>
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**Address**

Pace Analytical Services, Inc.

1241 Bellevue Street
Green Bay, WI 54302
## QC Summary

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<tr>
<th>Test Name</th>
<th>Method Blank Result Conc</th>
<th>LCS Spiked Conc</th>
<th>LCS Recovery %</th>
<th>LCSD Spiked Conc</th>
<th>LCSD Recovery %</th>
<th>LCS/ LCSD Control Limits</th>
<th>Client Sample ID</th>
<th>Lab Sample ID</th>
<th>MB ID</th>
<th>Client Sample ID</th>
<th>Lab Sample ID</th>
<th>MB ID</th>
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Conc = ug/L, unless otherwise noted
C = QC Code, see Qualifier Sheet
Parent Result is reported down to MDL in order to allow Validation of this worksheet
The %R and RPD results are calculated from raw data values with more significant figures than are reported on this form.
**QC Summary**

**Batch:** 882003  
**Lab Section:** GAS  
**QC Batch Number:** 19313  
**Prep Method:** SW846 5030B  
**Analytical Method:** SW846 8021B

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<th>Client Sample ID</th>
<th>Lab Sample ID</th>
<th>MB ID</th>
<th>Client Sample ID</th>
<th>Lab Sample ID</th>
<th>MB ID</th>
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<tr>
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<td>MB</td>
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<th>Method Blank</th>
<th>Result Conc</th>
<th>LCS Spiked Conc</th>
<th>LCS Recovery % C</th>
<th>LCSD Spiked Conc</th>
<th>LCSD Recovery % C</th>
<th>LCS/LCSD Control Limits</th>
<th>Parent Sample Number</th>
<th>Parent Result Conc</th>
<th>MS Spiked Conc</th>
<th>MS Recovery % C</th>
<th>MSD Spiked Conc</th>
<th>MSD Recovery % C</th>
<th>MS/MSD Control Limits</th>
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</thead>
<tbody>
<tr>
<td>1,2,4-Trimethylbenzene</td>
<td>&lt; 0.30</td>
<td>0.0 ± 20.6</td>
<td>100</td>
<td>20.0</td>
<td>20.0 ± 20.8</td>
<td>104</td>
<td>1.1</td>
<td>82</td>
<td>116</td>
<td>20</td>
<td>1.1</td>
<td>82</td>
<td>116</td>
<td>20</td>
</tr>
<tr>
<td>1,3,5-Trimethylbenzene</td>
<td>&lt; 0.4</td>
<td>0.4 ± 20.0</td>
<td>120</td>
<td>20.0</td>
<td>20.0 ± 20.9</td>
<td>104</td>
<td>1.3</td>
<td>82</td>
<td>116</td>
<td>20</td>
<td>1.3</td>
<td>82</td>
<td>116</td>
<td>20</td>
</tr>
<tr>
<td>Benzoate</td>
<td>&lt; 0.14</td>
<td>0.14 ± 21.5</td>
<td>108</td>
<td>20.0</td>
<td>20.0 ± 21.7</td>
<td>109</td>
<td>1.0</td>
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<td>115</td>
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<td>1.0</td>
<td>85</td>
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<td>20</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>&lt; 0.4</td>
<td>0.4 ± 20.0</td>
<td>108</td>
<td>20.0</td>
<td>20.0 ± 21.6</td>
<td>109</td>
<td>1.2</td>
<td>85</td>
<td>115</td>
<td>20</td>
<td>1.2</td>
<td>85</td>
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<td>20</td>
</tr>
<tr>
<td>Methyl-2-ethyl-ether</td>
<td>&lt; 0.35</td>
<td>0.35 ± 21.0</td>
<td>100</td>
<td>20.0</td>
<td>20.0 ± 21.2</td>
<td>105</td>
<td>0.9</td>
<td>82</td>
<td>116</td>
<td>20</td>
<td>0.9</td>
<td>82</td>
<td>116</td>
<td>20</td>
</tr>
<tr>
<td>Toluene</td>
<td>&lt; 0.36</td>
<td>0.36 ± 21.6</td>
<td>108</td>
<td>20.0</td>
<td>20.0 ± 21.9</td>
<td>109</td>
<td>1.1</td>
<td>85</td>
<td>115</td>
<td>20</td>
<td>1.1</td>
<td>85</td>
<td>115</td>
<td>20</td>
</tr>
<tr>
<td>Xylenes, m + p</td>
<td>&lt; 0.74</td>
<td>0.74 ± 42.3</td>
<td>108</td>
<td>40.0</td>
<td>40.0 ± 43.0</td>
<td>107</td>
<td>1.2</td>
<td>83</td>
<td>115</td>
<td>20</td>
<td>1.2</td>
<td>83</td>
<td>115</td>
<td>20</td>
</tr>
<tr>
<td>Xylenes, o</td>
<td>&lt; 0.36</td>
<td>0.36 ± 21.9</td>
<td>108</td>
<td>20.0</td>
<td>20.0 ± 21.1</td>
<td>106</td>
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<td>85</td>
<td>115</td>
<td>20</td>
<td>0.8</td>
<td>85</td>
<td>115</td>
<td>20</td>
</tr>
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<td>Total Tricresylate</td>
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<td>—</td>
<td>100</td>
<td>—</td>
<td>100</td>
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<td>—</td>
<td>100</td>
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</tbody>
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Conc = ug/L, unless otherwise noted  
C = QC Code, see Qualifier Sheet  
Report Date: 4/2/2007  
QC Batch Number: 19313  
Page 12  
The %R and RPD results are calculated from raw data values with more significant figures than are reported on this form.
<table>
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<th>Sample Condition Upon Receipt</th>
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</thead>
<tbody>
<tr>
<td><strong>Client Name:</strong></td>
</tr>
<tr>
<td><strong>Courier:</strong> Fed Ex, UPS, UPS, Client, Other</td>
</tr>
<tr>
<td><strong>Tracking #:</strong> 38508358</td>
</tr>
<tr>
<td><strong>Packing Material:</strong> Bubble Wrap, Bubble Bag, None, Other</td>
</tr>
<tr>
<td><strong>Cooler Temperature:</strong> Yes, No</td>
</tr>
<tr>
<td><strong>Thermometer Used:</strong> Yes, No, Intact: Yes, No</td>
</tr>
<tr>
<td><strong>Chain of Custody Present:</strong> Yes, No</td>
</tr>
<tr>
<td><strong>Chain of Custody Filled Out:</strong> Yes, No</td>
</tr>
<tr>
<td><strong>Chain of Custody Relinquished:</strong> Yes, No</td>
</tr>
<tr>
<td><strong>Sampler Name &amp; Signature on COC:</strong> Yes, No, Intact: Yes, No</td>
</tr>
<tr>
<td><strong>Samples Arrived within Hold Time:</strong> Yes, No, Intact: Yes, No</td>
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<tr>
<td><strong>Short Hold Time Analysis (&lt;72hr):</strong> Yes, No, Intact: Yes, No</td>
</tr>
<tr>
<td><strong>Rush Turn Around Time Requested:</strong> Yes, No, Intact: Yes, No</td>
</tr>
<tr>
<td><strong>Sufficient Volume:</strong> Yes, No, Intact: Yes, No</td>
</tr>
<tr>
<td><strong>Correct Containers Used:</strong> Yes, No, Intact: Yes, No</td>
</tr>
<tr>
<td><strong>Pace Containers Used:</strong> Yes, No, Intact: Yes, No</td>
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</table>

<table>
<thead>
<tr>
<th>Client Notification/ Resolution:</th>
<th>Field Data Required?</th>
<th>Y / N</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Person Contacted:</strong></td>
<td><strong>Date/Time:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Comments/ Resolution:</strong></td>
<td></td>
<td></td>
</tr>
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</table>

**Project Manager Review:**

**Date:** 163/28/07

**Note:** Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHRR Certification Office (i.e. out of hold, incorrect preservative, out of temp, incorrect containers)
### Section A
**Required Client Information:**
- **Company:** ANC
- **Address:** 1461 Hammond Ave - Suite 110, Superior, WI 54880
- **Email:** HR@anccompany.com
- **Phone:** 715-399-3251

### Section B
**Required Project Information:**
- **Request By:** Joe McGowan

### Section C
**Invoice Information:**
- **Attention:** Barry Rower

### Section D
**Sample ID**

<table>
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<tr>
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<th>SAMPLE ID</th>
<th>COMPOSITE START</th>
<th>COMPOSITE END</th>
<th>DATE</th>
<th>TIME</th>
<th>DATE</th>
<th>TIME</th>
<th>MATRIX CODE</th>
<th>ORIGIN</th>
<th>TEAM CODE</th>
<th>SIGNATURE</th>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>D5W-2</td>
<td>002</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td></td>
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<tr>
<td>3</td>
<td>D5W-3</td>
<td>003</td>
<td></td>
<td>x</td>
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<td>x</td>
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<td></td>
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</tr>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### Additional Comments:

---

**CHAIN-OF-CUSTODY / Analytical Request Document**

*The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.*
June 15, 2007

Enbridge Energy L.P.
c/o Mr. Joe McGaver
119 North 25th Street East
Superior, WI 54880

SUBJECT: No Further Action Determination
January 1, 2007 Enbridge Energy L.P. Line 14 Milepost 149.5 Spill,
Owen, WI  
WDNR Spill # 20070101WC10-1

Dear Mr. McGaver:

On June 13, 2007, the Wisconsin Department of Natural Resources received the documents
"Case Closure Request and Letter of Compliance: MP 149.5 (Owen, WI)" prepared by Natural

The WDNR West Central Region Closure Committee has reviewed the document and concurs
that the environment has been restored to the extent practicable as provided in ch. NR 708.09,
Wis. Adm. Code. Therefore, the immediate action in response to a release has been completed
and the Department of Natural Resources is requiring no further action at this time.

We appreciate your efforts to protect and restore the environment at this site. If you have any
questions regarding this No Further Action determination, please contact me in Eau Claire at
715/839-1604.

Sincerely,

Thomas J. Kendzierski P.G.
Spill Coordinator
Bureau for Remediation & Redevelopment
West Central Region

cc: Barry Power, Natural Resources Engineering Co.
Dean and Joyce Jarvis, N12508 County Road P, Owen, WI 54460
Jennifer Lord-Koraichi, Clark County Emergency Government, Neillsville
David Siebert, WDNR Office of Energy
### Table 3-4  Spill-Related Properties of MacKay Heavy Bitumen Diluted with Synthetic Light Oil

<table>
<thead>
<tr>
<th>Spill-related properties</th>
<th>MacKay River Heavy Bitumen Diluted with Synthetic Light Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaporation (Volume %)</td>
<td>0</td>
</tr>
<tr>
<td>Adhesion (g/m²)</td>
<td>52</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>1 °C</td>
</tr>
<tr>
<td></td>
<td>15 °C</td>
</tr>
<tr>
<td>Dynamic Viscosity (mPa.s)</td>
<td>1 °C</td>
</tr>
<tr>
<td></td>
<td>15 °C</td>
</tr>
<tr>
<td>Kinematic Viscosity (mm²/s)</td>
<td>1 °C</td>
</tr>
<tr>
<td></td>
<td>15 °C</td>
</tr>
<tr>
<td>Interfacial Tension (dyne/cm)</td>
<td>Oil/ Air</td>
</tr>
<tr>
<td></td>
<td>Oil/ Seawater</td>
</tr>
<tr>
<td>Pour Point (°C)</td>
<td>&lt;-24</td>
</tr>
<tr>
<td>Flash Point (°C)</td>
<td>10</td>
</tr>
<tr>
<td>Emulsion Formation-Tendency and Stability @ 1 °C</td>
<td>Tendency</td>
</tr>
<tr>
<td></td>
<td>Stability</td>
</tr>
<tr>
<td></td>
<td>Water Content</td>
</tr>
<tr>
<td>Emulsion Formation-Tendency and Stability @ 15 °C</td>
<td>Tendency</td>
</tr>
<tr>
<td></td>
<td>Stability</td>
</tr>
<tr>
<td></td>
<td>Water Content</td>
</tr>
<tr>
<td>ASTM Modified Distillation</td>
<td>Evaporation (%)</td>
</tr>
<tr>
<td></td>
<td>IBP</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>47.5</td>
</tr>
</tbody>
</table>

Weathering Model:

\[
F_v = \frac{\ln[1 + (C_1/T_k)exp(C_2-C_3/T_k)]}{(C_1/T_k)}
\]

where: Fv is volume fraction of oil evaporated,
\(\theta\) is evaporative exposure,
T_k is environmental temperature (K),
\(C_1 = 14416\),
\(C_2 = 71.14\),
\(C_3 = 23665\).
Table 3-1  Spill-Related Properties of Syncrude Synthetic Light Oil

<table>
<thead>
<tr>
<th>Spill-related properties</th>
<th>Syncrude Synthetic Light Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaporation (Volume %)</td>
<td>0</td>
</tr>
<tr>
<td>Adhesion (g/m²)</td>
<td>18</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td></td>
</tr>
<tr>
<td>1 °C</td>
<td>0.886</td>
</tr>
<tr>
<td>15 °C</td>
<td>0.873</td>
</tr>
<tr>
<td>Dynamic Viscosity (mPa.s)</td>
<td></td>
</tr>
<tr>
<td>1 °C</td>
<td>11.9</td>
</tr>
<tr>
<td>15 °C</td>
<td>6.0</td>
</tr>
<tr>
<td>Kinematic Viscosity (mm²/s)</td>
<td></td>
</tr>
<tr>
<td>1 °C</td>
<td>13.4</td>
</tr>
<tr>
<td>15 °C</td>
<td>6.8</td>
</tr>
<tr>
<td>Interfacial Tension (dyne/cm)</td>
<td></td>
</tr>
<tr>
<td>Oil/ Air</td>
<td>28.1</td>
</tr>
<tr>
<td>Oil/ Seawater</td>
<td>26.3</td>
</tr>
<tr>
<td>Pour Point (°C)</td>
<td></td>
</tr>
<tr>
<td>-24</td>
<td>-24</td>
</tr>
<tr>
<td>Flash Point (°C)</td>
<td></td>
</tr>
<tr>
<td>Equipment limit</td>
<td>-5</td>
</tr>
<tr>
<td>Emulsion Formation-Tendency and Stability @ 1 °C</td>
<td></td>
</tr>
<tr>
<td>Tendency</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Stability</td>
<td>Unstable</td>
</tr>
<tr>
<td>Water Content</td>
<td>0%</td>
</tr>
<tr>
<td>Emulsion Formation-Tendency and Stability @ 15 °C</td>
<td></td>
</tr>
<tr>
<td>Tendency</td>
<td>Unlikely</td>
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<td>Stability</td>
<td>Unstable</td>
</tr>
<tr>
<td>Water Content</td>
<td>0%</td>
</tr>
<tr>
<td>ASTM Modified Distillation</td>
<td></td>
</tr>
<tr>
<td>Evaporation (% volume)</td>
<td></td>
</tr>
<tr>
<td>IBP</td>
<td>99</td>
</tr>
<tr>
<td>5</td>
<td>156</td>
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<td>10</td>
<td>201</td>
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<td>15</td>
<td>245</td>
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<td>287</td>
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<td>25</td>
<td>316</td>
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<td>30</td>
<td>338</td>
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<td>40</td>
<td>373</td>
</tr>
<tr>
<td>50</td>
<td>402</td>
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<tr>
<td>Weathering Model</td>
<td></td>
</tr>
<tr>
<td>( F_v = )</td>
<td></td>
</tr>
<tr>
<td>( \ln\left[1 + \left(\frac{C_1}{T_k}\right)^0\exp\left(\frac{C_2-C_3}{T_k}\right)\right] )</td>
<td></td>
</tr>
<tr>
<td>where: ( F_v ) is volume fraction of oil evaporated</td>
<td></td>
</tr>
<tr>
<td>( \theta ) is evaporative exposure</td>
<td></td>
</tr>
<tr>
<td>( T_k ) is environmental temperature (K)</td>
<td></td>
</tr>
<tr>
<td>( C_1 = 6190 )</td>
<td></td>
</tr>
<tr>
<td>( C_2 = 13.70 )</td>
<td></td>
</tr>
<tr>
<td>( C_3 = 6728 )</td>
<td></td>
</tr>
</tbody>
</table>
Table 3-3  Spill-Related Properties of Cold Lake Bitumen Diluted with Condensate (CL)

<table>
<thead>
<tr>
<th>Spill-related properties</th>
<th>Cold Lake Bitumen Diluted with Condensate</th>
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<tr>
<td>Evaporation (Volume %)</td>
<td>0 14.28 16.99</td>
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<tr>
<td>Adhesion (g/m²)</td>
<td>98 146 131</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td></td>
</tr>
<tr>
<td>1 °C</td>
<td>0.948 0.987 0.990</td>
</tr>
<tr>
<td>15 °C</td>
<td>0.936 0.977 0.981</td>
</tr>
<tr>
<td>Dynamic Viscosity (mPa.s)</td>
<td></td>
</tr>
<tr>
<td>1 °C</td>
<td>1363.0 57548.0 98625.0</td>
</tr>
<tr>
<td>15 °C</td>
<td>368.0 9227.0 14486.0</td>
</tr>
<tr>
<td>Kinematic Viscosity (mm²/s)</td>
<td></td>
</tr>
<tr>
<td>1 °C</td>
<td>1437.8 58306.0 99621.2</td>
</tr>
<tr>
<td>15 °C</td>
<td>393.2 9444.2 14766.6</td>
</tr>
<tr>
<td>Interfacial Tension (dyne/cm)</td>
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</tr>
<tr>
<td>Oil/ Air</td>
<td>35.3 36.8 38.5</td>
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<tr>
<td>Oil/ Seawater</td>
<td>23.2 24.7 &gt;27</td>
</tr>
<tr>
<td>Pour Point (°C)</td>
<td>Equipment Limit</td>
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<tr>
<td></td>
<td>&lt;-24 -15 -12</td>
</tr>
<tr>
<td>Flash Point (°C)</td>
<td>Equipment Limit Equipment Limit</td>
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<td></td>
<td>-4.5 4 4</td>
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<td>Emulsion Formation-Tendency and Stability @ 1 °C</td>
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</tr>
<tr>
<td>Tendency Index</td>
<td>Entrained Unstable Unstable</td>
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<tr>
<td>Stability Index</td>
<td>41% 0% 23%</td>
</tr>
<tr>
<td>Water Content</td>
<td></td>
</tr>
<tr>
<td>Emulsion Formation-Tendency and Stability @ 14 °C</td>
<td>Very likely Unlikely Unlikely</td>
</tr>
<tr>
<td>Tendency Index</td>
<td>Meso-stable Unstable Unstable</td>
</tr>
<tr>
<td>Stability Index</td>
<td>53% 0% 0%</td>
</tr>
<tr>
<td>Water Content</td>
<td></td>
</tr>
<tr>
<td>ASTM Modified Distillation</td>
<td></td>
</tr>
<tr>
<td>Evaporation (%) Volume (°C)</td>
<td>74 36</td>
</tr>
<tr>
<td>Liquid Temperature (°C)</td>
<td>5 59</td>
</tr>
<tr>
<td>Vapour Temperature (°C)</td>
<td>10 62</td>
</tr>
<tr>
<td>15 105</td>
<td></td>
</tr>
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<td>20 227</td>
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<td>25 282</td>
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<td>30 321</td>
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<tr>
<td>40 336</td>
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</tr>
<tr>
<td>Weathering Model</td>
<td></td>
</tr>
<tr>
<td>$F_v = \frac{\ln(1 + (C_1/Tk)\theta \exp(C_2-C_3/Tk))}{(C_1/Tk)}$</td>
<td></td>
</tr>
<tr>
<td>where:   $F_v$ is volume fraction of oil evaporated</td>
<td></td>
</tr>
<tr>
<td>$\theta$ is evaporative exposure</td>
<td></td>
</tr>
<tr>
<td>$Tk$ is environmental temperature (K)</td>
<td></td>
</tr>
<tr>
<td>$C_1$ = 12191</td>
<td></td>
</tr>
<tr>
<td>$C_2$ = 8.20</td>
<td></td>
</tr>
<tr>
<td>$C_3$ = 5239</td>
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</tr>
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</table>
Table 3-2  Spill-Related Properties of CRW Condensate

<table>
<thead>
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<th>Spill-related properties</th>
<th>CRW Condensate</th>
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<tbody>
<tr>
<td>Evaporation (Volume %)</td>
<td>0 56.78 75.14</td>
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<tr>
<td>Adhesion (g/m²)</td>
<td>2 3 16</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td></td>
</tr>
<tr>
<td>1 °C</td>
<td>0.744 0.823 0.869</td>
</tr>
<tr>
<td>15 °C</td>
<td>0.734 0.810 0.852</td>
</tr>
<tr>
<td>Dynamic Viscosity (mPa.s)</td>
<td></td>
</tr>
<tr>
<td>1 °C</td>
<td>0.6 2.4 13.9</td>
</tr>
<tr>
<td>15 °C</td>
<td>0.6 6.1 6.3</td>
</tr>
<tr>
<td>Kinematic Viscosity (mm²/s)</td>
<td></td>
</tr>
<tr>
<td>1 °C</td>
<td>0.8 2.9 16.0</td>
</tr>
<tr>
<td>15 °C</td>
<td>0.8 7.5 7.3</td>
</tr>
<tr>
<td>Interfacial Tension (dyne/cm)</td>
<td></td>
</tr>
<tr>
<td>Oil/ Air</td>
<td>21.7 23.8 25.7</td>
</tr>
<tr>
<td>Oil/ Seawater</td>
<td>10.2 11.3 11.9</td>
</tr>
<tr>
<td>Pour Point (°C)</td>
<td>&lt;-25 &lt;-22 &lt;-23</td>
</tr>
<tr>
<td>Flash Point (°C)</td>
<td>Below -5°C 9 41.5</td>
</tr>
<tr>
<td>Emulsion Formation-Tendency and Stability @ 1 °C</td>
<td></td>
</tr>
<tr>
<td>Tendency</td>
<td>Unlikely Unlikely Unlikely</td>
</tr>
<tr>
<td>Stability</td>
<td>Unstable Unstable Unstable</td>
</tr>
<tr>
<td>Water Content</td>
<td>0% 0% 5%</td>
</tr>
<tr>
<td>Emulsion Formation-Tendency and Stability @ 15 °C</td>
<td></td>
</tr>
<tr>
<td>Tendency</td>
<td>Unlikely Unlikely Unlikely</td>
</tr>
<tr>
<td>Stability</td>
<td>Unstable Unstable Unstable</td>
</tr>
<tr>
<td>Water Content</td>
<td>0% 0% 0%</td>
</tr>
<tr>
<td>ASTM Modified Distillation</td>
<td></td>
</tr>
<tr>
<td>Evaporation (%)</td>
<td>55 60 65 70 75 81 89 106 128</td>
</tr>
<tr>
<td>Liquid Temperature (°C)</td>
<td>40 47 52 56 61 67 73 89 108</td>
</tr>
<tr>
<td>Vapour Temperature (°C)</td>
<td></td>
</tr>
</tbody>
</table>
| Weathering Model 
\[
F_v = \frac{\ln[1 + (C_1/T_k)\theta\exp(C_2-C_3/T_k)]}{(C_1/T_k)}
\]
| where:  
\[
F_v \text{ is volume fraction of oil evaporated}
\]
\[
\theta \text{ is evaporative exposure}
\]
\[
T_k \text{ is environmental temperature (K)}
\]
\[
C_1 = 1946
\]
\[
C_2 = 2.47
\]
\[
C_3 = 2372
\]
SIS Posting

December 7, 2010

To: Shippers, Feeders and Connecting Carriers

Re: Revision to Quality Specifications for Component Streams to the
Enbridge Condensate (CRW) Pool

As communicated previously with respect to quality of component streams to the CRW Pool:

- New specifications and the associated monitoring and enforcement program for CRW streams were implemented on July 1, 2010. The exception was the Mercaptans specification which will take effect January 1, 2011.
- The specifications and monitoring and enforcement program may be revised from time to time as required.
- The Enbridge CRW Committee will continue to convene, when required, to discuss and possibly modify specifications and/or testing, monitoring and enforcement protocols driven by changing market conditions.

As a result of Committee and Industry discussion the following revisions are being implemented effective January 1, 2011.

1. The upper density limit for component streams to the CRW Pool is being lowered to 775 kg/m³. Please note densities greater than 775 kg/m³ but less than 800 kg/m³ are acceptable providing the conditions outlined in the “Comments” column of the “Quality Specifications for Component Streams to the CRW Pool” table are met.
2. The specification for C1, C2, and C3 Volatile Mercaptans will continue to proceed as planned on January 1, 2011 as 175 ppm but the enforcement action was revised to “Report Only”. The Committee will evaluate test results to determine the appropriate specification going forward.
3. Total Suspended Solids will be replaced with "Filterable Solids" and a new modification to the test method ASTM 4807 is referenced for sample preparation identified as "Procedure C" (see attachment to specification table).

In addition to Mercaptans as mentioned above the Committee also continues to review the most appropriate way to deal with potential for false positive test results for Olefins in certain condensates.

The revised specification table and referenced attachments can be found at the following location on OM2/SIS:

SIS Reports > Operations > Pipeline Reports - Mainline System and Line 9

If you have any questions please let me know at the contact particulars at the top of this letter.

Sincerely,

Patrick Keogh, P. Eng
<table>
<thead>
<tr>
<th>Quality</th>
<th>Units</th>
<th>Min</th>
<th>Max</th>
<th>Referee Test Method and Test Frequency</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (15 C)</td>
<td>kg/m³</td>
<td>600</td>
<td>775</td>
<td>ASTM 4052 Frequency: AR²</td>
<td>For test results greater than or equal to 600 kg/m³, but less than 650 kg/m³ perform RVP and Aromatics test to confirm it meets those specifications. If exceed max charge appropriate toll (i.e. Light Petroleum, etc.). Densities greater than 775 kg/m³ but less than 800 kg/m³ can be accepted if for each batch or volume received a Certificate of Analysis is provided demonstrating viscosity, filterable solids, and sulfur are within specification limits. Upon violation warning sent to violating shipper. If violation continues in 2nd month stream reclassified and shipper requested to nominate to appropriate stream (i.e. MSW, etc.). Once shipper demonstrates that they are back in spec range they are allowed to nominate to the CRW pool the following month.</td>
</tr>
<tr>
<td>Viscosity (7.5 C)</td>
<td>cSt</td>
<td>2.0</td>
<td>2.0</td>
<td>ASTM D445 Frequency: QR+⁴</td>
<td>Enbridge Tariff specification. If exceed max charge appropriate toll (i.e. Light Petroleum, etc.). Upon violation increase monitoring for 1 month. If it continues off spec for that month then notify. If continue off spec in the 2nd month you will be reclassified to the appropriate stream (i.e. MSW, etc) for the 3rd month. In the case of a violation that is corrected in month 2, more frequent monitoring would continue to confirm compliance.</td>
</tr>
<tr>
<td>Sulfur, total</td>
<td>wt%</td>
<td>0.5</td>
<td>0.5</td>
<td>ASTM D5453 Frequency: AR²</td>
<td>Industry Equalization specification. Follow similar procedure to Enbridge Book 5 03-03-21: Maintaining 0.5% Weight Sulphur Standard but modified for CRW. CRW Procedure to be developed.</td>
</tr>
<tr>
<td>Olefins, total</td>
<td>wt%</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>PONAOX(U) ASTM 6729 (250 cut) Frequency: QR+⁴</td>
<td>CAPP Directive specification. Enforcement and Consequence: Apply Olefin Decision Tree (all shippers to be advised of location of document once posted)</td>
</tr>
<tr>
<td>Reid Vapour Pressure</td>
<td>kPa</td>
<td>103</td>
<td>103</td>
<td>ASTM D323M Frequency: MR³</td>
<td>Rules and Regs. filed with NEB/FERC specification. Enforcement and Consequence: Immediate shut-in⁵</td>
</tr>
<tr>
<td>BS&amp;W</td>
<td>vol%</td>
<td>0.5</td>
<td>0.5</td>
<td>ASTM D95 Frequency: AR²</td>
<td>Rules and Regs. filed with NEB/FERC specification. Enforcement and Consequence: Immediate shut-in⁵</td>
</tr>
<tr>
<td>Organic Chlorides¹</td>
<td>wppm</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>ASTM D4929 Frequency: QR+⁴</td>
<td>Rules and Regs. filed with NEB/FERC specification. Enforcement and Consequence: Immediate shut-in upon identifying violation. Request 3rd party Certificate of Analysis prior to subsequent receipt for period of 1 month.</td>
</tr>
<tr>
<td>Aromatics, total (BTEX)</td>
<td>vol%</td>
<td>2.0</td>
<td>2.0</td>
<td>PONAOX(U) ASTM 6729 Frequency: QR+⁴</td>
<td>Below min possible with passing Wiehe crude compatibility test. Enforcement and Consequence: Reclassify⁶</td>
</tr>
<tr>
<td>Quality</td>
<td>Units</td>
<td>Min</td>
<td>Max</td>
<td>Referee Test Method and Test Frequency</td>
<td>Comments</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------</td>
<td>-----</td>
<td>-----</td>
<td>----------------------------------------</td>
<td>-----------------------------------------------------------</td>
</tr>
<tr>
<td>Mercaptans, volatile (cumulative C1, C2, C3)</td>
<td>ppmw S</td>
<td></td>
<td>175</td>
<td>ASTM D5623 Frequency: QR+4</td>
<td>Enforcement and Consequence: Report only.</td>
</tr>
<tr>
<td>H₂S (in liquid phase)</td>
<td>wppm</td>
<td></td>
<td>20</td>
<td>ASTM D5623 Frequency: QR+4</td>
<td>Enforcement and Consequence: Reclassify³</td>
</tr>
<tr>
<td>Benzene⁶</td>
<td>vol%</td>
<td></td>
<td>1.6</td>
<td>PONAOX(U) ASTM 6729 Frequency: QR+4</td>
<td>Enforcement and Consequence: Delayed shut-in⁷</td>
</tr>
<tr>
<td>Mercury¹</td>
<td>wppb</td>
<td></td>
<td>10</td>
<td>UOP 938 (CVAA) Frequency: QR+4</td>
<td>Enforcement and Consequence: Delayed shut-in⁷</td>
</tr>
<tr>
<td>Oxygenates</td>
<td>wppm</td>
<td></td>
<td>100</td>
<td>PONAOX(U) ASTM 6729 Frequency: QR+4</td>
<td>Enforcement and Consequence: Delayed shut-in⁷</td>
</tr>
<tr>
<td>Filterable Solids</td>
<td>mg/l</td>
<td></td>
<td>200</td>
<td>ASTM D4807 with “Procedure C” Frequency: QR+4</td>
<td>Enforcement and Consequence: Reclassify³</td>
</tr>
<tr>
<td>Phosphorous, volatile</td>
<td>ppm</td>
<td></td>
<td>Per CAPP guidelines</td>
<td>ICP AES D86 (250 cut) Frequency: QR+4</td>
<td>CAPP Guidance. Refer to ERCB Directive 058. Violating test results communicated to the ERCB.</td>
</tr>
<tr>
<td>Selenium</td>
<td>wppb</td>
<td></td>
<td>Application Only</td>
<td>ICP MS</td>
<td>For new stream applications this information to be provided to Enbridge</td>
</tr>
<tr>
<td>Pour Point</td>
<td>C</td>
<td>Application Only</td>
<td>ASTM D97</td>
<td>For new stream applications this information to be provided to Enbridge</td>
<td></td>
</tr>
<tr>
<td>Salt Content</td>
<td>ptb</td>
<td>Application Only</td>
<td>ASTM 3230</td>
<td>For new stream applications this information to be provided to Enbridge</td>
<td></td>
</tr>
<tr>
<td>Simdist</td>
<td></td>
<td>Application Only</td>
<td>ASTM D2887</td>
<td>For new stream applications this information to be provided to Enbridge</td>
<td></td>
</tr>
</tbody>
</table>

Notes
1. For these properties intent is that blending not occur up to specification limit
2. AR: All Receipts of CRW component streams tested using a weekly composite
3. MR: Monthly Random testing of CRW component streams
4. QR+: Quarterly Random testing plus up to 4 additional tests per CRW component stream. Upon violation perform probational testing at Enbridge discretion
5. Immediate shut-in upon identifying violation. Request 3rd party Certificate of Analysis prior to subsequent receipt for period of 1 month.
6. Upon violation increase monitoring for 1 month. If continues off spec for that month then notify. If continue off spec in the 2nd month reclassified to the appropriate stream (ie. MSW, etc) for the 3rd month. In the case of a violation that is corrected in month 2, more frequent monitoring would continue to confirm compliance.
7. Upon violation increase monitoring for 1 month. If violation continues for 2 consecutive months shut-in stream at end of 2nd month. Certificate of Analysis required to get back into pool.
8. Benzene level of the CRW pool to be monitored and if a test result of 1.25 vol% is received the Enbridge CRW Committee will reconvene to discuss appropriateness of benzene spec on CRW component streams.
October 4, 2006

Leo Golden
Director, Shipper Services
Enbridge Pipelines Inc.
3000, 425 – 1st Street SW
Calgary, AB T2P 3L8

RE: New Test Method for Olefin Screening in Crude Oil and Condensate

In January 2003, CAPP approved an industry-wide policy restricting the introduction of olefinic material to any conventional crude oil, condensate or bitumen stream. A letter was subsequently sent to pipelines outlining the policy and identifying the Fluorescent Indicator Adsorption (FIA) test as the method for olefin detection.

Upon implementation of the policy it was found that the FIA test, intended for measuring olefin content in liquid petroleum products, did not produce accurate measurements when applied to heavy crude oil and that a more accurate test method was required. As a result, a new test method using proton nuclear magnetic resonance (HNMR) spectroscopy has been developed and approved by the CAPP Crude Oil Committee for use as the test for olefin detection in all crude oil and condensate.

As part of the development of the HNMR test, trial tests were performed on samples from a variety of western Canadian crude types that do not contain olefins. During the trial testing, olefins were not falsely detected in any of the samples. Further trial testing confirmed that accurate measurement of olefin content was achieved when samples were mixed with olefinic material in the laboratory. The trial test results and the test method as a whole were reviewed by CAPP prior to its final approval.

The olefin restriction remains unchanged from 2003 however the HNMR test replaces the FIA test as the method of olefin detection for all crude oil and condensate.

The updated olefin restriction is as follows:

- **Olefinic material shall not be added to or blended with conventional crude oil streams, condensate streams or accepted as diluent for heavy crude oil or bitumen.** The test method to screen for the presence of olefinic material is the Proton Nuclear Magnetic Resonance Spectroscopy (HNMR) test.
- **The HNMR test replaces the FIA test as the test for olefin detection.** A test result that is greater than 1.0% olefins by mass as 1-decene equivalent is considered to indicate the presence of olefinic material and requires immediate retest for verification.
Repeated excursions (defined as 2 successive excursions) will result in the stream being excluded from conventional crude oil, condensate and bitumen streams until compliance can be demonstrated. The 1.0% is not to be considered an upper limit, rather an indicator that olefinic material is present. The specification objective is zero.

Examples of olefinic material include, but are not limited to: untreated cracked material, untreated coker by-products, olefin plant by-products and cat cracked stocks.

If you have any questions regarding this matter please contact me at (403) 267-1140.

Yours truly,

Paul Unruh
Crude Oil Markets and Regulatory Analyst
October 15, 2010

Patrick Kehoe
Enbridge CRW Committee Chair

Subject: Test Method for Filterable Solids Measurement in Condensate

Dear Patrick,

Further to my letter of February 16th, the CCQTA Condensate Quality project has completed its assessment of the suitability of ASTM D4807 for measuring solids content of condensates. The project group is satisfied that Maxxam’s modification to ASTM D 4807, identified as Procedure C, will provide accurate and repeatable results in condensate samples.

Procedure C:
Pre-dilute 200 mL of sample (subsampled from 500 mL bottle) with warm toluene (1:1 ratio) and filter it under a specified vacuum. If filtration time exceeds 20 min, reduce the sample size to one half of the original volume (100 mL) and repeat the procedure. Rinse the particulates on the filter with hot toluene until filtrate is colorless. Dry the filter with particulates at 105 deg C, reweigh, calculate and report the sediment value (ppm) and total volume of the filtered sample (mL).

Note that the proposed modification in Procedure C applies to the section dealing with sample preparation in ASTM D 4807. It does not alter any portion of the filtration or calculation steps in the method. It is therefore only a minor modification required to address issues with sample density and potential organic solids levels.

The Condensate Quality project group also requests that the designation for this test be changed from “Total Suspended Solids” to “Filterable Solids”. Total Suspended Solids or TSS as it is often referred to, is a term used to identify a specific type of particulate matter in water samples and does not apply to ASTM D4807. ASTM D4807 provides a measure of the amount of non-toluene soluble material in a hydrocarbon sample and is not a measure of the total solids present in a sample.

In this regard, the Condensate Quality project group is continuing its work in the development of an adequate method to measure “Total Particulate” in condensate. The results obtained from this work will more accurately reflect the amount of solids dispersed or suspended within a hydrocarbon sample.

We will report on our work to develop a test method for Total Particulate at a later date.

Respectfully,

Robert Falkiner
CCQTA Condensate Quality Project Manager
Letter to Pipelines

October 6, 2006

Re: Specification Limiting Phosphorus Content in Western Canadian Light Sweet Crude

CAPP has adopted a specification limiting phosphorus content, specifically “volatile phosphorus” (as defined below), in western Canadian light sweet crude oil streams. The specification is as follows:

- **Volatile phosphorus is defined as the phosphorus concentration in the distillate fraction of crude oil collected from the initial boiling point (IBP) to 250°C.**
- **Western Canadian crude oil that is to be shipped as part of a common light sweet crude stream must not exceed 0.5 mass parts per million volatile phosphorus upon delivery to a common stream. Based on the current accuracy of the test method used to measure volatile phosphorus (currently +/- 1 mass ppm), a test result greater than 1.5 mass ppm in the volatile fraction as determined by the attached test method is deemed to exceed specification.**

CAPP members are working in cooperation with industry to achieve this specification and western Canadian pipelines will begin enforcement starting January 1, 2007. As of this date, operators delivering to common light sweet crude streams must either meet specification or proceed with one of two options:

1. Provide a remediation plan for meeting specification within a defined timeframe and continue deliveries
2. Discontinue deliveries until their crude meets the new specification

**Background:**

Volatile phosphorus has been identified as a crude quality issue that negatively impacts the value of western Canadian light sweet crude oil. Volatile phosphorus is not a naturally occurring material, but is found in chemicals used in the oil and gas industry. For the purposes of this specification, it has been defined as phosphorus remaining in crude oil after it is distilled. The issue identified is that phosphorus in distilled crude oil forms deposits in refinery distillation towers resulting in refinery outages. CAPP with the support of producers, the Canadian Crude Quality Technical Association (CCQTA) and pipelines has been examining options to address this matter. A trial monitoring program has been undertaken by Pembina Pipeline and Rainbow Pipeline and test results are available by contacting the pipeline companies directly.

For additional information on options available to reduce volatile phosphorus concentrations in light sweet crude oil please refer to the CCQTA website [www.ccqta.com](http://www.ccqta.com) and refer to the phosphorus section. For general enquiries regarding this specification please contact me directly at (403) 267-1140.

Yours truly,

Paul Unruh
Crude Oil Markets and Regulatory Analyst
2010 CRUDE CHARACTERISTICS

The 2010 Crude Characteristics Booklet is a summary of selected chemical and physical properties of crude oils and condensates moved in the Enbridge Pipelines Inc. (Enbridge)/Enbridge Energy Partners, L.P. system. Samples were collected over a limited period of time and may or may not be representative of shipments over the entire year.

Density at 15°C, Reid Vapour Pressure at 37.8°C, Sulphur by Weight, Pour Point and Viscosity results at 10, 20, 30, 40 and 45°C were tabulated.

The data was accumulated as follows:

1- Incoming streams were sampled as received and later tested at central laboratories in Edmonton and Superior.

2- RVP, Viscosity and Pour Point data was obtained from samples collected during the January, June, and September of 2010.
   - Heavy crude viscosity data was reported from samples obtained in January.

3- Density figures were obtained from volume weighted receipt tickets into Enbridge custody throughout 2010.

4- Sulphur data was obtained throughout the year from samples taken at the first point of receipt or injection on the Enbridge system. Incentive Tolling sample data was used wherever possible. (Individual commodities that go into Enbridge blended streams were taken during the January, June, and September of the year)

5- All pour point results are taken from 2009 testing (pour point tests only conducted every second year)

VISCOSITY-TEMPERATURE RELATIONSHIP

The viscosity test of a commodity characterizes its resistance to flow in pipeline movement. The test itself may exaggerate the low temperature viscosity of paraffinic crude oils. Previous testing has shown that the viscosity behaviour of a crude oil in a pipeline follows a curve somewhere between the apparent viscosity (the extrapolated straight line portion of the viscosity-temperature plot) and the measured viscosity.

Measured values of viscosity should be used for interlab comparisons. Apparent values should be used for head loss calculations and surcharge grouping.

To increase pumping capacity, Enbridge/LPL has limited receipt viscosities to 350 cst. As seasonal temperatures vary, the blends of heavier crude oils with diluent will change to meet the viscosity limit.
### 2010 Crude Characteristics

<table>
<thead>
<tr>
<th>Product Identifier</th>
<th>Crude Type (Long Name)</th>
<th>Total Sulphur (% by wt.)</th>
<th>Pour Point (°C)</th>
<th>Reid Vapour Pressure (kPa)</th>
<th>Density (kg/m³)</th>
<th>Viscosity (cSt) at Specified Temperature (degree Celsius)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10.00</td>
</tr>
<tr>
<td>AHS</td>
<td>ALBAN HEAVY SYNTHETIC</td>
<td>2.35</td>
<td>&lt; -30°</td>
<td>48.0</td>
<td>933.7</td>
<td>292</td>
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<tr>
<td>ARB</td>
<td>ALBAN RESIDUAL BLEND</td>
<td>2.99</td>
<td>&lt; -30°</td>
<td>11.0°</td>
<td>925.9</td>
<td>237</td>
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<tr>
<td>AVB</td>
<td>ALBAN VACUUM BOTTOMS</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
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<tr>
<td>AWB</td>
<td>ACCESS WESTERN BLEND</td>
<td>3.83</td>
<td>&lt; -30°</td>
<td>53.7</td>
<td>923.7</td>
<td>296</td>
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<td>BG</td>
<td>BONNIE GLEN</td>
<td>0.37</td>
<td>&lt; -30°</td>
<td>64.0</td>
<td>816.1</td>
<td>3.39</td>
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<td>BGO</td>
<td>BONNIE GLEN SOUR</td>
<td>1.25°</td>
<td>54.0°</td>
<td>876.2°</td>
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<td>11.0°</td>
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<td>BOREALIS HEAVY BLEND</td>
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<td>41.0</td>
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<td>BR</td>
<td>BOW RIVER</td>
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<td>&lt; -30°</td>
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<td>916.1</td>
<td>113</td>
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<td>CAL</td>
<td>CENTRAL ALBERTA PIPELINE</td>
<td>0.99</td>
<td>844.5</td>
<td>7.12</td>
<td>6.48</td>
<td>4.91</td>
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<tr>
<td>CAM</td>
<td>AMOCO CONDENSATE</td>
<td>0.02</td>
<td>69.8</td>
<td>704.6</td>
<td>0.620</td>
<td>0.560</td>
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<td>CAROLINE CONDENSATE</td>
<td>0.41</td>
<td>45.2</td>
<td>739.9</td>
<td>0.670</td>
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<tr>
<td>CFD</td>
<td>FEDERATED CONDENSATE</td>
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<td>79.1</td>
<td>716.3</td>
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<td>0.530</td>
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<tr>
<td>CFT</td>
<td>FORT SASKATCHEWAN CONDENSATE</td>
<td>0.05</td>
<td>46.5</td>
<td>673.5</td>
<td>0.520</td>
<td>0.460</td>
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<tr>
<td>CGB</td>
<td>GIBSON CONDENSATE</td>
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<td>77.4</td>
<td>774.0</td>
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<td>CL</td>
<td>COLD LAKE</td>
<td>3.76</td>
<td>52.3</td>
<td>926.1</td>
<td>299</td>
<td>155</td>
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<tr>
<td>CNS</td>
<td>CNLR light sweet synthetic blend</td>
<td>0.06</td>
<td>24.0</td>
<td>848.5</td>
<td>4.53</td>
<td>3.50</td>
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<tr>
<td>CPC</td>
<td>PETROCANADA CONDENSATE</td>
<td>0.00</td>
<td>59.1</td>
<td>687.2</td>
<td>0.550</td>
<td>0.510</td>
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* Results from 2008 Crude Characteristics.
** Results from 2008 Crude Characteristics.
*** Commodity not moved. Results are prior to 2008 Crude Characteristics.
n/a = Test was not done.
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* Results from 2009 Crude Characteristics.
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n/a = Test was not done.
## 2010 Crude Characteristics

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"ND" indicates a value below the minimum detection limit
"-" indicates no available data

Results based on averages from Jan. 1 2007 to March 31 2011 from crudemonitor.ca, created on June 2, 2011
1 Viscosity based on regression calculations of Enbridge 2010 Crude Oil Characteristics
2 RVP based on Enbridge 2010 Crude Oil Characteristics, converted from kPa to psi
* Enbridge samples are from January, June, and September of 2010
See the Enbridge 2010 Crude Oil Characteristics report for more info on how viscosity and RVP are obtained

click on [http://www.crudemonitor.ca](http://www.crudemonitor.ca) for up-to-date information
### Canadian Crude Quick Reference Guide

#### Grade

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"ND" indicates a value below the minimum detection limit
"-" indicates no available data

Click on [http://www.crudemonitor.ca](http://www.crudemonitor.ca) for up-to-date information

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Distillation by ASTM D2892/ D5236 (TBP)
Sulfur by ASTM D4294, Density by ASTM D4052, D5002 and ASTM D70
- FOR IMMEDIATE RELEASE -
July 29, 2010

Contact person:
Brigette Reichenbaugh (269) 969-6366

Health Department Recommends Evacuation of Residents

The Calhoun County Public Health Department is recommending immediate evacuation of residents directly affected in and around the site of the Kalamazoo River Oil Spill. This area affects approximately 30 – 50 homes North and Northwest of the oil spill site.

Clearly identified Calhoun County Health Department and Michigan Department of Community Health officials and volunteers will personally visit those homes affected to deliver notices of recommended evacuation.

The Health Department is recommending evacuation due to the high than acceptable levels of Benzene found in air quality tests and the adverse long-term affect associated with exposure. Benzene is a chemical that is a colorless or light yellow liquid at room temperature. It has a sweet odor and is highly flammable. People who breathe in high levels of benzene may develop the following signs and symptoms: drowsiness, dizziness, rapid or irregular heartbeat, headaches, tremors, confusion, or unconsciousness.

The long-term effects of Benzene exposure is on the blood. Benzene causes harmful effects on the bone marrow and can cause a decrease in red blood cells, leading to anemia. It can also cause excessive bleeding and can affect the immune system, increasing the chance for infection. The Department of Health and Human Services (DHHS) has determined that benzene causes cancer in humans. Long-term exposure to high levels of benzene in the air can cause leukemia, cancer of the blood-forming organs.

Long-term air monitoring will continue indefinitely.

Volunteers are securing hotel rooms and arranging shelter locations for residents and pets. Residents will be notified of shelter locations and available hotels once they receive their evacuation notice.

Evacuated residents are asked to save all receipts for expenses incurred as a result of this evacuation. Evacuees will be reimbursed by Enbridge.

For questions, please call the Enbridge Oil Spill Hotline at (800) 306-6837 or the Public Health Department at (269) 969-6341.
For more information about Benzene, visit http://www.bt.cdc.gov/agent/benzene/basics/facts.asp

- END -
Health Department Issues Water Ban

Due to the recent release of more than 800,000 gallons of crude oil into Talmadge Creek and the Kalamazoo River located in Calhoun County Michigan, the Calhoun County Public Health Department has issued a ban on the use of water from both of these water bodies for the purpose of all irrigation and watering of livestock. The Health Department has also issued a ban on surface water activities on the Kalamazoo River as part of the county’s state of emergency, including swimming, wading, fishing, boating, canoeing and kayaking. Local health officials warn citizens to avoid all contact with water from the Kalamazoo River until further notice. The amount of oil released is based on Enbridge’s estimates. The US Environmental Protection Agency (EPA) has not independently verified this amount.

Specifically, this ban pertains to all portions of Talmadge Creek and all portions of the Kalamazoo River flowing west of the site of release located in Marshall, Michigan. This ban will remain in effect until further notification from the Calhoun County Public Health Department.

Farmers and producers who have agricultural-related questions should contact the Michigan Department of Agriculture at (800) 292-3939.

Other questions related to the spill should be directed to (800) 306-6837.

- END -
NEWS RELEASE

FOR IMMEDIATE RELEASE

ERCB ADDRESSES STATEMENTS IN NATURAL RESOURCES DEFENSE COUNCIL PIPELINE SAFETY REPORT

Calgary, Alberta (February 16, 2011) The Energy Resources Conservation Board (ERCB) is concerned that a report on pipeline safety issued this morning by the Natural Resources Defense Council (NRDC) contains misleading statements on pipeline safety in Alberta and on the characteristics of diluted bitumen.

The report implies that the Alberta pipelines have had a higher pipeline failure rate than the U.S. due to leaks caused by internal corrosion from transportation of diluted bitumen (DilBit). The NRDC’s analysis of published ERCB pipeline data is flawed, leading to misleading and incorrect conclusions.

The study includes incorrect statements about pipeline safety in Alberta including:

“The Alberta hazardous liquid pipeline system has a relatively high rate of pipeline failure posing an early indication of the risks DilBit poses to pipeline integrity.”

“Despite its relatively recent construction, Alberta’s hazardous liquid system, which carries a high proportion of diluted bitumen, had over four times as many reportable incidents per mile as the older U.S. System between 1990 and 2005.”

These statements are factually inaccurate. The NRDC’s comparison of ERCB data with that collected in the U.S. is flawed, as it selected data from a much broader array of ERCB pipelines than those included in U.S. data as hazardous liquid pipelines. Additionally, the NRDC did not recognize that the ERCB requires all incidents to be reported, regardless of whether or not any product is spilled, and also regardless of spill volume, whereas in the U.S. only spills of five barrels of liquids or more are required to be reported.

This results in a misleading comparison of pipeline failure numbers between the U.S. and Alberta. In the category identified by NRDC – pipelines shipping bitumen and blends of bitumen – the ERCB can identify only three spills resulting from internal corrosion between 1990 and 2005 (and only eight from 1975 to 2010). The resulting average failure frequency for the grouping of crude oil pipelines from 1990 to 2005 is thus 0.03 per 1000 km per year. This is significantly lower than the U.S. rate quoted in the NRDC study of 0.08 per 1000 km per year.

The report also states that “there are many indications that DilBit is significantly more corrosive to pipeline systems than conventional crude.” Analysis of pipeline failure statistics in Alberta has not identified any significant differences in failure frequency between pipelines handling conventional crude versus pipelines carrying crude bitumen, crude oil or synthetic crude oil.

Diluent by nature is a lower viscosity, higher-vapour pressure solvent. It could then be considered to be more “volatile” in its natural state, as it consists of lighter end hydrocarbons.
However, when blended with bitumen, the resulting blend is a “new” product consisting of thinned bitumen that more closely resembles conventional crude products. Once mixed with diluent, DilBit should behave in much the same manner as other crude oils of similar characteristics.

In conventional oils sands processing, sulphur is removed during processing, as well as water (which is a primary concern in regards to corrosivity). The tariff specification for the Keystone XL project, for example, is virtually the same in regards to water content and solids contents as that specified for other heavy oil pipelines, thus there is no reason to expect this product to behave in any substantially different way than other oil pipelines.

It should also be noted that pipelines in Alberta have never been safer. In 2009, Alberta posted a record-low pipeline failure rate of 1.7 pipeline failures per 1,000 km of pipeline (considering all substances), bettering the previous record-low of 2.1 set in both 2008 and 2007.

If the NRDC had contacted the ERCB for information in compiling their report, the ERCB would have been pleased to assist them in interpreting the published data used to compare Alberta and the United States, eliminate the factual errors in the report, and ensure that readers have access to accurate and complete information about pipeline safety in Alberta.

This statement is available on the ERCB website at www.ercb.ca.

For more information, contact:

Davis Sheremata, ERCB Communications
Phone: 403-605-4216
Email: davis.sheremata@ercb.ca

NR2011-04
Preliminary Seismic Evaluation of Enbridge Northern Gateway Pipelines Project

By:
Gail M. Atkinson, Ph.D.
Engineering Seismologist

For:
AMEC
Nov. 9, 2006

Final Revision: April 6, 2009
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2.2 Treatment of Uncertainty

2.3 Input Parameters for Seismic Hazard Analysis

3 - Results of Seismic Hazard Analysis

Table 1 (results)

5 – References
PRELIMINARY SEISMIC EVALUATION OF ENBRIDGE NORTHERN GATEWAY PIPELINES PROJECT

Executive Summary

A preliminary site-specific seismic hazard assessment was performed for 8 sites along the Gateway Pipeline route in B.C. The analysis determines the expected earthquake ground motions over a range of probability levels, including 1/500, 1/1000, 1/2500 and 1/5000 per annum. Peak ground acceleration and velocity is estimated, as well as response spectra (5% damped, horizontal component). The ground motions are calculated for reference site conditions of “soft rock”, or NEHRP B. (Note that the National Building Code uses a reference ground condition of NEHRP C, which is somewhat softer and would result in slightly higher ground motions.) The results are presented for the preferred model on Table 1 (p. 26).

1 - INTRODUCTION

This report presents a preliminary seismic hazard assessment for 8 sites along the proposed Gateway Pipeline route in B.C., for annual exceedence probabilities in the range from 1/500 to 1/5000. The location of the pipeline route and the 8 selected sites is shown in relation to historical seismicity (all known events of $M>1$ through 2005) on Figure 1. The analysis determines the likelihood of ground motion at the site by considering the magnitudes, rates of occurrence, and locations of earthquakes, using the probabilistic Cornell-McGuire method. The method is widely used throughout North America and forms the basis for seismic zoning maps in building codes in Canada (Adams and Halchuck, 2003). This assessment represents an update of the type of estimate provided in the National Seismic Hazard maps by the Geological Survey of Canada (GSC, Adams and Halchuck, 2003); the results of this study incorporate new information on seismicity and ground motion relations from the last 10 years of data.

In analyzing the engineering effects of ground motion, both the amplitude and frequency content of the vibrations are important. Therefore the seismic ground motions are expressed using the response spectrum (PSA(f)), which shows the maximum acceleration that a simple structure would experience as a function of its natural frequency. The response spectrum result is a Uniform Hazard Spectrum (UHS), in which the amplitude for each frequency corresponding to a specified exceedence probability is provided. The peak ground acceleration (PGA) for this probability is also estimated, as is the peak ground velocity (PGV). The frequency associated with the PGA varies, but in general the PGA is associated with high-frequency motions (near 10 Hz); the PGV is associated with motions near 2 Hz. The UHS results of this study are presented in the figures and tables provided in Section 3.
2 - SEISMIC HAZARD ANALYSIS METHOD

2.1 Overview

Seismic hazard analyses in Canada are based on probabilistic concepts which allow incorporation of both geologic interpretations of seismic potential and statistical data regarding the locations and sizes of past earthquakes. The Cornell-McGuire method (Cornell, 1968; McGuire, 1976, 1977, 2004) has proven particularly well-suited to calculate expected ground motions for a wide range of seismic hazard environments, offering flexibility in the consideration of spatial and temporal characteristics of regional earthquake occurrence, and the basic physics of the earthquake process.

In general, it is difficult to correlate seismicity with specific faults. Earthquakes typically occur at depths of 5 to 20 km, on faults that have no surface expression. Furthermore, faults mapped on the surface in western Canada were formed hundreds of thousands to millions of years ago, and may bear little relation to current seismic activity. Thus there is no clear-cut relationship between observed faults and seismicity. For the purposes of this preliminary analysis, it is therefore assumed that there are no active faults...
that the proposed pipeline route will cross. This assumption needs to be checked in final design and planning of the pipeline, by checking that there is no geologic evidence of recent fault movements (<10,000 years) along the proposed route. In the absence of specific evidence of neotectonic fault activity, the seismic hazards along the route can be determined from historical seismicity patterns, using broad seismic source zones such as those used for the NBCC national seismic hazard maps.

In this approach (known as the Cornell-McGuire method), the spatial distribution of earthquakes is described by defining seismic source zones (faults or areas, which may contain groups of faults) on the basis of seismotectonic interpretations; the earthquake potential of these zones is generally assumed to be uniform. The frequency of earthquake occurrence within each source zone is described by a magnitude recurrence relationship, truncated at an upper magnitude bound, Mx. Earthquake ground motion relations provide the link between the occurrence of earthquakes of various magnitudes and the resulting ground motion levels at any site of interest. The probability of exceeding a specified level of ground motion at a site can then be calculated by integrating hazard contributions over all magnitudes and distances, including all source zones. To obtain ground motion levels or earthquake response spectra for a specified probability, calculations are repeated for a number of ground motion values, for all desired ground motion parameters, and interpolation is used to determine the relationship between ground-motion amplitude and annual probability.

The Cornell-McGuire framework has been well-accepted in all parts of North America. In Canada, it forms the basis for the seismic hazard maps in the National Building Code of Canada (NBCC 1985 and beyond), and is the usual basis for seismic hazard evaluations of all important engineered structures. The results are generally expressed as a Uniform Hazard Spectrum (UHS), in which the amplitude for each frequency corresponding to a specified target probability is provided. The peak ground acceleration (PGA) and velocity (PGV) for the target probability may also be estimated. When time histories of ground-motion are required for use in engineering analyses, these may be derived to be consistent with the expected ground motion characteristics of the UHS for the target probability. The analysis methods used to generate UHS results and time histories are described in more detail by McGuire (2004).

2.2 Treatment of Uncertainty

It has long been recognized that seismic hazard analyses are subject to greater uncertainties than those associated with most environmental phenomena. Two types of uncertainty exist:
- random uncertainty due to the physical variability of earthquake processes
- model uncertainty due to incomplete knowledge concerning the processes governing earthquake occurrence and ground motion generation (e.g. uncertainties in input parameters to hazard analysis).

The first type of uncertainty is incorporated directly into the Cornell-McGuire analysis framework, and is included in a standard ‘best-estimate’ seismic hazard result. The second type of uncertainty implies a spread of possible results about those that might be considered a best estimate. This type of uncertainty can cause differences in results, among alternative hypotheses, of factors of more than two. It also implies that, as new information on seismic hazard becomes available (through seismic monitoring and research) hazard estimates may change significantly from those developed at an earlier time.

Seismic hazard analysis procedures have been developed in recent years to formally evaluate the level of model uncertainty (sometimes referred to as epistemic uncertainty) in hazard analyses. A logic tree approach is often used to represent each input parameter by a simple probability distribution, thereby producing a family of possible output hazard curves, with associated weights (McGuire, 2004). Such an approach has been used in hazard analyses for critical engineered structures such as nuclear power plants (e.g. Atkinson, 1990), and has also been used in the latest national seismic hazard maps (Adams and Halchuck, 2003). The logic tree approach is simply a way of formalizing consideration of the implications of alternative assumptions. It is most useful in cases where there is a range of competing alternative hypotheses that significantly impact the seismic hazard results. A full logic tree can be used to define the mean hazard and fractiles (e.g. median, 84th percentile) expressing confidence in the estimated UHS. Alternatively, a “logic shrub”, including the most significant branches of the logic tree, can be used to determine the mean-hazard UHS by weighting the alternatives for each of the key uncertainties (while leaving fixed the parameters that exert only a minor influence on the results). In this preliminary evaluation of hazard, we focus on a best estimate, using a sensitivity analysis to display alternative results that are obtained using different ground-motion relations. We focus on ground-motion relations as the key source of uncertainty due to the setting of the pipeline route. In general, the key uncertainties for most sites will be the ground-motion relations and the seismic source zone configuration. In this study, the seismic source zone configuration is not as critical as the ground-motion relations, because the seismic sources are very broad regional zones, with the pipeline being within zones representing low to moderate seismicity levels. We thus consider only uncertainty in ground-motion relations. Future refinements to the study can address other issues in greater detail. In particular, the question of exactly where along the route the zone boundaries should be placed may be significant.

2.2.1 Seismic Source Zones
A relevant aspect of the treatment of uncertainty in the new national seismic hazard maps, produced by the Geological Survey of Canada (GSC), concerns the issue of alternative seismotectonic hypotheses. Two alternative approaches to defining seismic source zones were defined. In one model (the Historical model), it was assumed that future large earthquakes in eastern Canada will be concentrated in zones of relatively limited spatial extent, in which they have occurred in the recent past (about 200 years of historical earthquake data on the location of large eastern earthquakes). This model tends to localize hazard in certain areas that are currently active.

In the second GSC model (the Regional model), it was assumed that future large earthquakes are distributed over somewhat broader zones, with more weighting given to the geological setting as opposed to historical seismicity. This tends to produce smoother hazard results; ground motion estimates are enhanced in parts of the zone that have had low seismicity rates within the period of historical record, and reduced in areas that have had high seismicity. In the GSC hazard analysis approach, which they term the robust approach, the higher of the ground motion estimates from these two alternative zonation models is adopted as the mapped ground-motion parameter (Adams and Halchuck, 2003).

For the Gateway Pipeline route, the implications of the H and R models are quite similar along most of the route. Thus the use of these two models does not really address tectonic uncertainties. For this preliminary assessment, we simply adopt the R model, which tends to give slightly higher values along the route for most sites. The R model sources as used in the study are shown in Figure 1. (Notes on Figure 1: all events were converted to moment magnitude before plotting, as discussed later in the report. The R model zones are very similar, but not identical, to the GSC R model sources.) We define an additional zone (NAB) to cover the area of moderate seismicity in northern Alberta that is not well-covered in the GSC model. Uncertainties in the source zonation are considered secondary to those in the ground-motion relations, and are not studied in this preliminary report. These uncertainties can be addressed in more detailed studies at a later date if warranted. In general, the adopted source zone model provides a good generalization of the seismicity levels that have been experienced over the pipeline route in the period of historical record (about 100 years).

2.2.2 Ground-Motion Relations

Uncertainties in the ground motion relations are typically the most important contributor to overall uncertainty in a seismic hazard analysis, and are the only epistemic uncertainty that is explicitly considered in this analysis. It is assessed by considering three alternative sets of ground-motion relations. The first is the Boore, Joyner and Fumal (1997) relations used in the 2005 national seismic hazard maps. These relations were based on regression analysis of California ground-motion data available in the early 1990s. The BJF97 relations are applicable to NEHRP C conditions, which is a soft-rock (or hard-soil) condition with an approximate shear wave velocity over the top 30 m of 600 m/s.
The second relation is the Atkinson (2005) relations for rock sites in B.C. These relations were based on modifying empirically-calibrated stochastic-model California relations (Atkinson and Silva, 2000) to be appropriate for B.C. rock site conditions, which differ from those in California. The A05 relations are applicable for NEHRP B conditions, which is a soft-rock with an approximate shear-wave velocity of 1000 m/s. Finally, more recent empirical ground-motion relations that take advantage of the global database of records for shallow earthquakes in active tectonic regions were considered. These are the relations of Boore and Atkinson (2006) developed for the PEER-NGA ground-motion project (http://peer.berkeley.edu/). The BA06 relations as defined for NEHRP B/C boundary site conditions (shear-wave velocity of 760 m/s) were considered. Note that the site conditions for the three relations are similar, but not identical, with the A05 relations representing the hardest condition (NEHRP B) and the BJF97 relations representing the softest condition (NEHRP C). All relations are defined for the horizontal component of motion; the BJF97 and A05 relations are for the random horizontal component, while the BA06 relations are for the average horizontal component. All use moment magnitude (M) as the magnitude variable. The relations use either closest distance to fault (A05) or closest distance to the surface projection of the fault (BJF97, BA06) as the distance metric. For use in the hazard calculations, all relations are converted to use the hypocentral distance measure for consistency with the seismic hazard software and the tectonic setting; the conversion factors given by EPRI (2004) are used for this purpose. Figure 2 plots the three sets of ground-motion relations, for PSA at frequencies of 0.5, 1 and 5 Hz, and peak ground acceleration (PGA), in terms of hypocentral distance.

In summary, the analysis in this report fully incorporates random variability in earthquake locations and ground motions. Model uncertainty is incorporated by examining the sensitivity of results to the key uncertainty, which is that in the ground-motion relations. The three ground-motion relations shown in Figure 2 are used to assess this sensitivity.
Figure 2 – Comparison of alternative ground-motion models used in seismic hazard analysis for PSA at $f=0.5$, 1, 5 Hz, and PGA (BJF97=Boore, Joyner and Fumal, 1997(NEHRP C); A05=Atkinson, 2005 (NEHRP B); BA06=Boore and Atkinson, 2006 (B/C boundary). All relations converted to hypocentral distance.
2.3 Input Parameters for Seismic Hazard Analysis

The input parameters for the seismic hazard analysis include the seismic source zoning, the magnitude recurrence parameters and maximum earthquake magnitude for each source zone, and the ground motion relations for response spectra at several vibration frequencies, PGV and PGA.

2.3.1 Seismic source models

Figure 1 shows the adopted source model, which follows the GSC R-model definition used in the 2005 NBCC national seismic hazard maps, with the addition of a zone for Northern Alberta. Seismicity data for the mapped region were obtained through 2005 from the Geological Survey of Canada (www.seismo.nrcan.gc.ca). All known events of $M>1$ are plotted, although the catalogue is not complete for the smaller events.

The GSC catalogue uses a mixture of magnitude scales, including ML (local magnitude), MS (surface wave magnitude) mb (body wave magnitude), Mc (coda wave magnitude), MN (Nuttli magnitude) and moment magnitude (M). The moment magnitude scale, $M$, was used in this study, because the ground motion relations are given in terms of moment magnitude. (Note: moment magnitude is similar to the more familiar “Richter magnitude” that is often used to describe the size of events in California; local magnitude, ML, is another term used to describe “Richter magnitude”.) For events with no moment magnitude determination, a conversion was made from other magnitudes via empirical relationships that are applicable to western Canada. This was not done for the GSC hazard calculations (Adams and Atkinson, 2003). In this region, according to studies by Cassidy et al. (2003) and by Ristau et al. (2005), the magnitude ML (Richter or local magnitude) is approximately equal to $M$. This was also found by Atkinson and McCartney (2005). Most of the catalogue events are given as ML, but there are also MS, mb, MN and Mc. To convert all magnitudes to a common scale, the following methods were used, in decreasing order of preference:

1. For magnitudes $>6$, MS was assumed equal to $M$ as per Johnston (1996).
2. For other events, ML was used if available, and it was assumed that $M=ML$.
3. The next choice was MN, with the relation $M=MN+0.4$.
4. The next magnitude choice was mb, with the relation $M=mb+0.3$.
5. The next choice was MS (for magnitude $<6$) with the empirical Johnston (1996) relation.
6. The last choice was Mc, which was converted to M assuming $M=Mc+0.2$, based on limited data between Mc and ML for the subject region.
2.3.2 Magnitude Recurrence Relations

Recurrence data, expressing the relative frequency of occurrence of earthquakes within a zone as a function of magnitude, can generally be fit to the Gutenberg-Richter relation:

\[ \log N(M) = a - bM \]

where \( N(M) \) is the number of events per annum of magnitude \( \geq M \), \( M \) is moment magnitude, and \( a \) and \( b \) are the rate and slope of the relation. In most parts of the world, \( b \) values are in the range from 0.8 to 1., while \( a \) values vary widely depending on the activity level of the region.

The magnitude recurrence relations obtained for the source zones of Figure 1 are shown in Figure 3. (Note: source zones \( > 200 \) km from the pipeline do not contribute to hazard and are not considered.) In developing these relations, uneven completeness of the catalogue was accounted for. This was accomplished by estimating the annual rate for events of different magnitudes separately, using, for each magnitude, seismicity data for the time period for which reporting of those data is complete. These completeness intervals are as follows:

<table>
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<th>Zone</th>
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<tr>
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<tr>
<td>NAB</td>
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</tr>
<tr>
<td>CST</td>
<td>1960</td>
</tr>
<tr>
<td>QCFR</td>
<td>1980</td>
</tr>
<tr>
<td>HECR</td>
<td>1980</td>
</tr>
<tr>
<td>NBC</td>
<td>1960</td>
</tr>
<tr>
<td>ROC</td>
<td>1970</td>
</tr>
</tbody>
</table>

Thus the annual rate of \( M3 \) events is based on just the last few decades, while the annual rate of \( M5 \) events considers all events from the early 1900’s.

The minimum magnitude for the hazard calculations is \( M5.0 \), as smaller events do not cause damage to well-engineered structures. The maximum magnitude (Mx) is conservatively assumed to be \( M 7.5 \) for all zones except the Queen Charlotte Fault (QCFR), for which it is assumed to be 8.5. The choice of maximum magnitude is not critical to seismic hazard results.
Three alternative sets of ground motion relations are considered as described in Section 2.2. These include the Boore, Joyner and Fumal (1997) relations, the Atkinson (2005) relations and the Boore and Atkinson (2006) relations. All have been converted to equivalent relations for hypocentral distance for consistency with their application in the seismic hazard computations (see EPRI, 2004). They provide PGA, PGV and response spectra (5% damped pseudo-acceleration) for the horizontal component of motion, on soft rock (NEHRP B to C), as a function of moment magnitude and distance from the earthquake source. These relations have been validated against ground-motion data in California (BJF97), B.C. and California (A05) and global tectonic data (BA06). The BJF97 relations were adopted in the NBCC 2005 calculations, but have been superseded
by the BA06 relations, which use about 5 times more data in the regression analyses. The BA06 relations generally predict lower amplitudes than BJF97. The A05 relations are the most directly applicable to this project, as they were developed and validated for ground motions in B.C., on typical B.C. rock conditions. These rock conditions are harder than those found in California, due to a combination of more competent rock types and the fact that B.C. was glaciated in the last 15,000 years, while California was not.

Random uncertainty in the relations was modeled by a lognormal distribution of ground motion amplitudes about these median relations, with a standard deviation of 0.25 log (base 10) units for high frequencies, increasing to 0.30 units at low frequencies. This random uncertainty is consistent with the results of recent studies (eg. EPRI, 2004; Boore and Atkinson, 2006).

3 - RESULTS OF SEISMIC HAZARD ANALYSIS

Using the input parameters given in the previous section, the PGA, PGV and response spectra were computed for a range of probabilities using the Cornell-McGuire method. The values of PGA and PSA (5% damped), for the horizontal component of motion on hard rock for these probabilities are displayed in Figures 4 through 11, for the 8 sites, where the site numbers increase from 1 to 8 as we proceed from west to east. The hazard is highest at the westernmost sites, due to the active plate tectonics near the coast, then decreases markedly as we move inland. It increases again for Site 5, within the Rocky Mountain Trench, then decreases again as we move towards Edmonton. For each site, the 1/500 and 1/2500 per annum (p.a.) motions are shown, for each of the 3 considered ground-motion relations. Note that the site conditions are slightly different for each relation, with the A05 relations corresponding to the hardest site condition (NEHRP B), and the BJF97 relations corresponding to the softest site condition (NEHRP C). Also shown on the figures are the corresponding GSC values (NBCC 2005) for the two cities that are most similar to each site in terms of seismic hazard environment (for NEHRP C).

The peak ground acceleration (PGA) is plotted for reference at a frequency of 50 Hz, but the shape of the curve between 10 Hz and 50 Hz is arbitrary (no spectral values were calculated for frequencies above 10 Hz). The PGA refers to the maximum acceleration of the ground shaking during the seismic event (ie. the peak amplitude on a free-field record of ground acceleration versus time) – it does not have an actual associated frequency, as the frequency at which the PGA occurs will depend on the earthquake magnitude and distance. The response spectrum shows the maximum acceleration of a damped single-degree-of-freedom oscillator, when subjected to the input record of ground acceleration versus time. Oscillators with a high natural frequency will respond to input ground motions that are rich in high frequency content, while oscillators with low natural frequency will respond more strongly to input ground motions that are rich in low frequency content.

It is observed that the A05 relations are generally an intermediate case between the BJF97 and BA06 relations, although the A05 relations have the highest amplitudes at high
frequencies; this is attributable to the harder rock site condition to which they apply. It is also noted that the results of this study are generally consistent with the GSC estimates, with the pipeline site values tending to lie between or near the GSC values for the two most comparable cities. (For Site 5, none of the 3 cities are very comparable.)

Figure 4 – Sensitivity of UHS for 1/500 (10% in 50 years) and 1/2500 (2% in 50 years) probability to ground-motion relations. Site 1 (westernmost site).
Figure 5 – Sensitivity of UHS for 1/500 (10% in 50 years) and 1/2500 (2% in 50 years) probability to ground-motion relations. Site 2.
Figure 6 – Sensitivity of UHS for 1/500 (10% in 50 years) and 1/2500 (2% in 50 years) probability to ground-motion relations. Site 3.
Figure 7 – Sensitivity of UHS for 1/500 (10% in 50 years) and 1/2500 (2% in 50 years) probability to ground-motion relations. Site 4.
Figure 8 – Sensitivity of UHS for 1/500 (10% in 50 years) and 1/2500 (2% in 50 years) probability to ground-motion relations. Site 5 (in ROC).
Figure 9 – Sensitivity of UHS for 1/500 (10% in 50 years) and 1/2500 (2% in 50 years) probability to ground-motion relations. Site 6.
Figure 10 – Sensitivity of UHS for 1/500 (10% in 50 years) and 1/2500 (2% in 50 years) probability to ground-motion relations. Site 7.
As noted in the previous section, the A05 relations are the most directly applicable to B.C. For this reason, and because they form an intermediate case in terms of results, it is recommended that for the preliminary analysis, the A05 results be adopted. Table 1 presents the seismic hazard estimates obtained based on the A05 ground-motion relations, for each of the 8 sites along the route. Figure 12 summarizes the results for 1/500 p.a., while Figure 13 summarizes the results for 1/2500 p.a. The GSC results for Edmonton, Prince George and Prince Rupert are shown for comparison. The lowest hazard results are obtained for sites 4 and 8, due to their location in zones of low seismicity. For these low-hazard sites, the estimates from this study are lower than those of the GSC at high frequencies. The reason is that the GSC imposes a “floor value” of ground motions based on occurrence rates of events averaged over stable continental regions throughout the world, whereas this study focuses on actual observed regional seismicity rates. A further reason is that the GSC estimates are amplified to NEHRP C conditions, whereas the estimates shown on Figures 12 and 13, and given in Table 1, are for NEHRP B. The GSC

Figure 11 – Sensitivity of UHS for 1/500 (10% in 50 years) and 1/2500 (2% in 50 years) probability to ground-motion relations. Site 8 (easternmost site).
floor values are considered conservative for sites in very low seismicity regions. Site 1 is the highest-hazard site, due to its proximity to the active tectonics along the B.C. west coast.

Figure 12 – Summary of UHS for 1/500 (10% in 50 years) for all sites, for A05 ground-motion relations.
To provide insight on what types of events correspond to the UHS, Figures 14 and 15 plot median response spectra and PGA predicted by the A05 ground-motion relations for various scenarios, in comparison to the UHS for the highest hazard site (site 1) and the lowest hazard sites (4 and 8); plots are provided for 1/500 and 1/2500 p.a. probability. The 1/500 UHS at the lowest hazard sites correspond to a $M_5$ event at a distance of >50 km at high frequencies, while low-frequency motions at the low hazard sites are matched by an event of about $M_6$ at 70 km. The high-hazard site is matched at 1/500 by an event of $M_7.5$ 100 km away. The 1/2500 UHS at the lowest hazard sites correspond to a $M_5$ event at a distance of about 40 km at high frequencies, while low-frequency motions at the low hazard sites are matched by an event of about $M_6$ within 30 km. The high-hazard site is matched at 1/2500 by an event of $M_7.5$ 40 km away.
Figure 14 – Comparison of UHS for 1/500 (10% in 50 years) for lowest-hazard sites (4 and 8) and highest-hazard site (1) to motions for selected scenario events, according to median A05 ground-motion relations.
Figure 15 – Comparison of UHS for 1/2500 (2% in 50 years) for lowest-hazard sites (4 and 8) and highest-hazard site (1) to motions for selected scenario events, according to median A05 ground-motion relations.
Table 1 – Preliminary analysis ground-motion amplitudes (A05 ground-motion model) recommended for Gateway pipeline sites. PSA, PGA in cm/s², PGV in cm/s. Horizontal component, 5% damped.

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<th>0.0004</th>
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4 - REFERENCES


Median PAH concentrations (ppb) in fish collected from impoundments of the Kalamazoo River in 2010.

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* - only 1 fish with concentrations above the 0.2 ppb detection limit (dl for all analytes = 0.2 ppb)
Median PAH Concentrations in Rock Bass

- 1-Methylnaphthalene
- 1-Methylphenanthrene
- Acenaphthene
- Anthracene
- Benzo(a)anthracene
- Benzo(b)fluoranthene
- Benzo(b)pyrene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Chrysene
- Dibenzo(a,h)anthracene
- Dibenz(a,h)pyrene
- Fluoranthene
- Fluorene
- Naphthalene
- Phenanthrene
- Pyrene
Preliminary Analysis of Contaminant Concentrations in Fish
Collected from the Kalamazoo River in 2010
After the Enbridge Oil Spill

Fish samples were collected from the Kalamazoo River following a major oil spill that entered the river downstream of the city of Marshall on July 26, 2010. Carp and smallmouth bass were collected from upstream of the spill (Marshall Pond) on August 2, 2010. Carp and rock bass were collected from Ceresco Pond while carp, rock bass, and bluegill were collected from Morrow Pond on October 28, 2010.

As of August 9, 2011 mercury results have been reported for all samples and PCB results have been reported for approximately half of the samples.

Since a full complement of identical species was not collected from each impoundment and because the samples were collected relatively soon after the oil spill, we can not determine if the spill had any impact on concentrations of mercury, PCBs, or other contaminants at this time. The available results do provide evidence indicating that a change to the pre-spill consumption advisory for the Kalamazoo River is probably unnecessary.

The current Michigan Fish Advisory recommends that children and women of childbearing age eat no more than 1 meal per month of carp from the Ceresco Impoundment downstream to the Morrow Dam due to elevated levels of PCBs. The advisory also recommends restricting consumption of smallmouth bass from the Ceresco Impoundment due to mercury and from the river between Battle Creek and Morrow Dam due to PCBs. In addition, the advisory recommends restricted consumption of channel catfish from the river between Battle Creek and Morrow Dam due to PCBs.

Carp have been collected from the Ceresco Impoundment regularly since 1987; total PCB concentrations in the samples collected since 2000 are presented in 2 graphs in Figure 1. The results indicate that PCB concentrations in the pond have declined since 2000 and that the concentrations in the carp collected in 2010 are not higher and are possibly lower than PCB concentrations in the carp collected in 2006. The median total PCB concentration in carp collected since 2006 is 0.09 ppm.

Figure 2 presents box-plots of the mercury concentrations in all of the fish collected in 2010 from the Kalamazoo River after the oil spill. All of the samples except one (a carp from Morrow Pond) had mercury concentrations below the MDCH screening value of 0.5 ppm. Median mercury concentrations ranged from 0.03 ppm to 0.12 ppm.

These PCB and mercury results indicate that the existing fish consumption recommendations presented in the 2011-2012 Michigan Fish Advisory are appropriate. Additional fish will be collected in 2011 and analyzed to verify that contaminant concentrations have not increased in fish from areas affected by the oil spill.

J. Bohr
8/10/2011
Figure 1. Length versus total PCB concentrations in carp collected from the Kalamazoo River, Ceresco Pond.
Figure 2. Boxplots of mercury concentrations in fish collected from the Kalamazoo River in 2010 following an oil spill.
ENBRIDGE PIPELINES INC.

CRUDE PETROLEUM TARIFF

RULES AND REGULATIONS

Governing the

TRANSPORTATION

of

CRUDE PETROLEUM

▲ Denotes changes in wording from NEB No. 278

EFFECTIVE MARCH 10, 2008

ISSUED BY
Ralph J.W. Fischer
Director, Planning & Analysis

Enbridge Pipelines Inc.
Suite 3000
425 - 1 Street S.W.
Calgary, AB T2P 3L8

COMPiled BY
Angelese R. Hood
Regulatory Strategy & Compliance

Tel.: (403) 718-3425
Fax: (403) 508-3140
RULES AND REGULATIONS

1. DEFINITIONS

As used in this tariff, the following terms have the following meanings:

"API" means American Petroleum Institute.


"Carrier" means Enbridge Pipelines Inc.

"Crude Petroleum" means the direct liquid product of oil wells, oil processing plants, the indirect liquid petroleum products of oil or gas wells, oil sands, or a mixture of such products, but does not include Natural Gas Liquids or Refined Petroleum Products.

"Density" means mass per unit volume at 15 degrees Celsius expressed in kilograms per cubic metre.

"Financial Assurances" means the financial assurances provided by the Shipper and accepted by the Carrier in accordance with Rule 19.

"Force Majeure" means an event, which is unforeseen, and beyond the control of the Shipper that either prevents the Shipper from delivering the affected volume to Carrier or prevents the Shipper from accepting delivery of the affected volume from Carrier. The following are the only instances that will be recognized as Force Majeure events: earthquakes; floods; landslides; civil disturbances; sabotage; the acts of public enemies; war; blockades; insurrections; riots; epidemics; the act of any government or other authority or statutory undertaking; the inability to obtain or the curtailment of electric power, water or fuel; strikes, lockouts or other labour disruptions; fires; explosions; breakdowns or failures of pipe, plant, machinery or equipment; and contamination or poisoning of catalyst and/or solvent or biological treatment facilities. For greater certainty, a lack of funds; the availability of a more attractive market; Shipper's inability to purchase Crude Petroleum; or inefficiencies in operations do not constitute events of Force Majeure.

"Kilopascal" is equivalent to 0.1450377 pounds per square inch.

"Natural Gas Liquids" means the indirect liquid petroleum products of oil or gas wells having an absolute vapour pressure in excess of 103 kilopascals.

"NEB" means the National Energy Board.

"Non-Performance Penalty" means the charge and cost referred to in Rule 18(a).

"Petroleum" means Crude Petroleum, Natural Gas Liquids and Refined Petroleum Products.

"Refined Petroleum Products" means the products of a refinery tendered as motor gasoline, aviation fuels, kerosene, diesel fuel and domestic heating oil falling within specifications established in the Carrier's tariff respecting Refined Petroleum Products.

"Regular Delivery Point" means a location for the delivery of Crude Petroleum as provided for in the Carrier's tariff for Tolls Applying on Crude Petroleum, Natural Gas Liquids and Refined Petroleum Products.

"Regular Receiving Point" means a location for the receipt of Crude Petroleum as provided for in the Carrier's tariff for Tolls Applying on Crude Petroleum, Natural Gas Liquids and Refined Petroleum Products.

"Retention Stock" means the volume of Petroleum required by the Carrier for operational and scheduling purposes as specified from time to time by the Carrier and includes working stock, tank bottoms and idle loopfill.

"Shipper" means the party that contracts with the Carrier for the transportation of Crude Petroleum under the terms of this tariff, and that has satisfied the Carrier of that party's capacity to perform its financial obligations that may arise from the transportation of its Crude Petroleum under the terms of this tariff, and includes a transferee of a Shipper's rights and obligations, as approved in accordance with Rule 15(c).

"Tender" means an offer by a Shipper to the Carrier in accordance with this tariff for the transportation of a stated quantity of Crude Petroleum from a Regular Receiving Point to a Regular Delivery Point.
2. COMMODITY

This tariff applies to the transportation of Crude Petroleum by the Carrier.

3. ORIGIN AND DESTINATION FACILITIES

a. Subject to the further provisions of this tariff, the Carrier will only accept Crude Petroleum for transportation:
   i. at Regular Receiving Points;
   ii. when the Crude Petroleum has been specified to be delivered to one or more Regular Delivery Points; and
   iii. when the party taking delivery of the Crude Petroleum has been specified in writing to the Carrier.

b. Except where the Carrier provides such facilities, the Carrier will only accept Crude Petroleum for transportation when the Shipper has provided the necessary facilities satisfactory to the Carrier at the specified Regular Delivery Point for such Crude Petroleum.

4. SPECIFICATIONS AS TO QUALITY

a. A Shipper shall not deliver to the Carrier and the Carrier shall not be obligated to accept Crude Petroleum that, as determined by the Carrier, has on receipt:
   i. a temperature greater than 38 degrees Celsius;
   ii. a Reid vapour pressure in excess of 103 kilopascals;
   iii. sediment and water in excess of 0.5 percent by volume;
   iv. a density in excess of 940 kilograms per cubic metre at 15 degrees Celsius;
   v. a kinematic viscosity in excess of 350 square millimetres per second determined at the Carrier's reference line temperature;
   vi. any organic chlorides; or
   vii. physical or chemical characteristics that may render such Crude Petroleum not readily transportable by the Carrier or that may materially affect the quality of other commodities transported by the Carrier or that may otherwise cause disadvantage to the Carrier.

b. A Shipper shall, as required by the Carrier, provide to the Carrier a certificate with respect to the specifications of Crude Petroleum to be received by the Carrier from such Shipper. If a Shipper fails to provide the Carrier with such certificate, then the Carrier shall not be obligated to accept the Shipper's Crude Petroleum.

c. If the Carrier determines that a Shipper does not comply with the provisions of paragraph (a) of Rule 4 of this tariff, then such Shipper shall remove its Crude Petroleum from the facilities of the Carrier as directed by the Carrier.

d. If a Shipper fails to remove its Crude Petroleum from the facilities of the Carrier as directed by the Carrier, then the Carrier shall have the right to remove and sell such Crude Petroleum in such lawful manner as deemed appropriate by the Carrier. The Carrier shall pay from the proceeds of such sale all costs incurred by the Carrier with respect to the storage, removal and sale of such Crude Petroleum. The remainder of such proceeds, if any, shall be held by the Carrier for the Shipper and any other party lawfully entitled to such proceeds.
RULES AND REGULATIONS

5. CHANGES IN QUALITY AND SEGREGATION

a. The Carrier shall endeavour to deliver substantially the same type of Crude Petroleum as that received from a Shipper, however the Carrier shall not be obligated to make delivery of the identical Crude Petroleum received by the Carrier.

b. If Crude Petroleum tendered to the Carrier is of a kind or quality that is not currently being transported by the Carrier, then the Carrier shall, at the request of the Shipper of such Crude Petroleum and subject to the operating conditions of the facilities of the Carrier, endeavour to segregate such Crude Petroleum during transportation by the Carrier. In such circumstances, the Shipper shall, at the request of the Carrier, make such Crude Petroleum available in such quantities and at such times as may be necessary to permit such segregated movements.

c. Subject to paragraph (a) of Rule 12 of this tariff, the Carrier shall not be liable for any damage, loss or consequential loss resulting from a change in the density or other quality of a Shipper's Crude Petroleum as a result of the Carrier's transportation of such Crude Petroleum, including without limitation the mixing of Crude Petroleum with other Petroleum in the facilities of the Carrier.

6. TENDERS, RATES, VOLUMES AND TENDER DISCLOSURE

a. Tenders shall be submitted to the Carrier in accordance with the notice of shipment format prescribed by the Carrier no later than the time and date set out in the Carrier's monthly nomination schedule. The Carrier shall notify all shippers of the monthly nomination schedule applicable for the calendar year. Notice of any amendment to a monthly nomination date shall be provided by the Carrier to all shippers at minimum 24 hours in advance of the proposed change in nomination date.

b. The Carrier may, subject to the availability of space and the operating conditions of the facilities of the Carrier, accept Tenders or revised Tenders after such time. The Carrier may publicly disclose the volume of each Shipper's Crude Petroleum tendered to the Carrier by the categories of:

i. light or medium crude petroleum;
ii. heavy crude petroleum;
iii. synthetics; or
iv. condensate.

The Carrier may also publicly disclose the identity of each feeder pipeline respecting such volumes of Crude Petroleum.

c. A Shipper shall, upon notice from the Carrier, provide written third party verification as required by the Carrier in support of such Shipper's Tender. The Carrier shall not be obligated to accept a Shipper's Crude Petroleum where such verification is, in the sole discretion of the Carrier, unacceptable to the Carrier.

d. The Carrier shall not be obligated to accept a Shipper's Crude Petroleum if the volume of such Crude Petroleum is less than the minimum volume or if the rate at which such Crude Petroleum is received by the Carrier is less than or greater than the rates specified from time to time by the Carrier for each Regular Receiving Point.

e. The Carrier shall not be obligated to make a delivery of a Shipper's Crude Petroleum of less than the minimum volume or at a rate less than or greater than the rates specified from time to time by the Carrier for each Regular Delivery Point.

f. A Shipper shall supply its share of Retention Stock by types and volumes as determined from time to time by the Carrier.

g. Tenders received by the Carrier acting for Enbridge Energy, Limited Partnership for transportation within the United States of America shall be subject to the rates, rules and regulations applicable to
RULES AND REGULATIONS

transportation by Enbridge Energy, Limited Partnership, which shall invoice the Shipper for such transportation.

7. APPLICATION OF TOLLS

The Carrier shall charge a Shipper the Carrier's toll for the transportation of Crude Petroleum that is in effect on the date of delivery at the designated Regular Delivery Point for such Crude Petroleum. If the designated delivery location for a Shipper's Crude Petroleum is a designated Regular Delivery Point of Enbridge Energy, Limited Partnership, then the Carrier shall charge such Shipper the Carrier's toll for the transportation of Crude Petroleum that is in effect on the date of such delivery.

8. PAYMENT OF TOLLS AND LIEN FOR UNPAID CHARGES

a. A Shipper shall pay all charges and costs as provided for in this tariff or otherwise lawfully due to the Carrier relating to the transportation or other handling of the Shipper's Crude Petroleum by the Carrier. The Shipper shall pay such charges and costs upon receipt of the Carrier's invoice respecting such charges and costs. If required by the Carrier, the Shipper shall pay such charges and costs before delivery, or before acceptance of a transfer, of the Shipper's Crude Petroleum by the Carrier.

b. The Carrier shall have a general lien on all of a Shipper's Crude Petroleum that is in the possession of the Carrier to secure the payment of all charges and costs accruing or due relating to the transportation or other handling of the Shipper's Petroleum by the Carrier. The general lien provided herein shall be in addition to any lien or security interest otherwise provided by law or contract. The Carrier may withhold the Shipper's Crude Petroleum from delivery and may exercise any other rights and remedies provided at law or by contract, until all such charges and costs have been paid.

c. If charges for the transportation of Shipper's Petroleum remain unpaid for ten days after notice of demand for payment of such charges is made to such Shipper by the Carrier, then the Carrier shall have the right to remove and sell any or all of such Shipper's Crude Petroleum that is in the possession of the Carrier in such lawful manner as deemed appropriate by the Carrier.

d. The Carrier shall pay from the proceeds of such sale all charges and costs accruing or due relating to the transportation of such Shipper's Petroleum by the Carrier and all costs incurred by the Carrier with respect to the storage, removal and sale of such Shipper's Crude Petroleum. The remainder of such proceeds, if any, shall be held by the Carrier for the Shipper and any other party lawfully entitled to such proceeds.

e. When required, the Carrier shall, with or without notice to the Shipper, appoint agent(s) to retain possession of the Shipper's Crude Petroleum on behalf of the Carrier for the purpose of enforcing the general lien described in this Rule. The Carrier hereby advises that it has appointed Enbridge Energy, Limited Partnership as one agent appointed to hold possession of the Shipper's Crude Petroleum for the purpose of enforcing its general lien.

9. MEASURING, TESTING AND DEDUCTIONS

a. The Carrier shall gauge or meter, or cause to be gauged or metered, a Shipper's Crude Petroleum upon receipt and delivery by the Carrier. The Shipper or the designate of the Shipper may be present at such gauging or metering. If tank gauges are used, the volume of Crude Petroleum shall be computed from tank tables on a 100 percent volume basis. The Carrier shall have the right to enter the premises where Crude Petroleum is received or delivered by the Carrier and shall be granted access to all facilities for the purpose of gauging or metering and to make any examination, inspection, measurement or test as required by the Carrier to verify the accuracy of such facilities and the quality of such Shipper's Crude Petroleum.

b. The Carrier shall correct the density and volume of Crude Petroleum received and delivered by the Carrier from the actual temperature of such Crude Petroleum to 15 degrees Celsius by use of API 2540 Petroleum Measurement Standards or the latest revision to such Standards.
RULES AND REGULATIONS

c. The Carrier shall correct the metered volume of Crude Petroleum for compressibility by the use of API Manual of Petroleum Measurement Standards, Chapter 11.2.1 M or the latest revision to such Chapter.

d. The Carrier shall determine the percentage of sediment and water in Crude Petroleum by the use of a centrifuge or other method agreed to by the Carrier and the Shipper. The Carrier shall deduct the amount of sediment and water from the corrected volume of such Crude Petroleum.

e. The Carrier shall, as deemed necessary by the Carrier, adjust the measured volume of Crude Petroleum for shrinkage in accordance with API Bulletin 2509 C or the latest revision to such Bulletin.

f. The Carrier shall, as deemed necessary by the Carrier, determine the kinematic viscosity of Crude Petroleum received by the Carrier in accordance with ASTM D 445 or the latest revision to such Standard or such other test as may be agreed to by the Carrier and the Shipper.

g. The results of all such gauging, metering and testing by the Carrier shall be final.

10. EVIDENCE OF RECEIPTS AND DELIVERIES

The Carrier shall evidence the receipt and delivery of Crude Petroleum by tickets showing the volume, type, temperature, density, sediment and water and any other data with respect to such Crude Petroleum as may be specified from time to time by the Carrier. Such tickets shall be signed by the Shipper, or the designate of the Shipper, and the Carrier.

11. REMOVAL, DELIVERY AND ACCEPTANCE

a. A Shipper or the designate of the Shipper shall accept such Shipper’s Crude Petroleum upon arrival at the designated Regular Delivery Point for such Crude Petroleum, or as otherwise directed by the Carrier.

b. If a Shipper fails to remove its Crude Petroleum from the facilities of the Carrier in accordance with the provisions of paragraph (a) of Rule 11 of this tariff, and a disruption of Carrier’s operations results, Shipper shall be solely responsible for all costs or losses to Carrier associated with such disruption, including loss of revenue resulting therefrom, unless the non-removal of such Crude Petroleum is due to the direct negligence of Carrier.

c. If the Crude Petroleum is not removed from Carrier’s facilities and the Carrier determines, in its sole discretion, that a disruption of Carrier’s operations may result, Carrier shall provide Shipper with twenty-four (24) hours’ notice to remove specified Crude Petroleum of the Shipper from the Carrier’s facilities. Should Shipper not remove the specified Crude Petroleum from the Carrier’s facilities within said notice period, then the Carrier shall have the right to remove and sell any or all of such Shipper’s Crude Petroleum that is in the possession of the Carrier in such lawful manner as deemed appropriate by the Carrier.

d. The Carrier shall pay from the proceeds of such sale all charges and costs accruing or due relating to the disruption of the Carrier’s operations and all costs incurred by the Carrier with respect to the storage, removal and sale of such Shipper’s Crude Petroleum. The remainder of such proceeds, if any, shall be held by the Carrier for the Shipper and any other party lawfully entitled to such proceeds.

e. When required, the Carrier shall, with or without notice to the Shipper, appoint agent(s) to retain possession of the Shipper’s Crude Petroleum on behalf of the Carrier for the purpose of enforcing this Rule. The Carrier hereby advises that it has appointed Enbridge Energy, Limited Partnership as one agent appointed to hold possession of the Shipper’s Crude Petroleum for the purpose of enforcing this Rule.
RULES AND REGULATIONS

12. LIABILITY OF THE CARRIER

a. Except where caused by the direct negligence of the Carrier, the Carrier shall not be liable to a Shipper for any delay, damage, loss or consequential loss resulting from any cause while the Carrier is in possession or control of such Shipper's Crude Petroleum, including without limitation the breakdown of the facilities of the Carrier.

b. If damage or loss to Petroleum results from any cause other than the direct negligence of the Carrier while the Carrier is in possession or control of such Petroleum, then the Carrier may apportion the cost of such damage or loss on a pro rata basis among all Shippers. Each Shipper's share of such cost shall be determined by the Carrier based on the proportion of the volume of the Shipper's Crude Petroleum in the possession of the Carrier on the date of such loss to the total volume of Petroleum in the possession of the Carrier on the date of such loss.

13. INDEMNIFICATION BY THE SHIPPER

a. A Shipper shall indemnify the Carrier for any damage, loss, costs or consequential loss incurred by the Carrier or any other party as a result of such Shipper's failure to comply with any provision of this tariff.

14. APPORTIONMENT

a. If more Crude Petroleum is tendered than can be transported by the Carrier, then the Carrier shall apportion such tenders among all such Shippers on the basis of such current tenders and the current operating conditions of the facilities of the Carrier applicable to the transportation of Crude Petroleum.

b. Subject to allocations to priority destinations designated by the NEB, the Carrier shall apportion each such Shipper a pro rata share of the capacity of such facilities of the Carrier based on such current tenders. Where blending of Crude Petroleum can achieve an increase in the capacity of the facilities of the Carrier, such increase in capacity shall be apportioned on a pro rata basis first to Shippers tendering such blends with any remaining increase in capacity apportioned on a pro rata basis to all other tenders.

15. REQUESTED CHANGE BY THE SHIPPER

a. Subject to the operating conditions of the facilities of the Carrier, the Carrier may, upon the written request of a Shipper, allow a Shipper to change:

i. the designated Regular Receiving Point for its Crude Petroleum;

ii. the designated volume and type of its Crude Petroleum to be received at a designated Regular Receiving Point;

iii. the designated Regular Delivery Point for its Crude Petroleum;

iv. the designated volume and type of its Crude Petroleum to be delivered to a designated Regular Delivery Point; and

v. the party designated to take delivery of its Crude Petroleum.

b. The Carrier may allow a Shipper to transfer, in such manner as may be specified by the Carrier from time to time, such Shipper's rights and obligations under this tariff respecting its Crude Petroleum to another Shipper.

c. A transfer of a Shipper's rights and obligations under Rule 15(b) under this tariff respecting its Crude Petroleum will not be binding or effective on the Carrier until the Carrier has provided a notice of acceptance to the transferor and transferee. The Carrier will not provide a notice of acceptance of a transfer until such time as the transferee has satisfied the Carrier of its capacity to undertake the
RULES AND REGULATIONS

transferor's obligations and has provided any Financial Assurances requested by the Carrier in accordance with Rule 19 of this tariff.

16. ADVERSE CLAIMS AGAINST CRUDE PETROLEUM

a. A Shipper shall not Tender or deliver to the Carrier Crude Petroleum which is involved in litigation, the ownership of which may be in dispute or which is encumbered by a lien or charge of any kind unless the Shipper provides written notification to the Carrier of such litigation, dispute, lien or charge not less than 20 days before such Tender is made to the Carrier.

b. The Carrier shall not be obligated to accept Crude Petroleum that is involved in litigation, the ownership of which may be in dispute or which is encumbered by a lien or charge of any kind.

c. A Shipper shall advise the Carrier in writing if, at any time while the Shipper's Crude Petroleum is in the possession of the Carrier, such Crude Petroleum becomes involved in litigation, the ownership of such Crude Petroleum becomes in dispute or such Crude Petroleum becomes encumbered by a lien or charge of any kind.

d. A Shipper shall, upon demand from the Carrier, provide a bond or other form of indemnity satisfactory to the Carrier protecting the Carrier against any liability or loss that may arise as a result of such Shipper's Crude Petroleum that is involved in litigation, the ownership of which may be in dispute or which is encumbered by a lien or charge of any kind.

17. CLAIMS, SUITS AND TIME FOR FILING

a. A Shipper shall advise the Carrier in writing of any claim for delay, damage or loss resulting from the transportation of such Shipper's Crude Petroleum by the Carrier within 30 days of delivery of such Crude Petroleum by the Carrier or, in the case of a failure to make delivery, then within 30 days after a reasonable time for delivery has elapsed.

b. A Shipper shall institute any action arising out of any claim against the Carrier within 180 days from the date that written notice is given by the Carrier to such Shipper that the Carrier has disallowed such claim or any part of such claim.

c. If a Shipper fails to comply with the provisions of paragraph (a) or paragraph (b) of Rule 17 of this tariff, then such Shipper waives all rights it has to bring an action against the Carrier with respect to such claim.

18. NON-PERFORMANCE

a. In months of apportionment, all nominations, which are apportioned, shall have the Non-Performance Penalty applied to that portion of shortfall in receipts by a Shipper that exceeds five (5) percent of that Shipper's apportioned volume. However, the Non-Performance Penalty will not be applied to that portion of shortfalls caused by Force Majeure events; Carrier imposed restrictions on feeder pipeline deliveries into the Carrier; or any carry over volumes.

b. The Shipper shall provide the Carrier with written notice of the Force Majeure event within four business days of the event. Such notice shall state the nature of the event, the estimated duration of the event, and the volume affected. The Shipper shall use reasonable diligence to remedy the Force Majeure event as quickly as reasonably practicable and shall keep Carrier informed as to the progress in the efforts to remedy the event; provided the Shipper shall not be required to settle strikes, lockouts or other labour disruptions contrary to its wishes.

c. At any time up to thirty (30) calendar days following the receipt of the notice referred to in Rule 18(b) the Carrier will issue written notice to the Shipper informing the Shipper in the event the Carrier disputes all or a portion of the Shipper's claim of Force Majeure. The Carrier shall invoice the Shipper for the amount of the Non-Performance Penalty calculated in accordance with Rule 18(a) and the Shipper shall be obligated to make payment of the invoiced amount.
RULES AND REGULATIONS

d. The Carrier shall publish, on at least a monthly basis, a summary of all Force Majeure notices issued pursuant to Rule 18(b) and 18(c), which shall contain only the name of the Shipper claiming Force Majeure, volume affected, the amount of the Non-Performance Penalty disputed and/or undisputed, and the status of all disputed claims.

19. FINANCIAL ASSURANCES

a. At any time, upon the request of the Carrier, any prospective or existing Shipper shall provide information to the Carrier that will allow the Carrier to determine the prospective or existing Shipper’s capacity to perform any financial obligations that could arise from the transportation or other handling of that Shipper’s Crude Petroleum under the terms of this tariff, including the payment of transportation or other handling charges, equalization obligations and the value of the allowance oil and negative Shipper’s balance positions. The Carrier shall not be obligated to accept Crude Petroleum for transportation from an existing or prospective Shipper if the Shipper or prospective Shipper fails to provide the requested information to the Carrier within ten (10) days of the Carrier’s written request, or if the Carrier’s review of the requested information reveals that the existing or prospective Shipper does not have the capacity to perform any financial obligations that could arise from the transportation of that Shipper’s Crude Petroleum under the terms of this tariff, including the payment of transportation charges, equalization obligations and the reasonably determined value of the allowance oil and negative Shipper’s balance positions.

b. Subject to the provisions of Rule 19(c), the Carrier, upon notice to the Shipper, may only require one or more of the following Financial Assurances for the payment of all charges and costs as provided for in this tariff, or otherwise lawfully due to the Carrier, to be provided at the expense of the Shipper:

i. prepayment;

ii. a letter of credit in favour of Carrier in an amount sufficient to ensure payment of all costs and charges that could reasonably accrue due to the Carrier, in a form and from an institution acceptable to Carrier;

iii. a guarantee in an amount sufficient to ensure payment of all such costs and charges that could reasonably accrue due to the Carrier, in a form and from a third party acceptable to Carrier; or

iv. such other enforceable collateral security, including but not limited to security agreements over assets of the Shipper, in a form acceptable to the Carrier (the “Financial Assurances”).

c. In the event that the Carrier reasonably determines that:

i. the existing or prospective Shipper’s financial condition is or has become impaired or unsatisfactory;

ii. any Financial Assurances previously provided by a Shipper no longer provide adequate security for the performance of the Shipper’s obligations that could arise from the transportation of its Crude Petroleum under the terms of this tariff; or

iii. the Carrier otherwise determines that it is necessary to obtain Financial Assurances from the Shipper,

then the Shipper shall provide Financial Assurances for the payment of the charges and costs as provided for in this tariff or otherwise lawfully due to the Carrier relating to the transportation of the Shipper’s Crude Petroleum by the Carrier. For the purpose of this tariff, and without limiting the generality of the charges and costs lawfully due to the Carrier relating to the transportation of the Shipper’s Crude Petroleum, those charges and costs shall include transportation charges, equalization obligations, negative Shipper’s balance positions and the allowance oil. The Carrier shall not be obligated to accept Crude Petroleum for transportation from an existing or prospective Shipper if the Shipper or prospective Shipper fails to deliver the Financial Assurances to Carrier within ten (10) days of Shipper’s receipt of Carrier’s written request for such Financial Assurances.
RULES AND REGULATIONS

20. In addition to these Rules & Regulations, Enbridge Pipelines Inc. Crude Petroleum Tariff also incorporates the following practices:

a. Practice applicable to automatic balancing ▲ Effective Date: January 6, 2006
b. Practice applicable to in-line transfers Effective Date: January 1, 2004

Copies of Carrier’s Practices and supporting documents are available on-line at:

http://www.enbridge.com/pipelines/about/tariffs-and-tolls.php or

through the Carrier’s Shipper Services group, located at:

#3000, 425 – 1st Street, SW
Calgary, AB T2P 3L8
Canada
Phone number: (403) 508-3135
Surface Water Guidelines in effect in Alberta, British Columbia and Nation-wide.

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1 British Columbia Approved Water Quality Guidelines (BCAWQG) for the Protection of Aquatic Life, (BC MWLAP 2006a)
2 Working Water Quality Guidelines for British Columbia (BCSQG), (BC MWLAP 2006b).
3 Guidelines for Canadian Drinking Water Quality (GCDWQ), (Health Canada 2008).
4 Canadian Council of the Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQG) for the Protection of Aquatic Life, (CCME 2007)

NG: No Guidelines
NGR: No Guidelines Required
Sediment Guidelines in effect in Alberta, British Columbia and Nation-wide.

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1 British Columbia Approved Sediment Quality Guidelines (BCASQG) for the Protection of Aquatic Life, (BC MWLAP 2006a).
2 Working Sediment Quality Guidelines for British Columbia (BCSQG), (BC MWLAP 2006b).
3 Canadian Council of the Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQG) for the Protection of Aquatic Life, (CCME 2007)
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References


Drewes, Mitch. Habitat Technician, Department of Fisheries and Oceans Canada – Terrace BC


## Table 4-5 Stack and Emission Parameters of Project Emission Sources at the Kitimat Terminal

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<tr>
<th>Parameter</th>
<th>VLCC Tanker</th>
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<td>c  Emission rates without brackets are maximums for short term effects modelling. Emission rates in brackets are averages for long term effects modelling. The ENGTW2 source was modeled as a Suezmax tanker for the short term effects modelling (maximum emissions). The ENGTW2 source was modeled as combined Suezmax-Aframax tanker for the long term effects modelling (average emissions).</td>
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### Table 4-5 Stack and Emission Parameters of Project Emission Sources at the Kitimat Terminal (cont’d)

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**NOTES:**

- NOₓ expressed as NO₂ equivalent.
- TRS expressed as H₂S equivalent.
- N/A Not applicable
- - Not available
Table 4-5 Stack and Emission Parameters of Project Emission Sources at the Kitimat Terminal (cont’d)

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- **b** TRS expressed as H2S equivalent.
- N/A Not applicable
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