INFORMATION RESPONSES
LOWER CHURCHILL PROJECT
CEAA REFERENCE NO.07-05-26178

JOINT REVIEW PANEL

Volume I
IR#s JRP.146 to JRP164

August 2010

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Need, Purpose and Rationale for the Project

Requesting Organization – Joint Review Panel **Information Request No.: JRP.146**

Subject - Need, Purpose and Rationale for the Project

References:

EIS Guidelines, Section 4.3.1 (Need, Purpose and Rationale of the Project) and Section 4.5.1 (Environmental Effects)

Related Comments / Information Requests:

CEAR # 285 (Hydro-Québec)
CEAR # 287 (Grand Riverkeeper Labrador Inc.)
CEAR # 289 (Innu Nation)
CEAR # 291 (Sierra Club Atlantic)

IR # JRP.5, 5S/25S, 7, 7S/85S, 25, 25S, 25S/26S

Rationale:

Nalcor Energy has failed to justify the Project in energy and economic terms and has not provided an assessment of greenhouse gas (GHG) emission reduction in possible export markets as required in the detailed criteria provided in the EIS Guidelines.

Section 4.3.1 of the EIS Guidelines requires the following:

> [T]he EIS shall provide a comprehensive explanation of the need, purpose and rationale for the Project. The statement of the project's justification shall be presented in both energy and economic terms, shall provide a clear description of the methodologies, assumptions and conclusions used in the analysis. (p. 15)

In particular, Sections 4.3.1 (e), (g) and (h) further state that the EIS shall include the following:

> (e) Export market opportunities, forecasts and expected evolution; (…)
>
> (g) Risks to the Project, in-stream flow variability, market prices and schedule delays, interest rates and other risk factors relevant to the decision to proceed with the Project;
>
> (h) Projected financial benefits for the Project (including their distribution) as measured by standard financial indicators (p. 15)

Section 4.5.1 of the EIS Guidelines further require the EIS to contain "(…) a description of specific greenhouse gas emissions that the Project will or could offset, the necessary conditions for that offset occurring, and a quantitative net estimate of potential greenhouse gas reductions or increases." (p. 33)

Requesting Organization – Joint Review Panel **Information Request No.: JRP.146**

Information Requested:

JRP.5 asked Nalcor Energy for certain specific information required by Sections 4.3.1 (e), (g), (h) of the EIS Guidelines as quoted above. Further, the rationale for JRP.5S/25S stated the following:

> The Panel requires more information than was provided by Nalcor Energy in its response to JRP.5. Nalcor Energy is asked to revisit its response to JRP.5 in light of the following clarification.
>
> The Panel appreciates that Nalcor Energy would not, at this time, have in place the firm market and project financing arrangements required for Project sanction (Gate 3 stage), and is not asking for that information. Rather, the Panel is requesting order of magnitude estimates, financial analysis, risk assessments, and sensitivities normally or generally available at the feasibility stage of a Project of this nature.

That information requested has not been supplied but is required in order to assess Nalcor Energy's statements of need in energy and economic terms and to assess environmental effects and benefits. Nalcor Energy may use estimates and assumptions, approximate proportions of energy supplied to various markets and current and projected prices in those markets.

JRP.7 asked Nalcor Energy to provide "a comparative analysis of GHG displacement scenarios for possible electricity markets served and generation sources displaced" and this request was reiterated in JRP.7S/85S when the Panel requested "(…) a detailed analysis of specific sources of energy and associated GHG emissions that could potentially be replaced or avoided by the Project in each of the potential markets for the Project's electricity (including location, capacity, current energy sources and associated GHG emissions), including those with lower emissions such as wind or demand management options". Nalcor Energy has not provided sufficient information in response to either of these requests, to allow the Panel to determine the amount of GHG likely to be displaced by the Project. Nalcor Energy is asked to provide additional information on the anticipated GHG emissions displaced in identified potential markets.

Response:

Nalcor Energy (Nalcor) has previously provided justification for the Lower Churchill Hydroelectric Generation Project (Project) in energy and economic terms in the Environmental Impact Statement (EIS) and in previous responses to IRs. Nalcor is pleased to provide additional information that will allow the Panel to further assess Nalcor's statements of need in both energy and economic terms, with an emphasis on the methodologies and assumptions used in the analysis. This information is contained in the attached *"Supplemental Report on the Need, Purpose, and Rationale"* (Nalcor July 2010).

This supplemental report provides Nalcor's perspective on factors supporting the need, purpose and rationale for the Project and specifically addresses:

- Export market opportunities including forecasts and evolution of sales;
- Economic viability and calculation of the Project's financial benefits as measured by standard financial indicators; and
- Risks to the Project and the risk management processes implemented by Nalcor to mitigate exposure of the company, stakeholders, and the environment to conditions unfavourable to the Project.

The conclusions are consistent with both the EIS as well as Nalcor's responses to previous IRs and support Nalcor's previous assertions.

The need for the Project is to address the future demand for hydroelectric generation in the Province, provide an electric energy supply for sale to third parties, and develop the Province's natural resource assets for the benefit of the Province and its people. The purpose of the Project is to satisfy this identified need by developing the hydroelectric potential of the lower Churchill River. The rationale for the Project is to meet the identified demand for clean, renewable energy, to displace greenhouse gas (GHG) emitting sources, and to generate benefits by providing electricity to third parties in order to generate revenues for the Province.

The Project resource is significant enough to provide a competitive, long-term, clean, and reliable source of electricity at a reasonable price to a number of other regional markets within Eastern Canada and the northeastern United States. Market demand is expected to be strong within the timeframe of the Project, and arises from the need to meet renewable requirements, to replace aging infrastructure and to meet load growth. Given its scale, the Project represents one of the most important and realizable opportunities for Canada to meet its environmental commitments and curb greenhouse gas and other emissions in a meaningful way.

Regarding the matter of GHG displacement, Nalcor has provided considerable information on this topic in the EIS as well as in responses to various information requests. These points are summarized in this response in order to provide context for the response to the specific points raised in this information request. Volume 1, Section 2.4.3 of the EIS addresses the question of climate change. The importance of clarity with respect to government GHG regulation was identified. In addition, comparative information regarding the GHG displacement potential of the Project was provided in section 2.4.3.4 of Volume 1 of the EIS, where the GHG emissions of equivalent production from coal, fuel oil, and natural gas fired combined cycle generation were provided. The GHG emissions in other Canadian jurisdictions were also provided.

Nalcor's response to IR# JRP.7 indicated that electricity markets are competitive, and that the dispatch of generating facilities is based on reliability, marginal cost, and regulatory constraints. Without clarity on GHG regulation, it is impossible to predict whether higher intensity, but otherwise low marginal cost GHG emitting facilities would be displaced. The response also noted that neither Canada nor Newfoundland and Labrador has implemented GHG regulation, and therefore that the impact of GHG regulation cannot be readily forecasted. The response to IR# JRP.7 further noted that the GHG displacement potential of the Project will ultimately be influenced by government policy and regulation by capping emissions, changing the relative cost of generation through taxation, or by actions that change demand. The importance of government policy was reiterated in Nalcor's response to IR# JRP.7c.

Notwithstanding the dependence of the scenarios presented on clarity of government policy, which is beyond both Nalcor's and the Panel's control, Nalcor provided the Panel with potential displacement scenarios in the response to IR# JRP.7a. While Nalcor is of the view that the information provided in the EIS – a comparison of GHG emissions from fossil fuel generation alternatives and an identification of the need for clarity regarding government policy – complied with the *Guidelines*, the identification of GHG displacement scenarios has provided the Panel with the level of detail that can reasonably be provided in the absence of GHG regulation.

Further certainty was requested in information request IR# JRP.7S/85S. Nalcor's concerns with the level of specificity were raised in its response to the information request:

> The specific sources of energy displaced by the Project in each of the potential markets will be determined by the dispatch decisions within the respective markets. The factors that affect dispatch decisions in each of the different types of markets are outlined the response to IR# JRP.5S/25Sa. It is not possible for Nalcor Energy (Nalcor) to identify specific sources that would be displaced with any greater certainty than what is presented in the response to IR# JRP.7a because dispatch decisions on individual facilities are made by the operators of the facilities and not by the sellers in the market. The absence of a formal federal GHG policy framework both in the Canada and in the United States results in additional uncertainty in relation to the effect of the Project on displacing alternative energy sources and GHG emissions in each of the markets.

The notion of addressing specific markets and sources of energy is incompatible with the operation of electricity markets, where decisions are made on a market or system-wide basis, where transfers in the form of imports and exports are common, and where restrictions on specific facilities cannot be predicted in the absence of site-specific GHG regulation. In response to the information request, however, Nalcor did provide detailed information showing the specific GHG emissions from various thermal facilities in Atlantic Canada, and clearly indicated that further specificity of emission displacement cannot be achieved in the absence of GHG emission regulation.

Nalcor notes this current information request further increases the level of specificity requested in that Nalcor is now asked to consider "the amount of GHG likely (our emphasis) to be displaced by the Project". A discussion of "GHG likely to be displaced" requires further consideration of market and regulatory conditions than the evaluation of emissions "that the Project will or could offset" requested in the *Guidelines*. Fortunately, the Government of Canada has provided additional guidance on its plans for regulation of GHG emissions for the electricity sector, and these plans permit Nalcor to provide an indication of the amount of GHG likely to be displaced by the Project. An evaluation of the implications of the proposed regulation is provided in the "*Supplemental Report on the Need, Purpose, and Rationale"*, but the highlights are presented below.

Future of Generating Facilities in Key Markets

- Canada's proposed GHG regulations would see coal fired power plants remain in service until the end of their economic lives. As a result, Trenton and Lingan in Nova Scotia are expected to retire in 2019/2020.
- Based on Newfoundland and Labrador's *Energy Plan*, the retirement of the heavy fuel oil (HFO) fired Holyrood Thermal Generating Station is forecasted to take place when the Project is placed in service.
- Ontario has announced the retirement of units at the Pickering nuclear facility.
- No retirements are predicted in New Brunswick until 2030.

Generation Alternatives

- Navigant reports that natural gas fired combined cycle generation (CCGT) is emerging as the marginal generation alternative in key destination markets, other than Newfoundland and Labrador and Quebec.
- Natural gas CCGT will establish price benchmarks in competitive wholesale markets.
- The Project and other renewables will compete with natural gas CCGT rather than with each other.
- Given its flexibility and competitiveness, the Project can also compete with nuclear generation.

Given these considerations, Nalcor established three portfolio scenarios:

1) a low GHG displacement scenario, where the Project displaces Holyrood, existing non-emitting nuclear generation in Ontario, and natural gas CCGT,

2) a high GHG displacement scenario, where the Project displaces Holyrood, coal fired generation in the Maritime Provinces, and natural gas CCGT, and

3) a medium GHG displacement scenario, where the Project displaces Holyrood, and CCGT developments in all target markets.

In each case, a net GHG displacement analysis is completed, and emissions from the Project during construction and operation are considered. For fifty years of operation, the net GHG displacements over fifty years of operation are 173, 328, and 535 megatonnes (Mt) respectively, and the average of these scenarios is 345 Mt.

The requests for information in this IR related to GHG's are:

1. Section 4.5.1 of the EIS Guidelines require "(…) a description of specific greenhouse gas emissions that the Project will or could offset, the necessary conditions for that offset occurring, and a quantitative net estimate of potential greenhouse gas reductions or increases."

2. Information to allow the Panel to determine the amount of GHG likely to be displaced by the Project.

A theoretical quantified estimate of GHG displacement is offered relative to an itemized market perspective. Obvious limitations exist in presenting precise displacement scenarios as the precise portfolio of sales has not been established at this time, and of course Nalcor will never be in a position to direct how purchasers operate their facilities, so future emissions are at the discretion of their owners. However, the logic in the probable displacement scenarios is presented and is considered to be both reasonable and conservative.

LOWER CHURCHILL HYDROELECTRIC GENERATION PROJECT

Attachment A

Supplemental Report on Need, Purpose and Rationale
Prepared in Response to IR #JRP.146

July 27, 2010

nalcor energy

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1.0 INTRODUCTION

For over 50 years, Nalcor Energy (Nalcor) and its predecessors have been providing power to the people of the Province of Newfoundland and Labrador (the Province). In 1974, the Churchill Falls Power Station was completed and planning commenced for the generation of more power on the Churchill River. In 1980, a proposed development on the Churchill River was designed and a full Environmental Impact Statement produced which went through regulatory review including public hearings. The project was approved but did not proceed for economic and non-environmental reasons. In 2006, Nalcor registered a new proposed project, the Lower Churchill Hydroelectric Generation Project (Project), for assessment under the provincial and federal environmental assessment processes.

The need for the Project is to address the future demand for hydroelectric generation in the Province, provide an electric energy supply for sale to third parties, and develop the Province's natural resource assets for the benefit of the Province and its people. The purpose of the Project is to satisfy this identified need by developing the hydroelectric potential of the lower Churchill River. The rationale for the Project is to meet the identified demand for clean, renewable energy, to displace greenhouse gas (GHG) emitting sources, and to generate benefits by providing electricity to third parties in order to generate revenues for the Province. The proposed Project is the chosen alternative that best meets the identified need, purpose and rationale for the Project.

The Project resource is large enough to provide a competitive, long-term, clean, and reliable source of electricity at a reasonable price to a number of other regional markets within Eastern Canada and the northeastern United States. Market demand is expected to be quite strong and is based on requirements to meet renewable objectives, replace aging infrastructure, and to meet new load growth within the timeframe of the Project. Given its scale, the Project represents one of the most important and realizable opportunities for Canada to meet its environmental commitments and curb greenhouse gas and other emissions in a meaningful way.

The objective of this report is to expand on the analysis and assessment establishing this fundamental need, purpose and rationale for the Project in terms of:

- Government of Newfoundland and Labrador policy and Nalcor's mandate;
- Market Demand and Project Justification in Energy Terms;
- Project Justification in Economic Terms;
- Project Justification in Environmental Terms (GHG Displacement); and
- Financial Benefits.

2.0 NEWFOUNDLAND AND LABRADOR ENERGY PLAN

The Newfoundland and Labrador Energy Plan (Energy Plan) represents a comprehensive energy policy for Newfoundland and Labrador, and was released in September 2007 following an extensive public consultation process by the Government of Newfoundland and Labrador. The Energy Plan envisions a future where "our energy resources contribute to a vibrant and sustainable Newfoundland and Labrador where people are proud to live and work, the standard of living is high, and the environment is protected now and into the future; and to ensure that the people of Newfoundland and Labrador take pride and ownership in our energy resources and strategically develop them in such a way that returns maximize benefits to the Province for generations to come"[1].

Two core objectives of the Energy Plan, being environmental sustainability and economic self reliance for the best long-term interests of the people and the Province, define the need, purpose and rationale for development of the Project. The Energy Plan makes meeting our current and future electricity needs with environmentally friendly, stable and competitively priced energy and power a priority, and endorses the development of the Project as a cornerstone public policy action to fulfill this obligation.

Nalcor's role as the execution lead for the Project was affirmed in May 2006 by the Government of Newfoundland and Labrador after the completion of an Expression of Interest (EOI) process which was initiated in January 2005. Direction to Nalcor to proceed with planning of the Project is affirmed within the release of the Energy Plan and includes the following policy directives relevant to the Project:

- The Government of Newfoundland and Labrador will lead the development of the Lower Churchill Hydroelectric Project, through the Energy Corporation (Nalcor)[2]
- The Government of Newfoundland and Labrador will maintain the moratorium on small hydro developments, subject to a review concurrent with a decision on proceeding with the Lower Churchill Project[3]
- Export focus will be on achieving direct access to both long and shorter-term customers in a number of markets, including Ontario, New Brunswick, Quebec, Nova Scotia, P.E.I., New England and New York. Achieving direct access is necessary to ensure we:
    a) Secure a fair share of the economic upside potential of developments over the long term.
    b) Position ourselves properly for realizing the long term value of the Upper Churchill development.[4]

These policy directives to Nalcor substantiate the need for Nalcor to:

- Develop the Project as a long-term supply of electricity for Newfoundland and Labrador
- Export production from the Project that is not used within Newfoundland and Labrador to neighbouring markets
- Develop markets and market access strategies that position Newfoundland and Labrador for realizing the value of the Upper Churchill development when the Churchill Falls power contract expires in 2041.

[1] Energy Plan, Page 2.
[2] Energy Plan, Page 32.
[3] Energy Plan, Page 34.
[4] Energy Plan, Page 44.

Furthermore, these directives flow from the underpinning goals of the Energy Plan:[5]

1. **Environmental Leadership.** We will ensure our environment is continually protected and improved, through the responsible development of clean, renewable sources of energy, including, but not limited to, hydroelectric and wind generation, investing in energy efficiency and conservation programs, and funding energy innovation.

2. **Energy Security.** We will ensure we have a secure, reliable and competitively-priced supply of energy for current and future needs of the people of Newfoundland and Labrador.

3. **Sustainable Economic Development.** We will develop our energy resources to help meet our social and economic responsibilities. We will reinvest the value we receive from our energy sector to secure our prosperity today and for future generations. We will ensure energy developments capitalize on our competitive advantages: our people, our industrial infrastructure, our geographic location and our political stability.

4. **Maximizing Electricity Export Value.** We will ensure we are positioned to maximize value over the long term from any electricity available for export and to invest the proceeds strategically.

[5] Energy Plan, Page 3.

3.0 MARKET DEMAND AND PROJECT JUSTIFICATION IN ENERGY TERMS

The justification for the Project in energy terms is based on the market demand for power in, and the ability of Nalcor to market the power to, the various markets identified.

The lower Churchill River has the best undeveloped hydroelectric sites in North America with the ability to generate slightly over 3,000 MW, with annual average energy production of almost 17 TWh for years to come. The scale of this Project means that power from the development will not only provide the resources to address future energy needs of the Province, it will also allow Nalcor to avail of opportunities in various export markets arising from aging infrastructure, medium-to-long-term load growth, renewable non-emitting energy needs and the need for dispatchable sources of energy. Each of these factors which drive the market opportunity is discussed in turn.

3.1 Competitive Position in Power Sector

The two generating facilities associated with the Project have been ranked among the top undeveloped hydroelectric sites in North America. This ranking dates back to an independent study entitled "Comparative Costs of Generation in North America, Canadian Regional Cooperation and Development Opportunities", National Energy Board, Electric Power Branch, January 1992. In this study (select results presented in Table 1) Gull Island's levelized unit energy cost (LUEC), and the combined weighted average LUEC of Gull Island/Muskrat Falls have the top economic ranking of all the potential hydro projects identified in the report. The Muskrat Falls facility individually is ranked third of the remaining undeveloped projects. This independent ranking of the economic competitiveness of the Project, as a supply to meet market requirements, is fully consistent with Nalcor's own assessment and analysis of the potential for the Project to participate in, and contribute to, the North American power sector.

Table 1 National Energy Board Economic Ranking of the Various Types of Generation in Canada and the US - Top 15

Rank	Province	Description	Generation Type	Fuel	Size	Nominal LUEC (mills/ KWh) 2000 $	Current Status (as of July, 2010 – as researched by Nalcor)
1.	Alberta	Keephills #3	steam	coal	375	32.6	Under development
2.	**Newfoundland and Labrador**	**Gull Island**	**hydro**	**water**	**2264**	**39.2**	**EA underway**
3.	**Quebec**	**Brisay**	**hydro**	**water**	**460**	**43.1**	**Developed**
4.	**Manitoba**	**Conawapa**	**hydro**	**water**	**1300**	**44.5**	**Under study**
5.	**Manitoba**	**Wuskwatim**	**hydro**	**water**	**350**	**44.7**	**Under development**
6.	**Newfoundland and Labrador**	**Muskrat Falls**	**hydro**	**water**	**820**	**44.7**	**EA underway**
7.	**Quebec**	**La Forge #1**	**hydro**	**water**	**820**	**44.8**	**Developed**
8.	**British Columbia**	**Peace Site "C"**	**hydro**	**water**	**900**	**46.3**	**Under Development**
9.	**Quebec**	**La Forge #2**	**hydro**	**water**	**318**	**46.4**	**Developed**
10.	**Quebec**	**Grande Baleine #1**	**hydro**	**water**	**1000**	**48.1**	**Cancelled**
11.	Ontario	Darlington B	nuclear	uranium	881	48.7	Developed
12.	Saskatchewan	Shand #2	steam	coal	280	48.7	Cancelled

Rank	Province	Description	Generation Type	Fuel	Size	Nominal LUEC (mills/ KWh) 2000 $	Current Status (as of July, 2010 – as researched by Nalcor)
13.	**Quebec**	**Sainte Marguerite**	**hydro**	**water**	**822**	**49.5**	**Developed**
14.	British Columbia	Hat Creek	steam	coal	500	50.2	Cancelled
15.	**Quebec**	**Eastmain**	**hydro**	**water**	**510**	**50.7**	**Developed**

Source: Comparative Costs of Generation in North America, Canadian Regional Cooperation and Development Opportunities, Table 1, pg. 9, National Energy Board, January 1992.

3.2 Market Opportunities

Export market opportunities are derived from underlying market conditions and have been identified as follows:

- Servicing existing demand currently served by aging generation facilities that are forecast to reach the end of their service lives in the next ten to twenty years;
- Displacement of existing GHG emitting thermal generation that must be reduced or shut down completely to comply with provincial and federal regulatory requirements;
- Growth in demand, net of demand side management and conservation targets; and
- Desire for dispatchable energy sources in a preferred supply portfolio.

Each of the identified markets has been assessed on the basis of these market opportunities, recognizing that the delivered cost of the Project must be competitive with the alternate supply options available in the respective markets.

While it is important to recognize that the Project will have a service life in excess of 75 years, for purposes of assessing market opportunities, the period to 2030 was considered most appropriate. Published market forecasts are generally 10 to 20 years. Nalcor also took into consideration the uncertainties associated with extended forecast periods and the fact that the majority of aging infrastructure will be retired within this time frame.

3.2.1 Opportunities to Replace Aging Infrastructure

The Canadian Electricity Association reported in 2008 that Canada will need to add 74,000 MW of capacity by 2030 to meet both system demand growth and plant retirements[6]. Newfoundland and Labrador, Nova Scotia, New Brunswick, and Ontario will all be affected to varying degrees by aging infrastructure over the next twenty years. Each of these jurisdictions will need to replace or refurbish generation infrastructure or find alternative sources of energy to meet load requirements; some of the key capacity retirements anticipated are as follows:

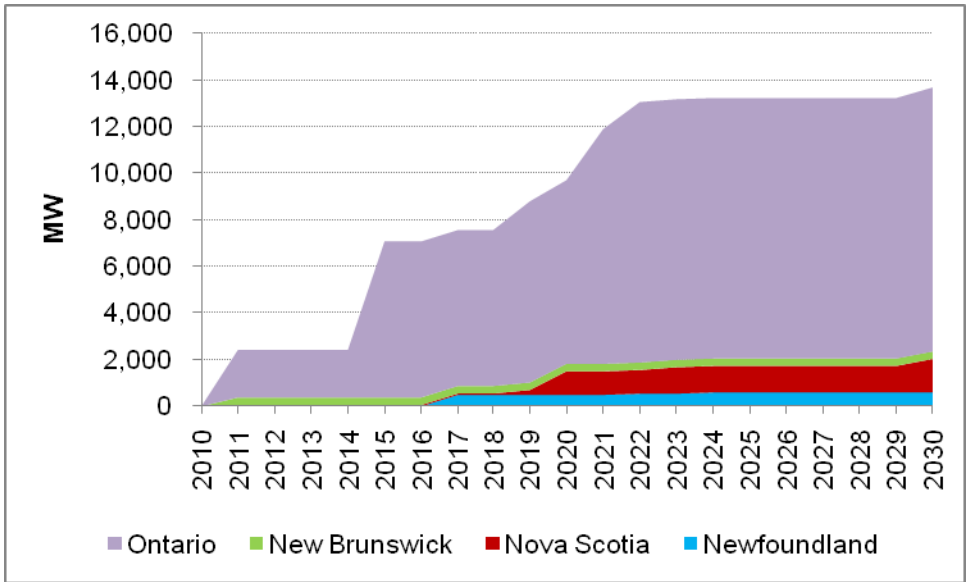
- Newfoundland and Labrador – in order for the 500 MW Holyrood generating station to stay in operation post 2020, major refurbishment will be required;

[6] The Power from Within, Sustainable Electricity: Inaugural Annual report, 2008, Canadian Electricity Industry, 2009. http://www.sustainableelectricity.ca/media/pdfs/CEA_SE_AR_e_final_mr.pdf.

- Nova Scotia - 1,430 MW of the installed capacity in Nova Scotia will reach the end of expected service life by 2030 or earlier[7];
- New Brunswick - 322 MW of installed capacity in New Brunswick will reach the end of expected service life by 2030 or earlier[8,9]; and
- Ontario – 2,000 MW of coal capacity is to be shut down this year, with the remaining 4,000 MW shut down by 2014. 2,200 MW at the Pickering nuclear facility will be shut down by 2020[10,11] as well.

As presented in Figure 1, almost 14,000 MW of installed capacity in Newfoundland and Labrador, Nova Scotia, New Brunswick and Ontario will reach the end of normal service life, is expected to retire, or is scheduled for shutdown by 2030.

Figure 1 Installed Resources Reaching Normal End of Service Life, Expected to Retire or Scheduled for Shutdown by 2030



Note: Assumes an average service life of 45 years for oil/ diesel and coal fired facilities where expected end of service life is not available. Refer to Table 2 for data sources.

[7] 2006 Depreciation Study, NSPI Response to Synapse Information Requests, 2009 General Rate Application, Nova Scotia Power Inc., 2008. http://www.nspower.ca/site-nsp/media/nspower/SynapseCombinedIRsREDACTED.pdf.
[8] Canadian Unit Module List, Website, Environment Canada. http://www.ec.gc.ca/cleanair-airpur/caol/canus/IPM_TECHNICAL/module_unit_list/module_e.cfm.
[9] 10-Year Assessment of the Adequacy of Generation and Transmission Facilities in New Brunswick: 2009-2019, New Brunswick System Operator, 2009. http://www.nbso.ca/public/_private/NBSO%2010-Year%20Assessment%202009.pdf.
[10] News Release, Government of Ontario, September 3, 2009 http://www.news.ontario.ca/mei/en/2009/09/ontario-coal-closure-launches-countdown-to-green-energy.html.
[11] Nuclear Energy, Website, Ministry of Energy and Infrastructure, Government of Ontario. http://www.news.ontario.ca/mei/en/2009/09/ontario-coal-closure-launches-countdown-to-green-energy.html.

Table 2 Reference Data for Figure 1

	Planned Retirement Year	Fuel	Capacity	Site	Reference
Ontario					
1	2011	Coal	2050	Multiple sites	News Release, Government of Ontario, September 3, 2010. http://www.news.ontario.ca/mei/en/2009/09/ontario-coal-closure-launches-countdown-to-green-energy.html
2	2015	Coal	4646	Multiple sites	Above
3	2019	Nuclear	1084	Pickering	News Release, OPG, February 16, 2010 http://www.opg.com/news/releases/100211%20Nuclear%20Investment%20Strategy asp
4	2020	Gas	105	Maitland + Thunder Bay gas	Navigant estimate: Commissioning date + 30 yr
5	2021	Nuclear	1084	Pickering	See above
6	2021	Gas	1103	Lennox	Ontario Power Authority, Integrated Power System Plan, 2007
7	2022	Gas	10	Port Colborne	Navigant estimate: Commissioning date + 30 yr
8	2022	Gas	1103	Lennox	Ontario Power Authority, Integrated Power System Plan, 2007
9	2030	Gas	153	Cochrane + Kirkland Lake	Navigant estimate: Commissioning date + 30 yr
New Brunswick					
10	2011	Oil	110	Dalhousie 1	NBSO 10 Year Outlook, 2010
11	2011	Oil	212	Dalhousie 2	See above
Nova Scotia					
12	2011	Oil	60	Victoria Junction	2006 Depreciation Study, NSPI Response to Synapse Information Requests, 2009 General Rate Application, Nova Scotia Power Inc., 2008.
13	2019	Coal	150	Trenton-5A	See above
14	2020	Gas	350	Tufts Cove	See above
15	2020	Coal	150	Pt Tupper	See above
16	2020	Coal	301	Lingan 1 & 2	See above
17	2023	Oil	120	Burnside	See above
18	2030	Coal	301	Lingan 3 & 4	See above
Newfoundland and Labrador					
19	2016	Oil	500	Holyrood	Nalcor estimate
20	2022	CT	50	Hardwoods	Nalcor estimate
21	2024	CT	50	Stephenville	Nalcor estimate

Source: Navigant Consulting

The United States electricity sector is facing similar challenges resulting from aging generation infrastructure, with over 45,500 MW of installed capacity expected to be retired by 2035[12]. In New York State almost half of the generating capacity is over 30 years old[13]. Nalcor is not relying on achieving long-term power purchase agreements (PPAs) in the New England and New York markets, and given the uncertainty surrounding plant retirements in these markets, Nalcor was conservative and did not include plant retirements in its assessment of the New York and New England markets.

[12] *Annual Energy Outlook 2010*, Energy Information Administration, Department of Energy, Government of the United States, 2010, http://www.eia.doe.gov/oiaf/aeo/index.html.

[13] *Power Trends 2009*, New York Independent System Operator, 2009. http://www.nyiso.com/public/webdocs/newsroom/press_releases/2009/nyiso_powertrends2009_final.pdf.

In considering the market opportunity to replace retired generation, it is appropriate to consider potential new generation capacity entering the market. Table 3 presents potential new capacity, other than the Project, that is either committed, or proposed in the identified markets. For purposes of the analysis undertaken by Navigant Consulting, "Committed" plants (defined as those in the Velocity Suite database with "Permitted", "Site Prep" or "Under Construction") in the 2016-2030 time frame were taken into consideration as a reduction of market potential.

Table 3 Committed and Proposed New Generation Outside NL (MW)

	Committed		Proposed		Total
	2010-2015	2016-2030	2010-2015	2016-2030	
New England					
Coal	125	0	0	0	125
Gas	1,264	0	1,228	0	2,492
Nuclear	0	0	0	0	0
PV	2	0	6	0	8
Wind	850	0	2,388	0	3,238
New York					
Coal	0	0	50	0	50
Fuel Oil	0	0	0	0	0
Gas	1,452	0	2,670	1,201	5,323
Nuclear	0	0	0	1,600	1,600
PV	0	0	49	0	49
Wind	731	0	3,123	820	4,674
Ontario					
Gas	1,083	0	2,773	0	3,856
Nuclear	0	0	0	2,400	2,400
PV	28	0	274	0	302
Hydro	1,461	0	54	2,026	3,541
Wind	681	0	2,800	5,199	8,680
Quebec					
Hydro	933	1,550	440	2,512	5,435
Wind	509	0	3,361	0	3,870
New Brunswick					
Gas	0	0	0	500	500
Nuclear	0	0	0	1,100	1,100
Wind	54	0	809	0	863
Nova Scotia					
Bioenergy	0	0	0	16	16
Gas	49	0	0	0	49
Wind	165	0	490	0	655
All Regions					
Bioenergy	0	0	0	16	16
Coal	125	0	50	0	175
Gas	3,848	0	6,671	1,701	12,220
Nuclear	0	0	0	5,100	5,100
PV	30	0	329	0	358
Hydro	2,394	1,550	494	4,538	8,976
Wind	2,990	0	12,971	6,019	21,980
Total	**9,387**	**1,550**	**20,514**	**17,374**	**48,825**

Source: Ventyx Velocity Suite database with selected additions from: Quebec water - Quebec- Hydro Quebec Strategic Plan 2009-2013; Ontario water – Navigant Consulting assessment of OPA Integrated Power System Plan 2007; Nova Scotia gas – 10 year System Outlook 2010-2019; Nova Scotia biomass – NSPI 2009 Integrated Resource Plan Update Report, Nov. 30, 2009, Plan A Base.

Proposed projects represent competition to the Project. As presented in Table 3, competition from potential new supply is dominated by gas, nuclear and wind. In this context, the Project is unique and highly competitive because other supply options lack the positive attributes of hydropower: natural gas is not essentially non-emitting; new nuclear facilities have significant construction unknowns, are new technologies and create long term waste issues; and wind is intermittent and not dispatchable. The only other potential hydro development is in Quebec (projects totaling 2,512 MW) and Ontario (projects totaling 2,026 MW). Nalcor is confident that the Project is very cost competitive with these projects.

3.2.2 Opportunities to Replace GHG Emitting Fuel Generation

Hydroelectric technology is proven, reliable and will bring about real, sustained reductions in GHG emissions from the electricity sector. The generation potential of the lower Churchill River will not only increase the supply of non-emitting power generation within the Province, but it can also enable other jurisdictions to meet their GHG emissions targets and their respective renewable energy needs.

Market demand for non-emitting generation will be driven by GHG regulation and eligibility under renewable portfolio standards (RPS). Market participants have to reflect these requirements in their planning processes. The adoption of federal GHG regulations in Canada and the US is anticipated prior to the in service dates of the Project. The Government of Canada has established a target to reduce GHG emissions to 17% below 2005 levels by 2020 and a target of 90% of the Canada's electricity provided by non-emitting sources[13].

The integration of additional renewables in key markets through renewable portfolio standards (RPS) is considered by Nalcor to be an additional market opportunity because the introduction of large quantities of intermittent renewable generation will have operating implications for these markets, thus increasing the requirement for dispatchable generation. Nalcor will continue to work with potential customers in refining the specific product requirements to fulfill these requirements. Large hydro has great operating flexibility relative to other supply sources, and is by far superior to all other sources in that it is both non-emitting and dispatchable. Hydropower generating facilities can quickly ramp up or down power production and this ability can be used to enhance the load-following capability of the overall grid.

The Canadian Federal Government has started to take steps towards regulation of GHG emissions in the electricity sector with the announcement of a stringent new emission standard for new and existing coal plants that reach the end of their service lives. This emission standard is at the level of a high efficiency natural gas facility. Although details of the policy have not been announced, the Government has indicated that 33 (65%) of Canada's 51 existing coal plants will be reaching the end of their economic life by 2025.[14] Given the difficulty and expense of retrofitting existing plants for carbon capture and storage, it is likely that these plants would be retired rather than being refurbished. There are 24 coal plants in Ontario, New Brunswick and Nova Scotia; all but two are expected to reach the end of their economic lives by 2030.

[13] Canada's Action on Climate Change, Website, Government of Canada. http://www.climatechange.gc.ca/default.asp?lang=En&n=72F16A84-1.
[14] Press release, Government of Canada, June 23, 2010.

In assessing regional market opportunities, provincial and state regulations are also highly pertinent as identified in Table 4. The Government of Nova Scotia has established a renewable energy target of 25% by 2015 and a goal of 40% renewable energy by 2020[15]. Nova Scotia has also introduced legislation limiting GHG emissions from the electricity sector to 7.5 Mt by 2020, which is over 23 per cent below 2008 emissions levels[16]. Nova Scotia's Renewable Electricity Plan recognizes the longer-term potential of the lower Churchill River development in bringing renewable imports to Nova Scotia[17]. Similarly Ontario has introduced GHG emission targets: 6% below 1990 levels by 2014 and 15% below 1990 levels by 2020.[18]

Table 4 Renewable Portfolio Standard / GHG Targets

State/Province	Renewable Portfolio Standard	GHG targets
Nova Scotia	25% by 2015 40% by 2020	GHG legislated hard caps: - 26.32 Mt - 2014, 2015, 2016 - 24.06 Mt – 2017, 2018, 2019 - 7.5 Mt – 2020
New Brunswick	10% by 2016	
Prince Edward Island	15% by 2010, 400 MW of wind 2016	
Quebec	No specific RPS; however, 4500 MW of new hydro projects to be implemented by 2011 and 4000 MW wind to be introduced by 2015	WCI target – 15% below 2005 levels by 2020
Ontario	Renewable target 15,700 MW by 2025	GHG targets – 6% below 1990 levels by 2014, 15% by 2020 WCI target 15% below 2005 levels by 2020
Maine	40% by 2017	RGGI – 10% below 2009 levels by 2018
New Hampshire	23.8% by 2025	RGGI – 10% below 2009 levels by 2018
Vermont	25% by 2025	RGGI – 10% below 2009 levels by 2018
Massachusetts	15% by 2020	RGGI – 10% below 2009 levels by 2018
Rhode Island	16% by 2019	RGGI – 10% below 2009 levels by 2018
Connecticut	27% by 2020	RGGI – 10% below 2009 levels by 2018
New York	30% by 2015	RGGI – 10% below 2009 levels by 2018

Sources:
United States: U.S. Department of Energy, http://apps1.eere.energy.gov/states/maps/renewable_portfolio_states.cfm.
New Brunswick: New Brunswick Electricity Act, Regulation 2006-58, Government of New Brunswick, July 2006.
Prince Edward Island: Prince Edward Island Renewable Energy Strategy, Government of Prince Edward Island, November 2008.
Nova Scotia: 2010 Renewable Electricity Plan, Government of Nova Scotia, April 2010.
Quebec: Energy Strategy 2006-2015, Government of Quebec.
Ontario: Ontario Climate Change Action Plan, Government of Ontario, December 2009.
RGGI website: http://www.rggi.org/home.
WCI website: http://www.westernclimateinitiative.org.

New England and New York states have adopted RPS's and are also committed to the Regional Greenhouse Gas Initiative (RGGI). These obligations increase the proportion of non-dispatchable generation and increase reliance on natural gas generation to balance the renewables and reduce emissions from higher emitting supply sources. This supports Nalcor's view that displacement of natural gas generation is the market opportunity in these markets.

[15] *Renewable Electricity Plan*, Government of Nova Scotia, April 2010, Greenhouse gas online searchable database, Environment Canada. http://www.ec.gc.ca/pdb/ghg/onlinedata/datasearch_e.cfm.
[16] Greenhouse Gas Emissions Regulations, Government of Nova Scotia, 2009. http://www.gov.ns.ca/just/regulations/regs/envgreenhouse.htm.
[17] Renewable Electricity Plan: A Path to Good Jobs, Stable Prices, and a Cleaner Environment, Government of Nova Scotia, 2010. http://www.gov.ns.ca/energy/resources/EM/renewable/renewable-electricity-plan.pdf.
[18] Ontario Greenhouse Gas Emissions Targets. A Technical Brief. Government of Ontario, 2007. www.ene.gov.on.ca/publications/6793e.pdf.

In addition, the new England Governors / Eastern Canadian Premiers Climate Change Action Plan includes a midterm goal of GHG reductions at least 10% below 1990 levels by 2020 and a long-term goal to reduce GHG emissions sufficiently to eliminate any dangerous threat to the climate; the action plan anticipates that this will require reductions of 75% to 80% below current levels.[19]

3.2.3 Opportunities to Meet Growth in Demand for Energy Capacity

Annual changes in energy demand are linked to many factors including most notably: economic activity, effectiveness of conservation and demand side management programs, weather patterns, price responsiveness and others. The interaction of these factors results in annual variations in demand. Nalcor is not relying on load growth as the basis for seeking long-term PPAs for the output of the Project; however, growth in demand over the long term will support the need for new energy supplies in the market place.

As presented in Table 5, growth in demand for energy and capacity over the next decade is forecast to be relatively moderate to low. However, some of these forecasts are dependent on aggressive Demand Side Management (DSM) and conservation targets. In particular, Nova Scotia Power Inc.'s (NSPI) forecast includes targeted cumulative DSM of 520 MW, 2.5 TWh by 2020, which represents 18% of the forecasted energy requirement. Similarly, Ontario's 2007 Integrated Power System Plan included aggressive conservation and demand management programs, with a targeted reduction of 6,200 MW (18% of peak demand) and 31 TWh (16%) of annual energy consumption by 2027. Failure to realize DSM and conservation targets will result in higher growth rates than forecast.

Table 5 Forecast Average Annual Growth in Energy Demand to 2020

Market	Energy	Capacity
Newfoundland and Labrador	1.3 %	1.1%
Nova Scotia[20] (Note 1)	-0.8%	-1.0%
New Brunswick[21]	0.6%	0.6%
Ontario[22]	0.6 %	0.5%
New York[23]	0.8%	0.8%
New England[24]	0.9%	1.4%

Note: NS energy growth 1.1% and capacity growth 0.9% without DSM & conservation.

The United States Department of Energy is forecasting total electricity demand to increase by almost 26% from 2010 to 2035, an annual average load growth of 1%[25]. The increase in the demand for electricity in New York and New England combined is forecasted at 76 TWh over the same time period.[26]

[19] Climate Change Action Plan 2001, New England Governors/Eastern Canadian Premiers, 2001. www.negc.org/documents/NEG-Ecpo%20CCAP.PDF.
[20] 10 Year System Outlook 2010 -2019 NSPI, June 30, 2010.
[21] NBSO 10 year Outlook, 2010-2020.
[22] Navigant Consulting , July 2010.
[23] NYISO Gold Book, 2010 Load and Capacity Data, April 2010.
[24] ISO NE Forecast Data 2010 CELT Report April 2010.
[25] Annual Energy Outlook 2010, Energy Information Administration, Department of Energy, Government of the United States, 2010, http://www.eia.doe.gov/oiaf/aeo/index.html.
[26] Ibid.

3.2.4 Dispatchable Power

Large hydro is an attractive generating resource to add to any market supply mix because of its operating flexibility relative to other supply sources. This allows the dispatch of the resources on a timely basis when the requirement for energy is highest because of demand and/or lack of availability of other supplies such as intermittent resources. Hydropower generating facilities can quickly ramp up or down the flow of power from the facilities and this ability can be used to enhance the stability of the overall grid, enabling additional development of other intermittent renewable resources such as wind power.

3.2.5 Market Opportunity Conclusions

Based on the market analysis undertaken, it is evident that there are abundant market opportunities for Lower Churchill power. Historic trends and forecasts support-long term growth in demand; however, Nalcor recognizes that in the short to medium term there is uncertainty regarding commercial and industrial load recovery and growth due to the current global economic recession and the extent to which demand side management and conservation programs will be realized. For example, Nova Scotia's forecasts are predicting relatively flat to negative load growth, predicated on aggressive DSM and conservation targets. The proponent is, therefore, focusing on requirements for replacement of aging infrastructure and the displacement of GHG emitting sources to comprise the long-term sales portfolio in Canadian markets. In fact, Nova Scotia, New Brunswick and Ontario present very significant market opportunities in these areas, despite their relatively low growth forecasts. With respect to US markets, Nalcor views these markets as shorter-term sales opportunities. In these markets the proponent plans to compete against the marginal unit cost, generally displacing natural gas generation in the short-term and day-ahead markets.

3.3 Market Analysis – Forecast and Expected Evolution

Navigant Consulting undertook an assessment of the market potential using the methodology as outlined below.

For each of the identified markets, an analysis of the market potential was undertaken in terms of the three opportunities: (1) load growth, taking into consideration known committed new generation projects in the respective markets; (2) replacement of aging infrastructure; and (3) displacement of emitting generation. This approach is based on estimating *changes* to the supply-demand balance from the base year (2015), rather than developing a complete supply-demand balance for each year. It does not take into account imports and exports; since most imports and exports are internal to the region, this omission has a negligible impact on the overall results. The methodology also does not take into account any mismatch between supply and demand as of the base year; however, any such mismatches would be minor relative to size of the market potential identified.

Load growth is estimated based on forecasts developed by each system operator[27]. There are two exceptions to this:

- Ontario, for which no recent long-term forecast is available (electricity consumption has fallen significantly in the last few years, making the forecast contained in the 2007 Integrated Power System Plan out of date). For Ontario, the system operator's forecasts for 2010 and 2011 were used[28], and demand was assumed to increase by 0.6%/year thereafter[29].
- Load growth for the interconnected systems in both Newfoundland and Labrador was forecast by the NLH System Planning Department, the most recent forecasts available were reflected in the analysis.

None of the forecasts developed by the system operators covered the entire study period (through 2030), so for the remaining years, the average growth rate over the last five years of the system operator's forecast was applied to the remaining years. For example, the New York Independent System Operator has a forecast of consumption through 2020, in which the compound annual growth rate between 2015 and 2020 is 0.94%; consumption was therefore assumed to increase by 0.94%/year between 2020 and 2030.

All consumption forecasts are net of conservation and demand management impacts. Load growth is taken as the difference between electricity consumption in 2015 and electricity consumption in each future year.

Load growth is offset by additions of new generating capacity in each market, as reported in Ventyx's "Velocity Suite" proprietary database, one of the standard sources of energy data in North America. Only plants that are committed (i.e. listed in the database as "Permitted", "Site Prep" or "Under Construction") and are scheduled to come into service after 2015 are included. Plants listed as "Proposed", "Feasibility Study", etc. are not included, as they could potentially be displaced if another better source of supply (such as the Project) were available.

The amount of existing generation that will be retired was forecast based on estimated retirement dates for specific plants. Only retirements of Canadian plants were considered, as complete and detailed information on New England and New York plants was not available. As well, only retirements of (Canadian) thermal plants were considered.

- In Ontario, all of the coal plants are planned to be retired by the end of 2014 before the study period and are therefore excluded from the market potential. The Pickering nuclear plant which is scheduled to reach the end of its service life by the end of 2020 is included as a retirement. As well, Lennox gas-fired peaking plant and a few small gas generating plants are expected to retire, based on market information supplied by Navigant Consulting.
- In New Brunswick, only the Dalhousie 2 oil-fired plant is assumed to retire within the study period, based on NBSO's *10 Year Outlook*. Coleson Cove is assumed to continue operating past 2030.

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[27] ISO New England, 2010-2019 Forecast Report of Capacity, Energy, Loads, and Transmission, April 2010, Revised May 18, 2010 ; New York Independent System Operator, 2010 Load & Capacity Data "Gold Book" ; Hydro-Québec Distribution, Energy Requirements Forecast, July 17, 2009: ; New Brunswick System Operator, 10-Year Assessment of the Adequacy of Generation and Transmission Facilities in New Brunswick 2009 – 2019, April 2009; Nova Scotia: Nova Scotia Power, 10 Year System Outlook 2010-2019 Draft Report, June 30, 2010; Newfoundland and Labrador: 2010 Planning Load Forecast dated February 2010, which includes the entire 2010 - 2030 period (for the Island interconnected system) and Long Term Planning Load Forecast for Newfoundland and Labrador dated October 2009 (forecast for Interconnected Labrador) which covers 2010 - 2028.. The forecast for 2029 and 2030 for Interconnected Labrador was based on the growth rate in the 2023 to 2028 forecast.

[28] IESO, 18-Month Outlook Update: An Assessment of the Reliability and Operability of the Ontario Electricity System from June 2010 to November 2011, May 20, 2010.

[29] Navigant Consulting Ltd. estimate.

- In Nova Scotia, retirement dates have been based on a study by NSPI as part of its 2009 Rate Application[30]. 1,400 MW is assumed to retire between 2015 and 2030. As noted above, hydroelectric plants were not assumed to retire even though they were shown as retiring in this report.
- In Newfoundland and Labrador, two combustion turbine (CT) plants with total capacity of 100 MW are expected to retire towards the end of the study period; however, their impact on the market potential is considered to be negligible as they are required for peaking capacity rather than for energy deliveries.

Displacement of emitting generation has been estimated based on the average output of each fossil-fuel-burning plant over the past five years (2005-2009). The output of some plants may increase over time due to increased demand, but this market potential is attributed to load growth rather than to emitting generation. The market potential in each year is some fraction of the estimated output of the fossil plants still in service. Since these plants are still in service, it is assumed that they will be used to provide peaking capacity, and would need to generate some power in order to serve this purpose. Thus, not all of their generation could be displaced by power from the Project.

The amount of existing fossil generation that could potentially be displaced was estimated to be 40% of oil-fired generation, 50% of gas-fired generation, and 70% of coal-fired generation from existing plants still in service (i.e., not yet retired). This was based on the average capacity factor of each category of plant (5% for oil-fired plants, 24% for gas-fired plants, and 50% for coal-fired plants), and an estimate supplied by Navigant Consulting of the minimum generation needed by each category of plant to serve as peaking capacity (3% for oil, 12% for gas, and 20% for coal). For example, a 500-MW coal plant would normally generate 2.2 TWh/year (based on a typical 50% capacity factor). In order to serve as peaking capacity, it would need to generate around 0.9 TWh/year (assuming a 20% capacity factor – i.e., operating during shoulder as well as peak periods). The market potential from displacement of emitting generation would thus be estimated at 1.3 TWh/year. If the plant was expected to retire during the study period, this would drop to zero at the time of retirement, and instead the plant's full output (2.2 TWh/year) would be counted as market potential due to replacement of aging assets. This is an approximation, as the actual displacement will vary from plant to plant.

3.4 Justification in Energy Terms - Conclusion

As presented in Tables 6 – 13 there are significant market opportunities well in excess of the planned output from the proposed projects.

Nalcor recognizes that in order to avail of these market opportunities, the delivered cost of energy must be competitive with alternative supply sources in the export markets, which Nalcor assumes will be predominantly driven off natural gas prices. The economic viability of the development on the basis of forecast prices is addressed in Section 5.

- By 2020, market potential in Nova Scotia and New Brunswick is estimated to be almost 13 TWh/year. A large portion of this amount, 7.6 TWh/year (60%), is potential displacement of fossil fuel generation, with 5.4 TWh due to potential replacement of aging generation capacity. Little is due to load growth, primarily because Nova Scotia has very aggressive targets for conservation, including an 8% decrease in

[30] Nova Scotia Power Inc., 2006 Depreciation Study, NSPI Response to Synapse Information Requests, 2009 General Rate Application, 2008.

demand between 2010 and 2020. If these conservation targets are not achieved, market potential would be correspondingly higher. The potential to avail of the opportunity to displace fossil fuel generation is considerable, particularly in Nova Scotia where hard GHG caps have been established and an aggressive 40% target of renewables by 2020 has been adopted.

- Ontario plans to retire 6,000 MW of coal plants and 3,000 MW of nuclear plants by the end of 2020, representing 44 TWh/year. While the coal generation will be decommissioned prior to the Project in-service date, 15 TWh of the 44 TWh relates to the retirement of units at the Pickering nuclear facility. Another 8 TWh/year of market potential comes from the opportunity to displace gas fired generation, and 4.5 TWh from load growth. The introduction of at least 2,500 MW of renewable generation under the Feed in Tariff program will also increase the need for dispatchable generation in this market.
- New York and New England are very large markets and together represent 96 TWh/year of market potential, of which 15 TWh is attributed to load growth, and 82 TWh/year from displacement of fossil generation. As noted in the methodology, no attempt has been made to quantify the potential for replacing aging generating capacity in these two markets. This is a conservative approach to estimating the market potential in these markets and consistent with our planned shorter term strategy in these markets.
- The analysis shows a relatively low market potential of approximately 3 TWh in Quebec by 2020; this is due to the anticipated commissioning of the Romaine Project as reflected in the initial five years of the study period. This low market potential may not manifest as sales to Quebec itself, but rather as reductions in exports from Quebec to the other regions, creating opportunities for replacement sales from the Project.
- Overall, the seven markets offer a combined energy market potential of about 135 TWh, including 22 TWh from load growth (net of committed new capacity), 13 TWh from replacement of aging Canadian generating capacity, and about 100 TWh from the opportunity to displace existing fossil generation.

Analysis of the forecast net change of the demand/supply balance and potential for displacement of carbon production in the identified markets demonstrates significant market potential to 2030.

Given that the overall identified market potential is almost eight times the size of the annual output of the projects in 2020, this substantial market need for reliable, non-emitting energy supplies clearly provides justification for development of the Project.

Table 6 Summary of Total Energy Market Potential

LCP Supply vs. Market Potential (TWh)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Market Potential																
New England	40.9	42.1	43.4	44.8	46.1	47.5	48.8	50.2	51.5	52.9	54.3	55.7	57.1	58.5	60.0	61.4
New York	40.7	41.8	42.9	44.5	46.5	48.7	50.3	52.0	53.7	55.4	57.1	58.8	60.5	62.3	64.0	65.8
Ontario	8.4	9.3	10.2	11.1	19.2	20.3	28.6	29.7	30.6	31.5	32.4	33.4	34.3	35.3	36.2	37.6
Quebec	0.0	(0.1)	(0.8)	0.9	2.4	3.2	3.9	5.3	6.7	8.6	9.3	10.6	11.9	13.2	14.6	16.0
New Brunswick	4.3	4.4	4.6	4.8	5.0	5.2	5.4	5.6	5.7	5.9	6.1	6.3	6.5	6.8	7.0	7.2
Nova Scotia	6.9	6.7	6.6	6.4	6.6	7.9	7.8	7.7	7.5	7.4	7.2	7.1	7.0	6.9	6.7	7.2
Newfoundland and Labrador	1.7	1.8	1.8	1.9	1.9	2.0	2.1	2.2	2.4	2.4	2.5	2.6	2.7	2.8	3.0	3.1
Total Market Potential	**103.0**	**106.1**	**108.7**	**114.4**	**127.8**	**134.8**	**146.9**	**152.5**	**158.1**	**164.1**	**169.0**	**174.5**	**180.0**	**185.7**	**191.5**	**198.3**
LCP Supply																
Gull Island		11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9
Muskrat Falls					4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Total LCP Supply		**11.9**	**11.9**	**11.9**	**16.7**	**16.7**	**16.7**	**16.7**	**16.7**	**16.7**	**16.7**	**16.7**	**16.7**	**16.7**	**16.7**	**16.7**

Note: Totals are sums of the market values and then rounded to one decimal place. As a result, totals may be slightly different than the sum of the rounded values.

Table 7 Energy Market Potential – Newfoundland and Labrador

NL (TWh)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Load forecast (TWh)	11.5	11.5	11.6	11.7	11.7	11.8	11.9	12.0	12.1	12.2	12.2	12.3	12.4	12.5	12.6	12.6
Load growth (cumulative) (note 1)		0.0	0.1	0.1	0.2	0.3	0.4	0.5	0.6	0.6	0.7	0.8	0.9	1.0	1.0	1.1
Displacement of thermal coal HFO/distillate natural gas	1.6	1.5	1.5	1.6	1.5	1.6	1.5	1.6	1.8	1.9	1.9	2.0	2.1	2.2	2.3	2.4
Displacement of otherwise planned generation	0.1	0.3	0.3	0.3	0.4	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7
Generation retirements																
Market Potential	**1.7**	**1.8**	**1.8**	**1.9**	**1.9**	**2.0**	**2.1**	**2.2**	**2.4**	**2.4**	**2.5**	**2.6**	**2.7**	**2.8**	**3.0**	**3.1**

Note 1 - For NL - Load growth is assumed to be met from a combination of increased thermal generation or other new generation capacity that would be otherwise developed if LCP is not the supply source.

Note 2: Totals are sums of the market values and then rounded to one decimal place. As a result, totals may be slightly different than the sum of the rounded values.

Table 8 Energy Market Potential - Ontario

Ontario (TWh)	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Load Forecast	147.1	148.0	148.9	149.8	150.7	151.6	152.5	153.4	154.3	155.2	156.2	157.1	158.0	159.0	159.9	160.9
Cumulative Load Growth	0.0	0.9	1.8	2.7	3.6	4.5	5.4	6.3	7.2	8.1	9.1	10.0	10.9	11.9	12.8	13.8
Less Committed New Capacity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Generation Retirements	0.0	0.0	0.0	0.0	7.2	7.5	15.0	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	16.2
Net change to demand /supply balance	**0.0**	**0.9**	**1.8**	**2.7**	**10.8**	**11.9**	**20.4**	**21.7**	**22.6**	**23.5**	**24.5**	**25.4**	**26.3**	**27.3**	**28.2**	**30.0**
Carbon Based Production																
Fuel Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas	8.4	8.4	8.4	8.4	8.4	8.3	8.2	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	7.6
Coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**8.4**	**8.4**	**8.4**	**8.4**	**8.4**	**8.3**	**8.2**	**8.0**	**8.0**	**8.0**	**8.0**	**8.0**	**8.0**	**8.0**	**8.0**	**7.6**
Market Potential	**8.4**	**9.3**	**10.2**	**11.1**	**19.2**	**20.3**	**28.6**	**29.7**	**30.6**	**31.5**	**32.4**	**33.4**	**34.3**	**35.3**	**36.2**	**37.6**

Note: Totals are sums of the market values and then rounded to one decimal place. As a result, totals may be slightly different than the sum of the rounded values.

Table 9 Energy Market Potential – Nova Scotia

Nova Scotia (TWh)	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Load Forecast	12.1	12.0	11.8	11.7	11.6	11.4	11.3	11.1	11.0	10.8	10.7	10.6	10.4	10.3	10.2	10.0
Cumulative Load Growth	0.0	(0.1)	(0.3)	(0.4)	(0.6)	(0.7)	(0.9)	(1.0)	(1.2)	(1.3)	(1.4)	(1.6)	(1.7)	(1.8)	(2.0)	(2.1)
Less Committed New Capacity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Generation Retirements	0.0	0.0	0.0	0.0	1.1	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	7.5
Net change to demand /supply balance	**0.0**	**(0.1)**	**(0.3)**	**(0.4)**	**0.5**	**4.6**	**4.5**	**4.3**	**4.2**	**4.0**	**3.9**	**3.8**	**3.6**	**3.5**	**3.4**	**5.4**
Carbon Based Production																
Fuel Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas	0.7	0.7	0.7	0.7	0.7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Coal	6.2	6.2	6.2	6.2	5.4	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	1.7
Total	**6.9**	**6.9**	**6.9**	**6.9**	**6.1**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**1.9**
Market Potential	**6.9**	**6.7**	**6.6**	**6.4**	**6.6**	**7.9**	**7.8**	**7.7**	**7.5**	**7.4**	**7.2**	**7.1**	**7.0**	**6.9**	**6.7**	**7.2**

Note: Totals are sums of the market values and then rounded to one decimal place. As a result, totals may be slightly different than the sum of the rounded values.

Table 10 Energy Market Potential – New Brunswick

New Brunswick (TWh)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Load Forecast	14.6	14.7	14.9	15.1	15.3	15.5	15.7	15.8	16.0	16.2	16.4	16.6	16.8	17.0	17.3	17.5
Cumulative Load Growth	0.0	0.2	0.4	0.5	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.9
Less Committed New Capacity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Generation Retirements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net change to demand /supply balance	**0.0**	**0.2**	**0.4**	**0.5**	**0.7**	**0.9**	**1.1**	**1.3**	**1.5**	**1.7**	**1.9**	**2.1**	**2.3**	**2.5**	**2.7**	**2.9**
Carbon Based Production																
Fuel Oil	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Gas	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Coal	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Total	**4.3**	**4.3**	**4.3**	**4.3**	**4.3**	**4.3**	**4.3**	**4.3**	**4.3**	**4.3**	**4.3**	**4.3**	**4.3**	**4.3**	**4.3**	**4.3**
Market Potential	**4.3**	**4.4**	**4.6**	**4.8**	**5.0**	**5.2**	**5.4**	**5.6**	**5.7**	**5.9**	**6.1**	**6.3**	**6.5**	**6.8**	**7.0**	**7.2**

Note: Totals are sums of the market values and then rounded to one decimal place. As a result, totals may be slightly different than the sum of the rounded values.

Table 11 Energy Market Potential - Quebec

Quebec (TWh)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Load Forecast	194.0	198.6	199.9	201.6	203.1	205.2	205.9	207.3	208.7	210.6	211.3	212.6	213.9	215.2	216.6	218.0
Cumulative Load Growth	0.0	4.6	5.9	7.6	9.1	11.2	11.9	13.3	14.7	16.6	17.3	18.6	19.9	21.2	22.6	24.0
Less Committed New Capacity	0.0	(4.7)	(6.7)	(6.7)	(6.7)	(8.0)	(8.0)	(8.0)	(8.0)	(8.0)	(8.0)	(8.0)	(8.0)	(8.0)	(8.0)	(8.0)
Generation Retirements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net change to demand /supply balance	**0.0**	**(0.1)**	**(0.8)**	**0.9**	**2.4**	**3.2**	**3.9**	**5.3**	**6.7**	**8.6**	**9.3**	**10.6**	**11.9**	**13.2**	**14.6**	**16.0**
Carbon Based Production																
Fuel Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Market Potential	**0.0**	**(0.1)**	**(0.8)**	**0.9**	**2.4**	**3.2**	**3.9**	**5.3**	**6.7**	**8.6**	**9.3**	**10.6**	**11.9**	**13.2**	**14.6**	**16.0**

Note: Totals are sums of the market values and then rounded to one decimal place. As a result, totals may be slightly different than the sum of the rounded values.

Table 12 Energy Market Potential – New England

New England (TWh)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Load Forecast	137.3	138.5	139.8	141.2	142.5	143.8	145.2	146.5	147.9	149.3	150.7	152.1	153.5	154.9	156.4	157.8
Cumulative Load Growth	0.0	1.2	2.5	3.9	5.2	6.6	7.9	9.3	10.6	12.0	13.4	14.8	16.2	17.7	19.1	20.6
Less Committed New Capacity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net change to demand /supply balance	**0.0**	**1.2**	**2.5**	**3.9**	**5.2**	**6.6**	**7.9**	**9.3**	**10.6**	**12.0**	**13.4**	**14.8**	**16.2**	**17.7**	**19.1**	**20.6**
Carbon Based Production																
Fuel Oil	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Gas	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8
Coal	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Total	**40.9**	**40.9**	**40.9**	**40.9**	**40.9**	**40.9**	**40.9**	**40.9**	**40.9**	**40.9**	**40.9**	**40.9**	**40.9**	**40.9**	**40.9**	**40.9**
Market Potential	**40.9**	**42.1**	**43.4**	**44.8**	**46.1**	**47.5**	**48.8**	**50.2**	**51.5**	**52.9**	**54.3**	**55.7**	**57.1**	**58.5**	**60.0**	**61.4**

Note: Totals are sums of the market values and then rounded to one decimal place. As a result, totals may be slightly different than the sum of the rounded values.

Table 13 Energy Market Potential – New York

New York (TWh)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Load Forecast	165.4	166.5	167.5	169.1	171.2	173.3	175.0	176.6	178.3	180.0	181.7	183.4	185.1	186.9	188.6	190.4
Cumulative Load Growth	0.0	1.1	2.1	3.8	5.8	8.0	9.6	11.3	12.9	14.6	16.3	18.0	19.8	21.5	23.3	25.0
Less Committed New Capacity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net change to demand /supply balance	**0.0**	**1.1**	**2.1**	**3.8**	**5.8**	**8.0**	**9.6**	**11.3**	**12.9**	**14.6**	**16.3**	**18.0**	**19.8**	**21.5**	**23.3**	**25.0**
Carbon Based Production																
Fuel Oil	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Gas	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8
Coal	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
Total	**40.7**	**40.7**	**40.7**	**40.7**	**40.7**	**40.7**	**40.7**	**40.7**	**40.7**	**40.7**	**40.7**	**40.7**	**40.7**	**40.7**	**40.7**	**40.7**
Market Potential	**40.7**	**41.8**	**42.9**	**44.5**	**46.5**	**48.7**	**50.3**	**52.0**	**53.7**	**55.4**	**57.1**	**58.8**	**60.5**	**62.3**	**64.0**	**65.8**

Note: Totals are sums of the market values and then rounded to one decimal place. As a result, totals may be slightly different than the sum of the rounded values.

4.0 PROJECT JUSTIFICATION RELATIVE TO GHG DISPLACEMENT SCENARIOS

Energy sales from the Project will replace power generated from existing fossil fuel fired generating facilities or will avoid the construction of new GHG emitting facilities, resulting in the displacement or avoidance of GHG emissions. As discussed in the response to IR# JRP.5S/25S, the source and amount of GHG emissions expected to be displaced and/or avoided is influenced by a number of factors that influence both systems planning and dispatch decisions in each of the export markets including:

1. Marginal operating costs - The marginal cost of generation in a market, including any direct and indirect carbon costs, will be a key factor in the dispatch decision. The cost of fuel is a major contributor to the marginal operating costs of thermal generating units and fuel price fluctuations affect dispatch decisions. These costs are affected by commodity prices and government policy, and in the absence of policy intervention, natural gas fired generation has the highest marginal operating costs and will therefore likely be displaced by the Project.

2. Federal GHG Policy Framework - GHG policies and regulations will be a key factor in dispatch decisions in any given market. The need for policies and/or regulations directed at reducing GHG emissions is recognized by both the Government of Canada and the Government of the United States as evidenced by the following statements:.

   > *The Government of Canada is committed to ensuring that Canada is at the leading edge of clean energy technologies to reduce emissions and adapt to environmental change. At home, we are developing a Canadian approach that makes sense for our circumstances; it includes a regulatory system and emission trading*[31].
   >
   > *We* [the United States] *must take immediate action to reduce the carbon pollution that threatens our climate and sustains our dependence on fossil fuels. We have had limits in place on pollutants like sulfur dioxide, nitrogen dioxide, and other harmful emissions for some time. After decades of inaction, we will finally close the carbon pollution loophole by limiting the amount of carbon polluters are allowed to pump into the atmosphere*[32].

   The Government of Canada has announced proposed regulations that would see existing coal facilities close at the end of their expected economic life. Under the proposed regulations, facilities cannot be refurbished or replaced unless they include carbon capture and storage technology. This regulatory move has the potential to remove coal-fired generation from the marketplace in Canada by 2025 as the government estimates that most of the country's coal plants will reach the end of their economic life between 2015 and 2025[33].

3. Provincial GHG Emission and Renewable Energy Targets - Provincial GHG regulations will also influence dispatch decisions and will result in the displacement of higher emitting generation first. For example, the Government of Nova Scotia has introduced hard caps for GHG emissions from the electricity sector

[31] Canada's Action on Climate Change, Website, Environment Canada, May 2010. http://www.climatechange.gc.ca/default.asp?lang=En&n=4FE85A4C-1.
[32] Issues: Energy and the Environment, Website, The White House, Government of the United States, May 2010 http://www.whitehouse.gov/issues/energy-and-environment.
[33] Government of Canada to Regulate Emissions from Electricity Sector http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=E5B59675-BE60-4759-8FC3-D3513EAA841C.

and, with no trade allowed under the legislation, displacement of the highest emitting generation in Nova Scotia will be essential to ensuring industry compliance with the legislation[34]. Nova Scotia has also recently established a target that states that 40% of the electricity used in Nova Scotia must originate from renewable sources by 2020[35]. This target will further affect the dispatch decision in favour of renewable energy sources such as hydropower. Newfoundland and Labrador's initiative to cease production at the Holyrood Thermal Generating Station is also an important initiative to reduce emissions.[36]

4. State Renewable Portfolio/Energy Standards - Renewable Portfolio Standards (RPS) in most states result in the dispatcher having to maintain a balance between intermittent renewable resources, in particular wind power, and other resources to maintain stability on the grid. While large hydropower facilities are not eligible under most state RPS's and energy standards, power from these facilities is very effective in providing balance to a grid allowing for the integration of additional intermittent renewable resources in a market.

The clarity provided by the Government of Canada in its proposed GHG regulations provides some assistance in predicting GHG emissions in each of the markets addressed by the Project. However, while the proposed regulations provide for the retirement of coal fired facilities at the end of their useful lives, some coal fired facilities may remain in service until after 2030. Nalcor is of the view that more stringent regulation will be required in order to meet Canada's stated objective of 80% reduction in GHG emissions by 2050. As a result, low, medium, and high GHG displacement scenarios are provided. The low and medium displacement scenarios are consistent with Canada's currently proposed regulations, and the high scenario can be achieved with earlier and more stringent limitations on the use of coal.

The remainder of this section summarizes the results in each market, and provides a summary of the GHG displacement potential of the Project. The GHG emission intensities used in these calculations are as indicated in Table 1 of the response to IR# JRP.27.

4.1 Individual Market Discussion

4.1.1 Newfoundland and Labrador

The predicted thermal generation requirement in Newfoundland and Labrador is shown in Table 7. This production is from the Holyrood Thermal Generating Station, which burns heavy fuel oil. The sales opportunity for Newfoundland and the associated GHG emissions are shown in Table 14.

[34] Greenhouse Gas Emissions Regulations, Government of Nova Scotia, 2009, http://www.gov.ns.ca/just/regulations/regs/envgreenhouse.htm.

[35] Toward a Greener Future: Nova Scotia Climate Change Action Plan, Government of Nova Scotia, 2009, http://climatechange.gov.ns.ca/doc/ccap.pdf.

[36] *Responding to Climate Change in Newfoundland and Labrador*, Government of Newfoundland and Labrador, 2010 http://www.exec.gov.nl.ca/exec/cceeet/external/discussion.html

Table 14 NL Project Opportunity and GHG Displacement Potential

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Energy (TWh)	1.5	1.5	1.6	1.5	1.6	1.5	1.6	1.8	1.9	1.9	2.0	2.1	2.2	2.3	2.4
GHG (Mt CO_2e)	1.1	1.1	1.2	1.1	1.2	1.1	1.2	1.3	1.4	1.4	1.5	1.6	1.6	1.7	1.8

Since the Government of Newfoundland and Labrador has committed in the *Energy Plan* to retire Holyrood in the event that the Project is sanctioned, the displacement of these GHG's is very likely.

Table 7 also references energy associated with otherwise planned generation, and identifies these as potentially displaced by the Project. This determination was completed in the context of the domestic expansion plan for Newfoundland, and the potential developments are described in Section 6 of the Generation Planning Issues 2009 October Update, attached to the response to IR# JRP.26. From a domestic perspective, the report concludes that these projects are not required to meet domestic demand if the Project proceeds.

However, in the context of the broader North American market, Nalcor is of the view that these projects could proceed as export projects if they meet the tests outlined in subsection 4.2.2, and the development of the Project does not preclude these developments. These projects, however, have not been advanced for EA, so the energy requirements for the Newfoundland and Labrador system are assumed to be met by the Project for the purposes of this GHG analysis.

4.1.2 Nova Scotia

Table 9 shows the predicted retirements in Nova Scotia. Based on Canada's proposed regulations, Trenton and Lingan must be retired in the 2019/2020 timeframe. These facilities could be replaced by the Project.

This displacement is shown below:

Table 15 NS Project Opportunity and GHG Displacement Potential

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Energy (TWh)				1.1	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
GHG (Mt CO_2e)	0.0	0.0	0.0	1.1	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3

4.1.3 New Brunswick

Canada's proposed regulations do not require the retirement of any thermal facilities in New Brunswick, and any sales to New Brunswick would displace natural gas fired CCGT currently imported from New England. Any sale to New Brunswick would ultimately displace natural gas fired CCGT directed energy from New England, thus contributing to a reduction in that market. In the event that generators in New Brunswick become subject to more stringent GHG regulation, the displacement of coal fired generation at the Belledune plant becomes an additional displacement opportunity. Coal fired production for New Brunswick is shown in Table 10, and the GHG displacement potential is shown in the following table:

Table 16 NB Project Opportunity and GHG Displacement Potential

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Energy (TWh)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
GHG (Mt CO_2e)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4

4.1.4 Québec

Hydro-Québec is advancing La Romaine for in service in a timeframe similar to that of the Project, and has indicated that the Petit Mecatina development is next in its development queue. Both of these developments are more expensive than the Project, with La Romaine costing greater than 9 cents/kWh, and Petit Mecatina greater than 12 cents/kWh.

Since the Government of Québec and Hydro-Québec have proposed Petit Mecatina for export, the ultimate success of that project will be determined by its competiveness in Québec's export markets against natural gas fired combined cycle generation.

4.1.5 Ontario

The generation retirements in Ontario are nuclear units, and have negligible GHG emissions associated with them. A sale to Ontario could avoid the replacement of one or more nuclear units. For the purposes of this GHG analysis, the displacement of two 500 MW (net) nuclear units operating at 90% capacity factor is assumed. Nalcor notes that this is a conservative assumption given the large opportunity for natural gas displacement, as indicated in Table 8. The Project opportunity is:

Table 17 ON Project Opportunity and GHG Displacement Potential

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Energy (TWh)				7.2	7.5	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
GHG (Mt CO_2e)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

4.2 Market Trends and Effects of Other Renewable Projects and Demand-Side Management

4.2.1 Natural Gas CCGT for Existing Load and Load Growth

As discussed in the response to IR# JRP.5S/25S, energy sellers in competitive wholesale power markets compete solely on price and will replace the generation source on the margin. In the wholesale markets of New England and New York, natural gas-fired generation is the marginal generating source; during 2008 natural gas was the marginal fuel type 62% of the time in New England while the energy-clearing price was set by natural gas units 29% of the time and by dual-fuel [oil/gas] units 54% of the time in New York)[37,38].

According to Navigant, all of the potential markets for the Project, with the exception of Quebec and Newfoundland, rely extensively on gas-fired CCGTs. New England, New York and Ontario are all planning to

[37] 2008 Annual Markets Report, ISO New England Inc., 2009, http://www.iso-ne.com/markets/mktmonmit/rpts/other/amr08_final_061709.pdf.
[38] Fuel Diversity in the New York Electricity Market, New York Independent System Operator, 2008, http://www.nyiso.com/public/webdocs/documents/white_papers/fuel_diversity_11202008.pdf.

develop substantial amounts of new gas-fired generation and gas generation is the primary dispatchable generation option for new supply in the Maritimes.

As such, it is reasonable to assume that, at a minimum, any sales of power from the Project into these markets will displace natural-gas fired generation and its associated emissions.

4.2.2 Competitiveness of other Renewable/Non Emitting Projects

As stated in the response to IR# JRP.7S/85S, the marginal operating costs of renewable generating sources are not dependent on fuel, and as such, the Project will not displace other in-service renewable production.

Future non-emitting projects will have to compete with the price set by natural gas CCGT in order to establish their competiveness in the marketplace:

1. If they are less expensive than natural gas CCGT, then they will be expected to be competitive in the market.
2. If they are more expensive than natural gas CCGT, then they are not economically justifiable and not competitive with their thermal alternative.

In addition, the developers of competing renewable projects will need to secure transmission access and financing in order to support their developments, as defined in Section 5.

4.2.3 Demand-side Management Options/Programs

Demand-side management programs and targets are established in an attempt to manage load growth. These programs address concerns surrounding peak demand and the need to procure capacity to service this demand on a system. Demand-side management programs typically do not reduce the energy demand on the system.

Energy efficiency programs are incorporated in the planning and regulatory process for all electric utilities, and the load forecasts presented in Tables 6 through 13 are inclusive of the effects of any demand-side management programs.

4.3 Scenario Presentation

Sales arrangements for the Project are still under development by Nalcor. The Panel is aware of this and has acknowledged this fact in the preface of IR# JRP.146. In its previous response to IR# JRP.7, Nalcor provided two possible GHG displacement scenarios based on reasonable assumptions of generation displacement under a Quebec access route and a Maritime access route. To provide additional insight into the potential high, medium, and low displacement scenarios, Nalcor has developed three GHG displacement scenarios consistent with the market potential presented in Tables 6 through 13 and consistent with the proposed Canadian regulations for coal-fired power plants.

The first (low) scenario is anchored by a sale to Ontario that displaces nuclear generation. While the nuclear alternative is non-emitting, the characteristics of the Project, as discussed in Section 3.2.4, provide a strong competitive alternative to nuclear generation:

Table 18 Low GHG Displacement Scenario

Energy

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Supply (Note 1,2)	10.9	10.9	10.9	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4
NL - Emitting (Note 1,3)	1.5	1.5	1.6	1.5	1.6	1.5	1.6	1.8	1.9	1.9	2.0	2.1	2.2	2.3	2.4
NL - Non Emitting (Note 1,3)	0.3	0.3	0.3	0.4	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7
ON - Non Emitting (Note 1,4)	0.0	0.0	0.0	7.2	7.5	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
Other Market Sales (Note 1)	9.1	9.1	9.0	6.3	5.9	5.4	5.3	5.1	5.0	5.0	4.9	4.8	4.7	4.5	4.4

Notes

1 All entries in TWh
2 From Table 6 with 8% allowance for transmission losses
3 Refer to Section 4.1.1
4 Two 500 MW units as described in Section 4.1.5

GHG Displacement

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031-65
Supply (Note 1,2)	(1.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(7.0)
NL - Emitting (Note 1,3)	1.1	1.1	1.2	1.1	1.2	1.1	1.2	1.3	1.4	1.4	1.5	1.6	1.6	1.7	1.8	62.8
NL - Non Emitting (Note 1,3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ON - Non Emitting (Note 1,4)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Market Sales (Note 1)	3.8	3.8	3.8	2.6	2.5	2.2	2.2	2.1	2.1	2.1	2.0	2.0	1.9	1.9	1.8	63.8
Cumulative (Note 1)	3.7	8.5	13.3	16.8	20.3	23.4	26.6	29.9	33.2	36.5	39.8	43.2	46.6	49.9	53.4	173.0

Notes

1 Emissions in Mt CO_2e
2 Refer to EIS Volume 2A, Section 3.9.1.1
3 Refer to Section 4.1.1
4 Refer to Section 4.1.5
5 Totals are sums of the market values and then rounded to one decimal place. As a result, totals may be slightly different than the sum of the rounded values.

The second (high) scenario is anchored by a sale to Nova Scotia that displaces emitting generation at Trenton (2019) and Lingan (2020).

Table 19 High GHG Displacement Scenario

Energy

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Supply (Note 1,2)	10.9	10.9	10.9	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4
NL - Emitting (Note 1,3)	1.5	1.5	1.6	1.5	1.6	1.5	1.6	1.8	1.9	1.9	2.0	2.1	2.2	2.3	2.4
NL - Non Emitting (Note 1,3)	0.3	0.3	0.3	0.4	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7
NS - Emitting (Note 1,4)	0.0	0.0	0.0	1.1	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
NB - Emitting (Note 1, 5)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Other Market Sales (Note 1)	6.7	6.7	6.6	10.0	5.6	5.5	5.4	5.2	5.1	5.1	5.0	4.9	4.8	4.6	4.5

Notes

1 All entries in TWh
2 From Table 6 with 8% allowance for transmission losses
3 Refer to Section 4.1.1
4 Trenton, NS and Lingan, NS. Refer to Section 4.1.2
5 Belledune, NB. Refer to Section 4.1.3

GHG Displacement

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031-65
Supply (Note 1,2)	(1.0)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(7.0)
NL - Emitting (Note 1,3)	1.1	1.1	1.2	1.1	1.2	1.1	1.2	1.3	1.4	1.4	1.5	1.6	1.6	1.7	1.8	62.8
NL - Non Emitting (Note 1,3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NS -Emitting (Note 1,4)	0.0	0.0	0.0	1.1	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	184.5
NB - Emitting (Note 1, 5)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	82.7
Other Market Sales (Note 1)	2.8	2.8	2.8	4.2	2.3	2.3	2.2	2.2	2.1	2.1	2.1	2.0	2.0	1.9	1.9	65.2
Cumulative (Note 1)	5.3	11.4	17.5	26.1	37.0	47.8	58.7	69.6	80.6	91.6	102.6	113.6	124.7	135.7	146.8	534.9

Notes

1 Emissions in Mt CO_2e
2 Refer to EIS Volume 2A, Section 3.9.1.1
3 Refer to Section 4.1.1
4 Refer to Section 4.1.2
5 Refer to Section 4.1.3
6 Totals are sums of the market values and then rounded to one decimal place. As a result, totals may be slightly different than the sum of the rounded values.

The third (CCGT referenced) scenario is based on the premise that sales that simply displace CCGT generation.

Table 20 Moderate GHG Displacement Scenario

Energy

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Supply (Note 1,2)	10.9	10.9	10.9	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4
NL - Emitting (Note 1,3)	1.5	1.5	1.6	1.5	1.6	1.5	1.6	1.8	1.9	1.9	2.0	2.1	2.2	2.3	2.4
NL - Non Emitting (Note 1,3)	0.3	0.3	0.3	0.4	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7
CCGT Sales (Note 1)	9.1	9.1	9.0	13.5	13.4	13.3	13.2	13.0	12.9	12.9	12.8	12.7	12.6	12.4	12.3

Notes

1 All entries in TWh

2 From Table 6 with 8% allowance for transmission losses

3 Refer to Section 4.1.1

GHG

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031-65
Supply (Note 1,2)	(1.0)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(7.0)
NL - Emitting (Note 1,3)	1.1	1.1	1.2	1.1	1.2	1.1	1.2	1.3	1.4	1.4	1.5	1.6	1.6	1.7	1.8	62.8
NL - Non Emitting (Note 1,3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
																0.0
CCGT Sales (Note 1)	3.8	3.8	3.8	5.6	5.6	5.5	5.5	5.4	5.4	5.4	5.3	5.3	5.3	5.2	5.1	179.4
Cumulative Displacement	3.9	8.7	13.5	20.0	26.6	33.1	39.6	46.1	52.7	59.3	66.0	72.6	79.3	86.0	92.7	328.0

Notes

1 Emissions in Mt CO_2e

2 Refer to EIS Volume 2A, Section 3.9.1.1

3 Refer to Section 4.1.1

4 Totals are sums of the market values and then rounded to one decimal place. As a result, totals may be slightly different than the sum of the rounded values.

4.4 Summary

In each case, the GHG emissions displaced by the Project are substantially greater than the emissions from the construction and operation of the Project. Over a 50 year forecast period, the net GHG displacements (Table 21) of the Project for the three scenarios presented are:

Table 21 Project Net GHG Displacement

Net Displacement – Low Displacement Scenario	173. Mt
Net Displacement – Moderate Displacement Scenario	328. Mt
Net Displacement – High Displacement Scenario	535. Mt

The low and medium GHG displacement scenarios are achievable, and with more stringent GHG regulation can result in the high GHG displacement scenario being achieved. The scenarios indicate GHG displacements ranging from approximately 16 to 49 times the GHG emissions produced by the construction and operation of the Project over the first 50 years of operation. Earlier and more stringent GHG regulation will result in considerably greater displacement.

5.0 PROJECT JUSTIFICATION IN ECONOMIC TERMS

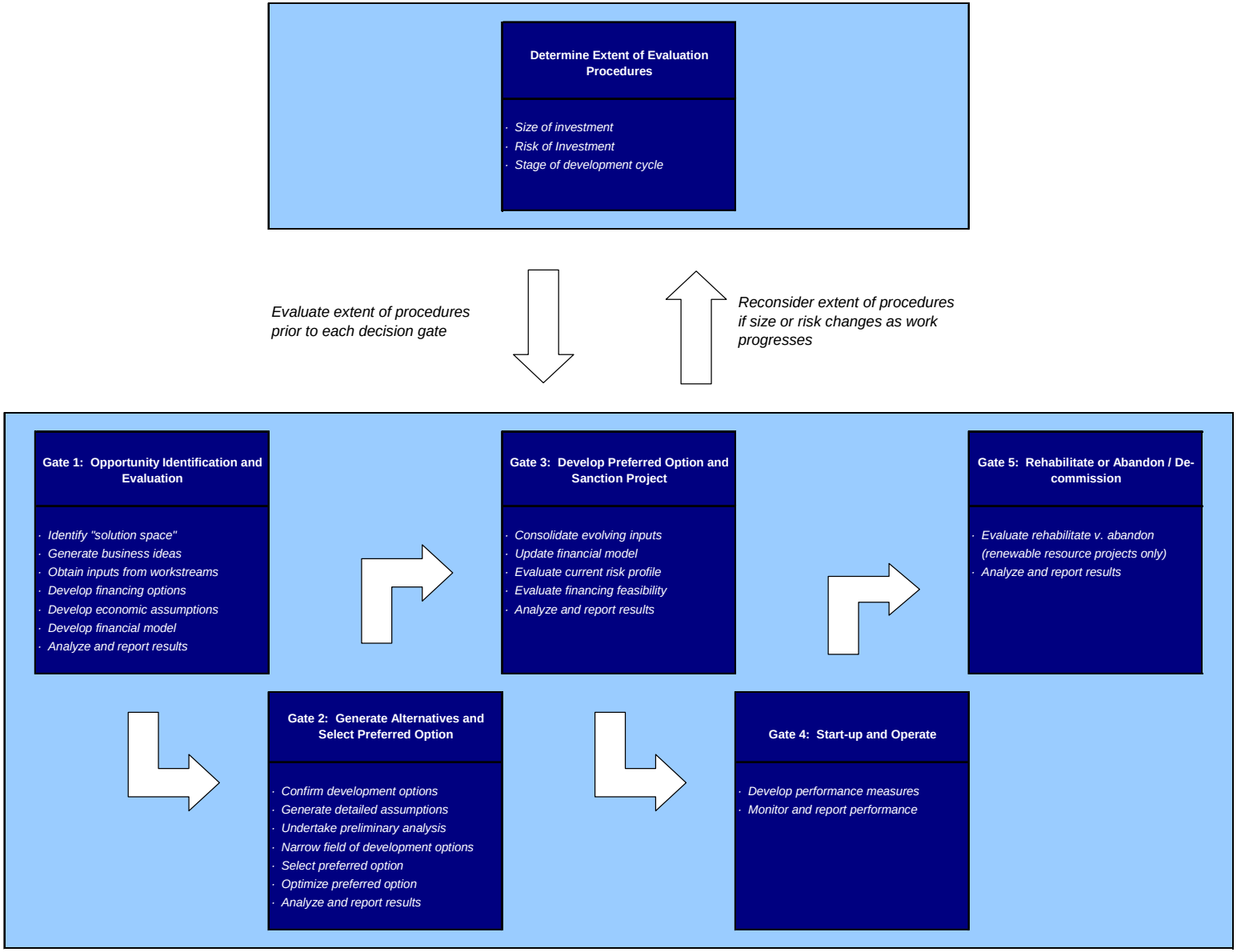
A key principle of the Energy Plan is to ensure economic benefits from the development of our energy resources are shared with future generations. Hence, in economic terms, the justification for the Project is based on the financial and economic returns that it will generate for the Province. As illustrated in the following sections, the economics of the Project are robust. The following sections present information on Nalcor's methodology, assumptions, and conclusions concerning economic viability of the Project.

5.1 Investment Evaluation Process and Methodology

Nalcor utilizes a specific methodology for the consistent evaluation of investment activities to ensure commercial investments are analyzed with an appropriate level of rigor and analysis using a structured approach to support informed investment decisions. For major development projects such as the Project, Nalcor's investment evaluation methodology is integrated with the various phases of the Project Development Gateway Process – described in Section 7 of this report and as illustrated in Figure 2 on the following page.

Given the size and scope of the Project, evaluation procedures performed have been extensive. Project finance models have been developed by Nalcor, with advice from Pricewaterhouse Coopers LLP ("PwC"), who has been retained as financial advisors for the Project. Nalcor uses a discounted cash flow ("DCF") modeling technique which involves estimating and projecting net future cash flows on a period-by-period basis and the selection of an appropriate discount rate to apply to such projected cash flows. Key inputs to the financial model, including hydrology, market prices, sales portfolio, capital expenditures, operating costs, and economic assumptions were developed by Nalcor's Investment Evaluation and Project groups, along with external experts. Financing assumptions, including capital structure, debt terms and conditions, and an equity target rate of return were developed by Nalcor with the assistance of PwC. Primary outputs of the financial modeling include prospective cost-out prices and market-based returns, including net present value ("NPV") and internal rate of return ("IRR"). If the NPV is positive and the IRR exceeds the equity target rate of return, the investment opportunity may be attractive, provided risks are deemed to be acceptable and capital for investment is available.

Figure 2 Nalcor Investment Evaluation Methodology (Development Projects)



5.2 Financial Assumptions

At this stage of the Project, firm market and project financing arrangements are not available. Therefore, Nalcor is providing preliminary estimates, financial analyses, risk assessments and sensitivities normally available at the feasibility stage of a project.

Nalcor has evaluated the Project using the following key financing assumptions:

- Length of analysis: 50 years from the full in-service date
- Debt-equity ratio: 70/30
- Borrowing term: 30 years
- Interest rate: 7.3 percent
- $US - $CDN exchange rate: $0.964
- Equity target rate of return: 12%

In selecting these key assumptions, it is assumed that normalcy will be restored to financial markets at the time Nalcor approaches the markets for debt financing, and in particular the project finance markets for undertakings similar to LCP. Given that the "new normal" for these markets is evolving, the financing assumptions used reflect the range developed in conjunction with PwC based on their research and experience with projects of LCP's type and magnitude. As indicated in Figure 2, financing feasibility will be undertaken by Nalcor prior to Gate 3.

5.3 Revenues

Table 22 presents the electricity market price projections for capacity and energy used in the financial model for Project markets. The price projection represents the most recent long-term price forecast prepared by the PIRA Energy Group ("PIRA"). PIRA was founded in 1976 and is an international energy consulting firm specializing in global energy market analysis and intelligence, including research and price forecasting services.

For the purposes of this representative revenue analysis, a portfolio of sales has been developed from the market references contained in Table 22. The export portfolio for this analysis includes a mix of on-peak and off-peak sales across markets accessible in eastern North America. Consequently, the portfolio price used is considered to be both conservative and reasonable for analysis.

In this analysis, sales to the Maritime Provinces are assumed to correspond to price projections for the New England market, and residual off-peak sales are assumed to correspond to price projections for the New York market. These selections reflect the transmission connections that exist between New England and the Maritime Provinces, as well as the transmission connections between New York and multiple markets in the region. Given this connectivity and the expected convergence of prices in the long term, Nalcor believes these assumptions are reasonable.

It should also be noted that 2025 is the last year for which price forecast information was available from PIRA, so prices are escalated at 2% per annum thereafter. Given the higher annual growth rates for market prices projected by PIRA during their forecast period, this long-term growth assumption is considered appropriately conservative for investment evaluation purposes.

Table 22 Market Energy and Capacity Forecast

		Market Energy and Capacity Price Forecast and Revenues															
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
NYISO Zone M	On Peak Energy ($US/MWh)	$77	$86	$90	$94	$98	$102	$106	$110	$113	$117	$121	$125	$128	$130	$133	$135
	Off Peak Energy ($US/MWh)	$59	$63	$66	$69	$73	$76	$80	$83	$87	$91	$96	$100	$102	$104	$106	$109
	Average Energy ($US/MWh)	$67	$74	$77	$81	$84	$88	$92	$96	$100	$104	$108	$112	$114	$116	$119	$121
	Capacity ($US/kW/yr)	$51	$55	$59	$62	$66	$70	$74	$79	$84	$90	$96	$102	$104	$107	$109	$111
ISO-NE Maritimes	On Peak Energy ($US/MWh)	$80	$85	$90	$95	$100	$106	$112	$115	$119	$123	$126	$130	$133	$135	$138	$141
	Off Peak Energy ($US/MWh)	$64	$67	$70	$74	$77	$81	$85	$89	$93	$97	$101	$106	$108	$110	$112	$115
	Average Energy ($US/MWh)	$71	$75	$79	$84	$88	$93	$97	$101	$105	$109	$113	$117	$120	$122	$125	$127
	Capacity ($US/kW/yr)	$67	$69	$70	$70	$70	$71	$71	$76	$81	$87	$93	$99	$101	$103	$105	$107
Ontario	On Peak Energy ($US/MWh)	$76	$84	$88	$92	$95	$99	$104	$107	$110	$114	$117	$121	$124	$126	$129	$131
	Off Peak Energy ($US/MWh)	$57	$62	$65	$68	$71	$74	$78	$81	$85	$88	$92	$97	$99	$100	$103	$105
	Average Energy ($US/MWh)	$65	$72	$76	$79	$82	$86	$90	$93	$97	$100	$104	$108	$110	$112	$115	$117
	Capacity ($US/kW/yr)	$20	$64	$67	$69	$71	$74	$76	$81	$87	$92	$98	$105	$107	$109	$111	$114
Energy Portfolio Average ($US/MWh)		-	-	$66	$84	$87	$92	$93	$97	$100	$104	$108	$112	$114	$116	$119	$121
Capacity Portfolio Average ($US/kW/yr)		-	-	-	$69	$71	$73	$75	$80	$85	$91	$97	$104	$106	$108	$110	$112
Annual Revenue ($million US)		-	-	$505	$1,047	$1,092	$1,249	$1,583	$1,646	$1,712	$1,781	$1,853	$1,928	$1,966	$2,006	$2,046	$2,087
Annual revenue ($million CAN)		-	-	$523	$1,086	$1,133	$1,295	$1,642	$1,708	$1,776	$1,848	$1,922	$2,000	$2,040	$2,081	$2,122	$2,165

Notes:
1. This electricity price projection has been derived from long term electricity market price projections prepared by the PIRA Energy Group as of October 2009.
2. Nominal dollars have been derived from constant dollars by assuming a general price inflation level of 2 percent per year.
3. Applicable injection point scalars to base forecast data are based on historical data.
Source: PIRA Energy Group and Investment Evaluation - Nalcor Energy.

5.4 Project Costs

Capital costs associated with the generation component of the Project are as contained in Table 23 and are approximately $6.5 billion, including direct and indirect capital costs and contingency.

Table 23 Project Construction Expenditures (Updated June 2009)

Parameter	Gull Island ($ millions)	Muskrat Falls ($ millions)	Total ($ millions)
Total Civil Works Costs	1,725	841	**2,566**
Total Electrical and Mechanical Works Costs	1,031	595	**1,626**
Total Construction Facilities and Support Costs	456	251	**707**
Total Transmission Costs	215	83	**297**
Total Management, Engineering and Other Costs	854	441	**1,295**
Totals	**4,280**	**2,210**	**6,490**
Composition of Capital Expenditures			
Labour	1,764	852	**2,617**
Materials	1,703	1,077	**2,780**
Equipment	813	281	**1,093**
Totals	**4,280**	**2,210**	**6,490**

Source: Table 3-10 in Response to IR #JRP.11

For the purposes of investment evaluation, other capital costs also include interest during construction and escalation. Operational expenses related to the Project are also included in the financial analysis.

5.5 Transmission Access

As indicated in the EIS and the responses to IR# JRP.5, JRP.24 and JRP.24S, Nalcor is advancing multiple market access alternatives for the Project. Export markets for the Project may be accessed via the Hydro-Québec TransÉnergie system or via a submarine HVdc transmission system through Newfoundland and on to the Maritime Provinces. Although the development of these transmission alternatives is beyond the scope of this Project, ultimately the cost of transmission access affects the competitiveness of the Project in the marketplace.

Nalcor has considered a range of costs for transmission access for purposes of modeling. Based on its conservative approach to modeling, Nalcor has selected the highest end of the range of upgrade costs, which in Nalcor's opinion does not consider opportunities for optimization and includes costs currently subject to a complaints process before the Regie de l'Énergie. The costs for transmission include estimates for capital costs of interconnection with the Hydro-Québec system, the costs of all upgrades identified by Hydro-Québec TransÉnergie, as well as costs for interconnecting with destination markets. The cost estimate for modeling includes OATT charges, the fees for upgrades beyond those provided for in applicable OATTs. When including this highest end of the range of transmission access costs for modeling, the business case is robust.

The final determination of the transmission route for the Project will be made at Gate 3, or Project Sanction.

5.6 Investment Evaluation - Conclusions

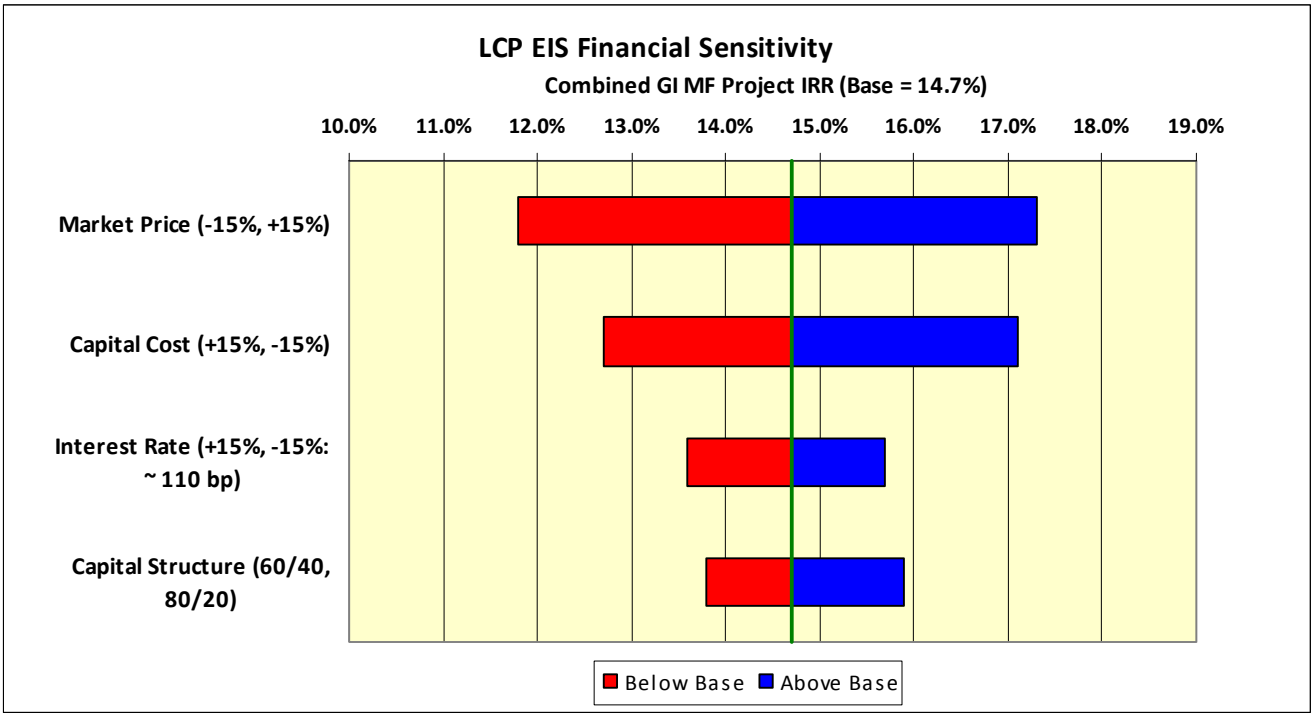
Based on the assumptions used in this analysis, the Project would realize a rate of return on equity of 14.7%, which exceeds the targeted return on equity of 12.0%.[39] The analysis indicates that the base project economics are attractive and could provide the lasting fiscal benefits for current and future generations of the people of the Province as contemplated by the Energy Plan.

Using a targeted 12.0 percent rate of return, the cost-out price for energy from the generating sites is $43 per MWh, expressed in 2010 dollars. This financial analysis does not include the economic spin-off benefits for the Province and the rest of Canada during the construction and operating phase, which are discussed in Section 5.

5.7 Sensitivity Analysis

Important components of the financial analysis for the Project are sensitivity analyses, where key variables are adjusted to determine the impacts on the Project's rate of return. Figure 3 illustrates the impact of four variables – market prices, capital costs, interest rates, and capital structure on the Project's IRR. As indicated, variations in market prices have the most significant relative impact on the financial viability of the Project, followed in order of magnitude by variations in capital costs, interest rates, and capital structure.

Figure 3 Project – Financial Sensitivity (Base IRR = 14.7 percent)



As Figure 3 illustrates, even if the actual market prices in each year of the projection period are 15% lower than projected, the Project will generate returns to equity in the range of Nalcor's target.

[39] The target rate of return on equity is discussed in the response to IR# JRP.147.

6.0 PROJECTED FINANCIAL BENEFITS

The financial benefits from the Project will be generated in two primary ways. The first is through the financial returns from the Project which will generate profits and dividends to the shareholder. The second is through broader economy-wide benefits which will result from the construction and operation of the hydro-electric plant and facilities. From the perspective of the Newfoundland and Labrador economy, there are four key beneficiary groups for the Project's financial benefits. The beneficiaries and their sources of benefits are listed below:

Nalcor Energy:	Net cash flow from the Project
Government:	Dividend paid from Nalcor
	Taxes paid by individuals and businesses
Labour:	Income and employment benefits from construction and operations
Business:	Business opportunities from construction and operation

In this analysis, these four groups are referred to collectively as the Newfoundland and Labrador economy and the expected financial benefits to each are presented individually and as a total in the following sections. While the Labrador Innu and Innu businesses will also receive benefits through their Impacts and Benefits Agreement for the Project, these benefits are not separated from the broader income and business benefits in this analysis.

6.1 Financial Returns

The primary source of financial benefits to the NL economy will be the net cash flow from the Project. The net cash flow from the Project is the cash available after capital costs, operating costs, tariffs and other costs are deducted from project revenue. In a capital-intensive project such as the Project, the cash flows will be negative in the early years during construction and will increase over time as the debt used to finance the Project is repaid.

The financial benefits from the net cash flow will accrue first to Nalcor as Project owner and secondly to the Government of Newfoundland and Labrador as the owner of Nalcor. Using the assumptions used in Section 5.4, the net cash flow will increase until it reaches approximately $1.1 billion annually (2010$) after the debt has been retired.

6.2 Economy-Wide Financial Benefits

The inclusion of broader economy-wide benefits must also be considered in the analysis of Project financial benefits to the NL economy. These broader economy-wide benefits will accrue to each of the stakeholder groups identified in Section 5.0.

The Government of Newfoundland and Labrador will benefit as those employed directly by the Project pay income and consumption taxes. The Newfoundland and Labrador labour force will benefit from the thousands of direct employment opportunities that will be available during the construction phase of the Project as well as from indirect employment opportunities in supplier companies and induced employment and income as the direct and indirect income flows through the economy. There will also be employment income benefits from the operation of the Project, albeit on a smaller scale than during construction. The smaller scale of the

operations employment is offset, however by the long-term nature of the operations employment. Finally, the Newfoundland and Labrador business community will benefit as they avail of supply opportunities related to the Project.

6.3 Financial Benefits Summary

The financial benefits expected to accrue to each of these groups have been compiled and are presented in Table 24.

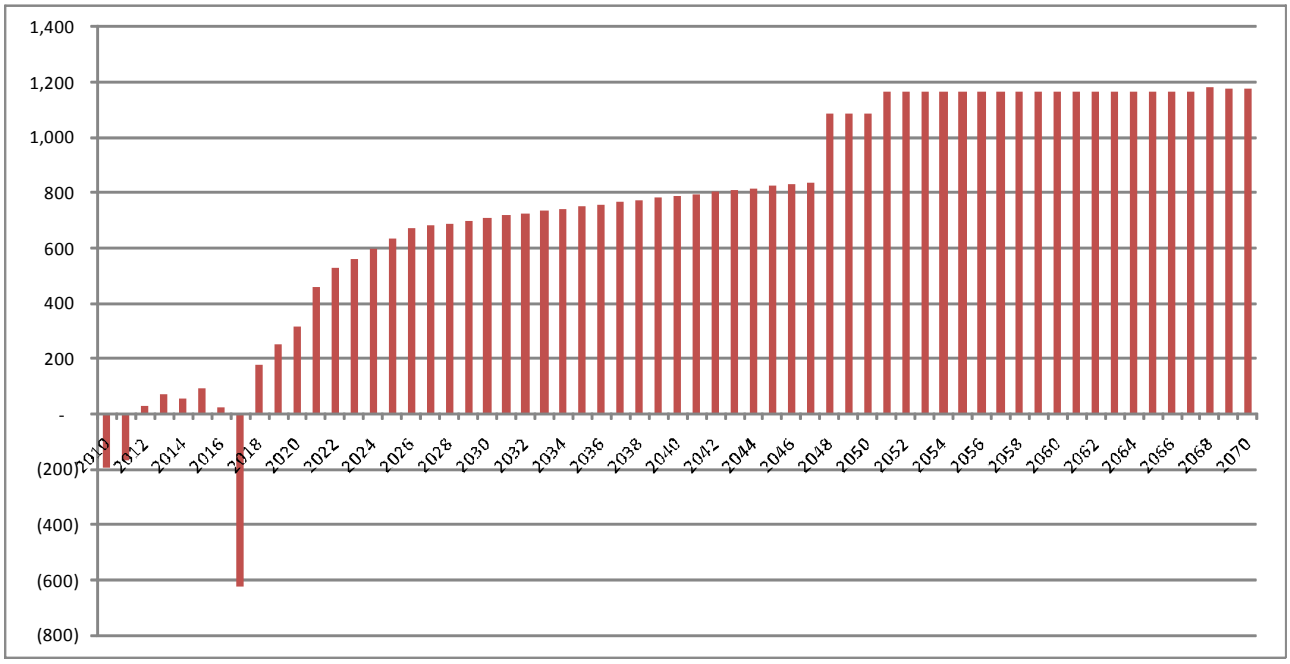
As Table 24 indicates the net financial benefits to the NL economy increase after the project has been completed and as the debt is retired, reaching over $1.1 billion annually by 2050. Also of particular interest is the 2010-2020 period during which time the project is being constructed. Offsetting the negative $2.35 billion in net cash flow which represents Nalcor's equity contribution to the Project are significant economy-wide benefits. In other words the direct and indirect benefits to the economy from the construction of the Project are roughly equivalent to Nalcor's equity infusion into the Project. From a provincial economy perspective, therefore, there is no net cost to the economy from the construction of the Project. After the construction phase and starting in the 2021-2030 period, there are net benefits to the provincial economy, which grow until 2050 at which point the debt has been retired.

The annual distribution of these benefits is illustrated in Figure 4, which follows Table 24.

Table 24 Financial Benefits to the Newfoundland and Labrador Economy (millions 2010$)

	Total	Period Totals					
		2010-20	2021-30	2031-40	2041-50	2051-60	2061-70
Income to NL Labour and Business							
Construction							
Direct	1,328	1,328	-	-	-	-	-
Indirect	331	331	-	-	-	-	-
Induced	367	367	-	-	-	-	-
Total from Construction	**2,025**	**2,025**	**-**	**-**	**-**	**-**	**-**
Operations							
Direct	514	18	90	94	99	104	109
Indirect	321	11	56	59	62	65	68
Induced	193	7	34	35	37	39	41
Total from Operations	**1,027**	**36**	**179**	**188**	**198**	**208**	**218**
Total Income to NL Labour and Business	**3,053**	**2,061**	**179**	**188**	**198**	**208**	**218**
Taxes to NL							
Construction							
Direct	198	198	-	-	-	-	-
Indirect	33	33	-	-	-	-	-
Induced	74	74	-	-	-	-	-
Other	25	25	-	-	-	-	-
Total Taxes to NL from Construction	**330**	**330**	**-**	**-**	**-**	-	-
Operations							
Direct	43	2	8	8	8	9	9
Indirect	8	0	1	1	1	2	2
Induced	16	1	3	3	3	3	3
Other	6	0	1	1	1	1	1
Total Taxes to NL from Operations	**72**	**3**	**13**	**13**	**14**	**15**	**15**
Total Taxes to NL	**402**	**333**	**13**	**13**	**14**	**15**	**15**
Net Cash Flow							
Net Cash Flow to Equity	**42,693**	**(2,351)**	**6,036**	**7,336**	**8,765**	**11,438**	**11,468**
Net Financial Benefits to NL	**46,148**	**43**	**6,228**	**7,538**	**8,977**	**11,660**	**11,702**
Average Net Financial Benefits to NL	**757**	**4**	**623**	**754**	**898**	**1,166**	**1,170**

Figure 4 Net Financial Benefits to the Newfoundland and Labrador Economy (millions 2010$)



6.4 Distribution of Financial Benefits

In considering the distribution of financial benefits, it is necessary to consider the roles and mandates of the various parties who play a role in the development of the Project. The parties include:

- Nalcor, the Proponent of the Project
- The Government of Newfoundland and Labrador, Nalcor's shareholder
- The Government of Canada
- Innu Nation, on behalf of the Innu of Labrador

In its role as developer, Nalcor will be the recipient of the direct financial benefits from the Project. A royalty, calculated at the rate of five percent of after-debt net cash flow, will be provided to Innu Nation on behalf of the Innu of Labrador consistent with the terms of the Impacts and Benefits Agreement, and any additional amounts will either be retained by Nalcor for investment in other energy-related activities or returned to its shareholder as a dividend. This provides the first step in the distribution of benefits:

- The Innu of Labrador receive a royalty share
- The Government of Newfoundland receives a dividend
- Any amounts not paid out are retained by Nalcor.

The terms and conditions of the Impacts and Benefits Agreement will establish the distribution of financial benefits to the Labrador Innu when the agreement is ratified.

In considering the distribution of benefits by the Province, that matter is fully within the mandate of the government of the day, and outside Nalcor's mandate. The royalties received from other major developments, such as Hibernia, Terra Nova, Whiterose, and Voisey's Bay, have been pooled with other revenues of the Province, and used for service delivery, infrastructure, and investments throughout the entire province. This approach is consistent with a policy that the natural resources of the Province are assets of the entire province, and not part of a particular area or region within the Province.

Similarly, amounts retained by Nalcor would be used for investments and business that fall within Nalcor's mandate without limitation as to which region of the Province that they might be used in. This approach is consistent with a policy that sees Nalcor invest in the best opportunities, on behalf of its shareholder, the Government of Newfoundland and Labrador.

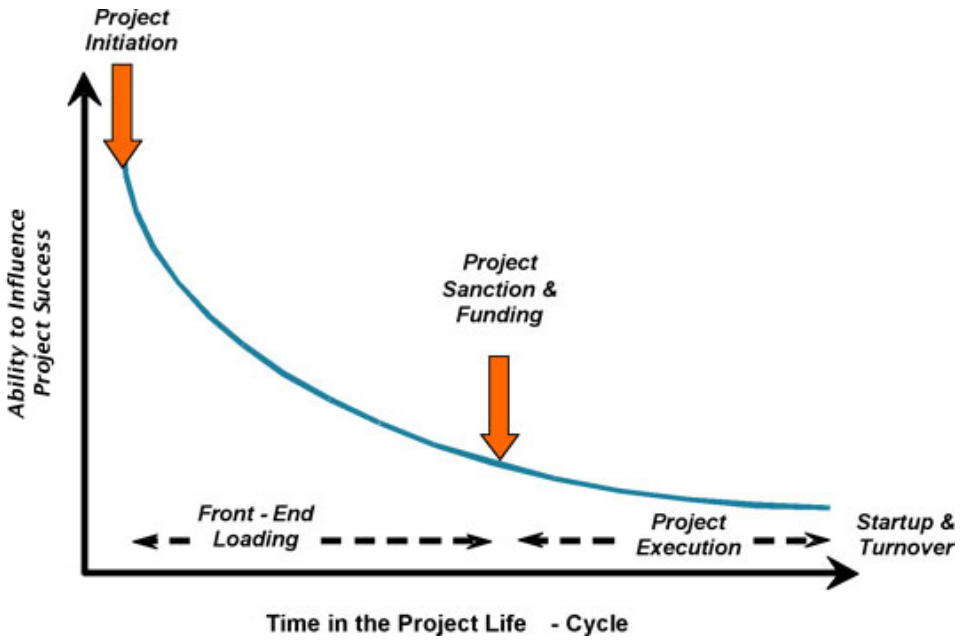
7.0 PROJECT RISK MANAGEMENT

7.1 Risk Management for the Project

Risk management is a critical governance structure for Nalcor. Specific project-level risk management processes, tools and resources have been implemented for the Project underneath the umbrella of Nalcor's corporate Enterprise Risk Management program.

Consistent with the "Project Influence Curve" shown in Figure 5, Nalcor has made extensive efforts in the early planning phases to identify, evaluate and implement opportunities to capture and maximize value that can be extracted from the Project. Nalcor believes that early risk (both opportunity and threats) planning is the key driving factor in increasing the predictability of the underlying business case for the Project, and has taken extensive steps to ensure the application of best practice for risk planning.

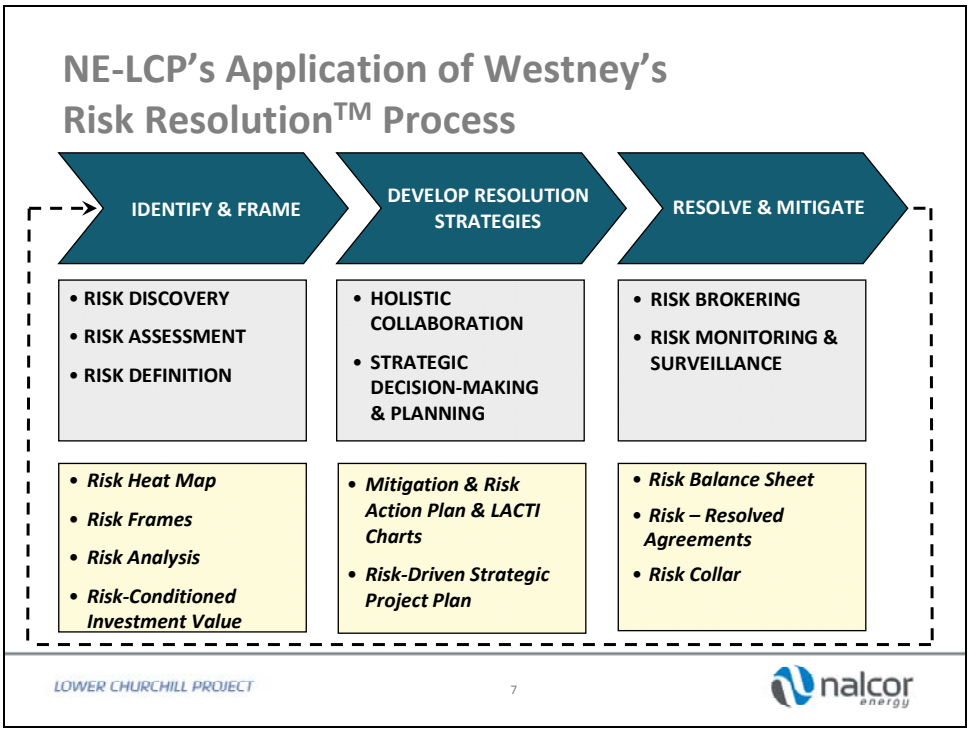
Figure 5 Project Influence Curve (Westney, 2008)



To this effect, in 2007 Nalcor engaged Westney Consulting Group to assist with the full implementation of a holistic risk management program with the Project. Westney are well known within the capital project industry for their leading-edge ideologies and approaches to addressing risks as a means to improve the predictability of the investment decision.

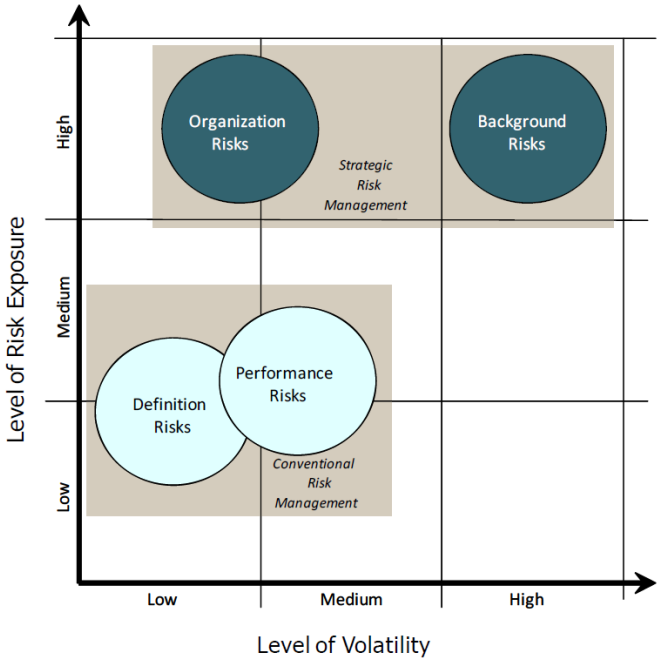
As illustrated in Figure 6 Nalcor has adopted Westney's Risk Resolution® methodology as the backbone of its risk management process for the Project.

Figure 6 Nalcor's Application of Westney's Risk Resolution Methodology



Westney's Risk Resolution® methodology represents a departure from the conventional approach to project risk management whereby risk analysis is focused on tactical risks. According to Westney, conventional project risk management fails to consider larger "strategic" risks that have had a predominant influence on mega-projects in recent years. As illustrated in Figure 7, these strategic risks have both large level of volatility and exposure.

Figure 7 Relationships Between Risk Exposure and Volatility (Westney, 2009)



Tactical risks and strategic risks are differentiated below:

Tactical Risks

- *Definition Risks* – These risks are associated with the degree of design development and planning definition for the given project scope, including such items as rock quantities, changing design criteria, location-driven factors, etc.
- *Performance Risks* – These risks are associated with normal/reasonably expected variations in owner and contractor performance, including such items as construction productivity risk, weather delays, material pricing, etc.

Strategic Risks

- *Background (external) Risks* – These are typically associated with changes in: scope, market conditions, location factors, commercial or partner requirements and behaviours.
- *Organization (internal) Risks* – These risks are typically associated with an asymmetry between size, complexity, and difficulty of projects and the organization's ability to deliver.

7.2 Risk Management Approach and Methodology

Application of the Risk Resolution® methodology began when the Project was in its earliest, formative stage and before major business decisions or commercial commitments were made. This methodology started with the identification and framing of all business and project risks with a technique called Risk Framing, which provides a means of assessing risk exposure prior to finalizing input parameters into the economic model used for investment evaluation. Through the use of interviews, surveys and analyses, major sources of risk and possible mitigation strategies were identified. Scenarios were created to represent the best- and worst-case outcomes for each type of risk, and then used as input to purpose-built, Monte-Carlo simulation models for cost and schedule that provide a range of possible values for Risk Exposure as input into risk-informed decision making.

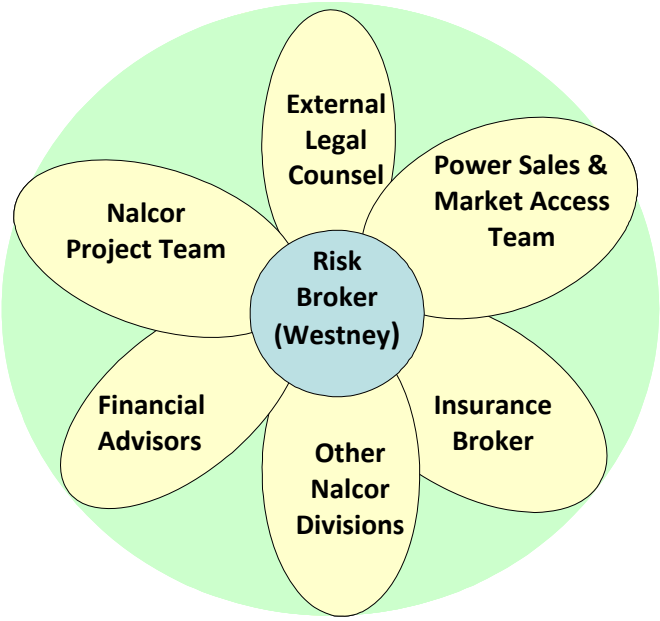
Nalcor's specific risk management programs for the Project are built upon a framework that includes five (5) categories:

- *Commercial*: Including risks to how the capital project will produce revenue via power purchase agreements with suppliers, off-takers, transmission access and tariffs, reservoir production rates, etc.
- *Financial*: Including risks to how the project's capital investment will be paid for via arrangements with partners, lenders, etc.
- *Regulatory & Stakeholder*: Includes risks regarding regulatory approvals, aboriginal negotiations and agreements, stakeholder engagement, etc.
- *Technical*: Including risks of the technology to be used to create the facilities required to produce the expected revenue, and the physical scope of those facilities.
- *Execution*: Including risks to the organization and contracting strategies for performing the engineering, procurement, construction, installation and start-up; and the plans for managing those activities.

7.3 Risk Management Philosophy

The underlying risk management philosophy adopted by Nalcor has been to package and allocate Project risks to the party who can most effectively manage the risks. The ability of Nalcor to allocate these risks will be very much dependent on the risk appetite of the various stakeholders (e.g. contractors, off-takers, insurance underwriters, etc.). A Risk Resolution Team was formed in 2007 to determine the optimal resolution strategy for the identified risks. Since then, this multi-faceted and disciplinary team, illustrated in Figure 8, has successfully developed and implemented mitigation strategies and plans for a number of risks to the Project.

Figure 8 Nalcor's Risk Resolution Team for the Project



Nalcor has extensively used risk-informed decision-making techniques to facilitate decision quality assurance for all aspects of the business case evaluation and project planning. While Nalcor considers it to be impractical to think that it can identify and manage all risks to which the Project may be exposed, the risk-informed decision-making approach facilitates decision analysis that is inclusive of all risk and uncertainty considerations.

7.4 Gateway Process

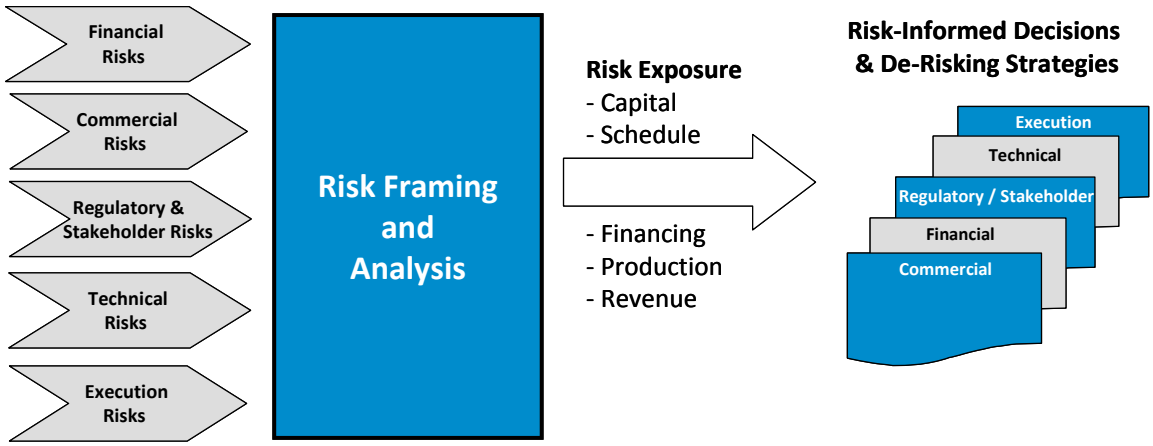
Quality assurance for decision making, as a mechanism to improve project predictability, has been incorporated within the planning and execution of the Project by implementing Nalcor's structured stage-gate process – the Gateway Process. The Gateway Process divides the lifecycle of the Project into several phases starting at opportunity identification and concluding at start-up of the production facility. Each Phase has a list of pre-defined deliverables deemed essential to make a risk-informed decision at the end of that Phase, referred to as a Gate.

A due diligence review is required prior to the decision at each Gate. The due diligence review provides an independent review of the status, progress, plans, issues and risks on each Project Plane, then integrates these

into the overall assessment of project risk exposure. These results drive risk-informed decisions and plans on each Project Plane.

As illustrated in Figure 9, Nalcor has leveraged the Risk Resolution® methodology as a key component of its process to facilitate risk-informed decision making within the Phases and each Gate of the Gateway Process.

Figure 9 Risk-informed Decision Making Approach



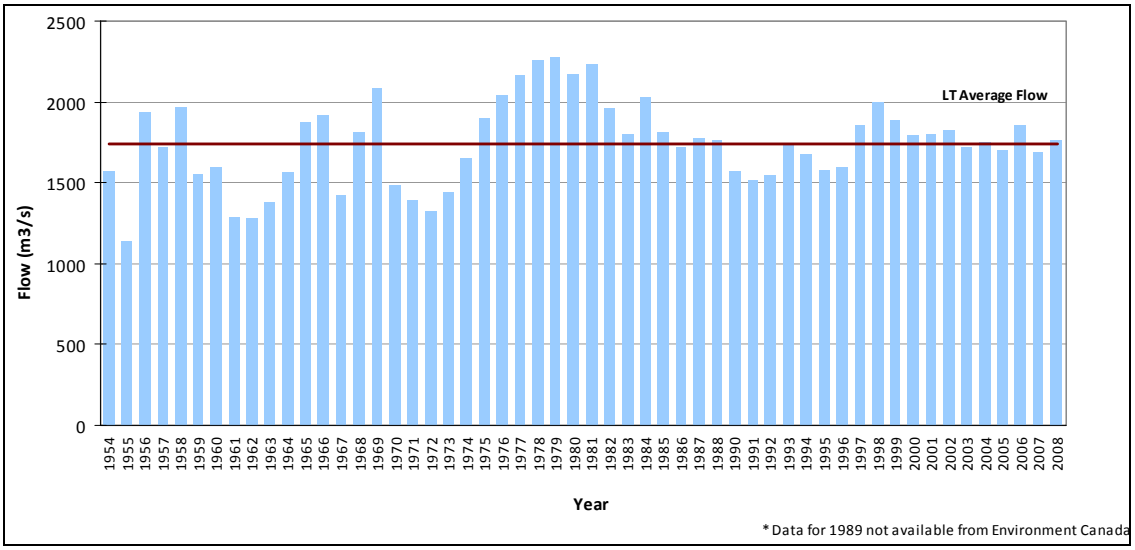
7.5 Project Specific Risks

Extensive risk planning exercises by Nalcor have resulted in the identification and development of mitigation strategies for a number of tactical and strategic project risks. Several of these key risks are discussed below.

7.5.1 In-Stream Flow Variability

In-stream flow variability is an inherent business risk for any hydroelectric project since flow rates and water levels are outside of the control of the project operator. As indicated in Figure 10, the in-stream variability of the Churchill River has been reduced considerably with the construction of the Churchill Falls generating facility.

Figure 10 Annual Average Flow at Muskrat Falls (03OE001) (Environment Canada)



Nalcor has access to a long-term (dating back to the 1940's) record of inflows for the lower Churchill River, and the Churchill Falls project provides long-term storage and regulation for approximately 75% of the inflows into the Churchill River. The Water Management Agreement (WMA) between Nalcor and Churchill Falls (Labrador) Corporation (CF(L)Co.) further mitigates this risk.

With a long term hydrologic record, significant upstream storage and regulation, and the terms of a water management agreement in place, risks associated with in-stream variability have been effectively mitigated.

7.5.2 Market Demand and Price Risk

Market demand and price risk are strategic risks against which Nalcor has options to control and mitigate. As described in Section 3, Nalcor has collected extensive market intelligence regarding market demand and price in order to understand its exposure due to market demand and price risk, as well as develop a mitigation strategy that is aligned with Nalcor's risk appetite.

Market demand and value will vary in different jurisdictions with the demand/supply drivers present in each jurisdiction such as: current market size, industrial/commercial demand – the potential for growth or shrinkage, fuel reliance, government energy and environmental policies, demographic and economic shifts, technological advances and resource development opportunities. These factors will be tempered to some degree, but not totally, by increased regionalization of transmission grids. The Project is a large generation resource with access both south-east to the Maritimes and west to Quebec, Ontario and the US, therefore diversification of markets is possible and prudent.

Nalcor intends to adopt a portfolio sales strategy as the core of this risk mitigation strategy. A portfolio strategy will be based on building a sales portfolio comprised of long, medium and short term sales to different customers and in different markets in order to effectively mitigate both demand and price risk. A mixed portfolio will provide predictable cash flow to meet financing and equity requirements, while providing opportunities over the medium and longer term to meet changing demand in Newfoundland and Labrador, and opportunities in both the short and longer term to capitalize on future shifts in market demand and market value. The diversification of the portfolio will be finalized based on the magnitude of risk-adjusted capital investment for each of the Gull Island and Muskrat Falls generation sites.

Long-term sales arrangements will provide revenue predictability, as the pricing formula and mechanism will be established for a pre-determined period (i.e. 15 – 20 years upon execution of the contract). Medium-term arrangements will be determined by the demand/supply forecast in effect for the applicable period and therefore will change potentially more dramatically with trends over time. Sales to short-term, day-ahead, and spot markets will be even more volatile, affected by short-term market impacts, subject to any mitigation from short-term financial instruments that may be availed of at that time. Nalcor's sales portfolio of a balanced combination of long, medium and short term sales will not only reduce exposure to price volatility, but will also allow Nalcor to gain some benefit from potential higher price market conditions when they arise.

7.5.3 Schedule Delays

Schedule delays may occur during either the pre-sanction (Gate 3) period or during the construction execution phase. Nalcor has identified a number of tactical and strategic risks that may result in schedule delays. These include, but are not limited to:

- Securing power purchase agreements;
- Securing transmission access agreements;
- Negotiation of aboriginal agreements;
- Achieving release from Environment Assessment;
- Availability of qualified engineering consultants;
- Availability and retention of skilled construction labor and supervision;
- Availability of experienced hydro contractors;
- Limited window available for river diversion at Gull Island;
- Uncertain geotechnical conditions;
- Winter construction limitations;
- Late design change; and
- Site access and logistics.

Consistent with the Risk Resolution® methodology, Risk Frames for these risks have been developed, which thoroughly define the risk and mitigation plans. These Risk Frames include a view of unmitigated and mitigated exposure to each risk, which is used as input to a purpose-built Monte-Carlo simulation model for schedule that provide a range of possible values for Risk Exposure as input into risk-informed decision making. All economic modeling for the Project have considered a range of probabilistic schedule completion dates when assessing the business investment. Westney Consulting Group, Inc. has leveraged its proprietary PRIMS® modeling technique to facilitate the modeling of schedule risks.

7.5.4 Regulatory Risk

As discussed above, the justification of the Project on energy terms is based partially on the evolution of electricity markets where GHG emissions are restricted. Changes to the regulatory regime therefore represent a risk, as the competitiveness of the Project in the marketplace will change relative to that of other generation alternatives. In particular, a relaxation of proposed GHG emission rules would re-introduce coal fired generation as a viable alternative. In light of the stated policies of both federal and provincial governments, this is considered to be a low risk at this time.

Nalcor continues to actively monitor regulatory policy decisions that may impact the Project so as to effectively ensure the consideration of this risk during project decision making.

7.5.5 Interest Rates

Prior to Decision Gate 3 (sanction), the Project will have established and secured equity financing, and remaining financing will be provided via debt markets. To mitigate any risk related to interest rate exposure, the Project intends to finance using conventional fixed rate financing obtained in bond markets and/or bank financing

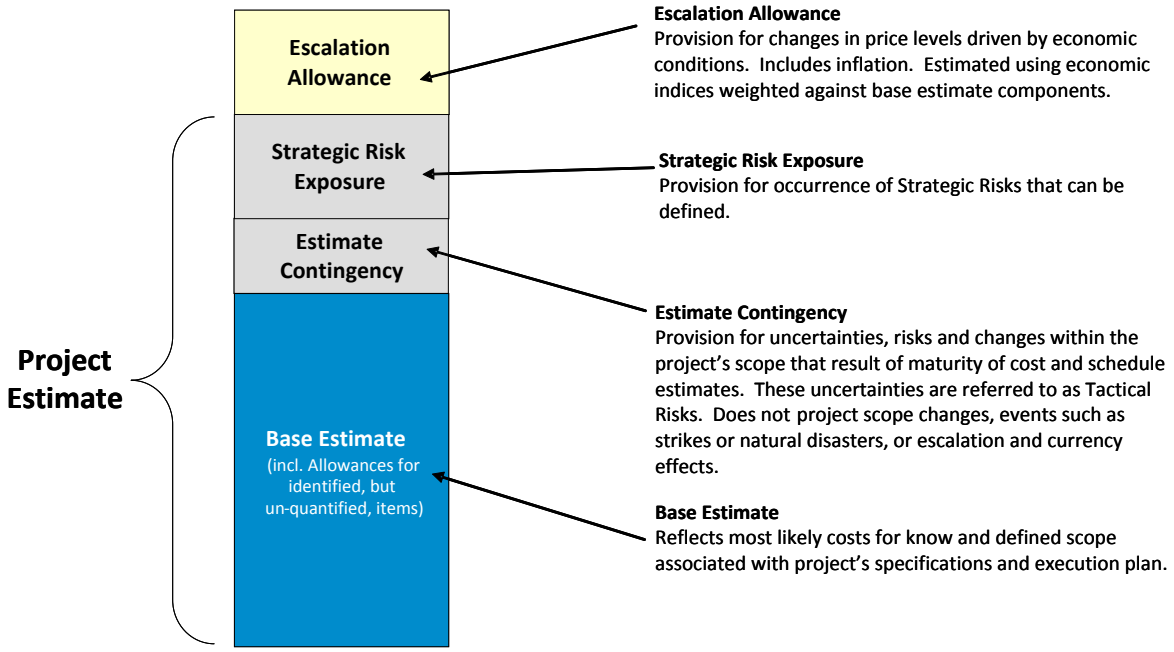
where floating rate exposure is eliminated via the purchase of interest rate swaps, effectively creating a fixed interest rate for the debt secured. Accordingly, interest rate risk is mitigated through use of this financing strategy. Project economics have been prepared using an assumption for a fixed interest rate that is viewed as reasonable by the Project and its financial advisors at the date of completing this report.

7.5.6 Construction Cost Risk

Consistent with the approach illustrated in Figure 9 and discussed under the section on Schedule Risks, Nalcor has gone through an extensive process to identify and assess potential construction cost risk, encompassing the four (4) categories of risks: Definition Risks, Performance Risks, Background (external) Risks, and Organization (internal) Risks. Following a detailed qualitative review of identified risks, key risks were further assessed using quantitative methods including the use of Monte-Carlo simulation techniques. When combined with the schedule delay analysis, the results included a range of possible outcomes that is used to make informed decisions on pragmatic levels to include for Estimate Contingency and Strategic Risk Exposure that have been included in economic modeling for the Project. Westney Consulting Group, Inc. has provided Monte-Carlo simulation modeling tools and techniques to assist in the completion of this analysis.

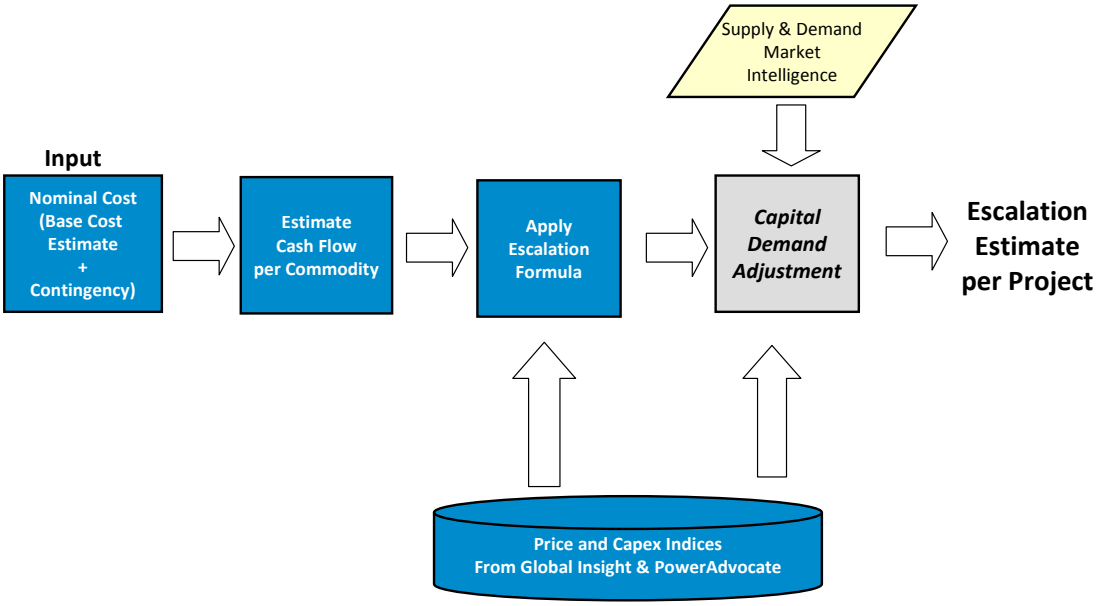
Consistent with Nalcor's governance plans for the Project, all capital cost and schedule estimates are prepared consistent with industry recognized best practice so as to ensure that all business planning and investment evaluation activities are completed using information commensurate with the level of technical and execution detail available. Capital cost estimates prepared for the purposes of business planning and investment evaluation will be comprised of three distinct components as illustrated and defined in Figure 11:

Figure 11 Project Cost Estimate Components



Understanding and considering construction cost risk due to cost escalation is also a core component of Nalcor's view of the expected outturn cost for the Project. Nalcor has developed an in-house escalation model specifically for the Project as shown on Figure 12 that facilitates the estimation of cost escalation due to both changes in the cost of raw materials, as well as the effects of a supply/demand imbalance. Detailed market supply and demand information for major cost components are gathered in-house from a variety of sources, which is then combined with base escalation indices produced by Global Insight and PowerAdvocate, companies that are recognized industry sources for such information. Upon consideration of all available data, Nalcor is able to produce grounded, well-researched forecast of cost escalation for use in its investment analysis.

Figure 12 Escalation Estimating Process



7.6 Summary of Risk Management for the Project

Nalcor has implemented a best-in-class risk management program for the Project, which is built upon the lessons learned from other mega-projects. As a key component of Nalcor's project governance structure, this risk management program has effectively allow Nalcor to work with third party specialist advisors / consultants to identify and manage both tactical and strategic project risks. The fullest application of this program has afforded decision quality assurance through robust risk-based decision making tactics that will help assure the predictability of the outcome of the Project.

8.0 CONCLUSIONS

The objective of this report was to expand on the analysis and assessment contained within the EIS that established the need, purpose and rationale for the Project. Representations in the report conclude the following:

- There is a clear mandate granted to Nalcor from the Province in the Energy Plan to develop natural resources to the benefit of the people of the province;
- There are abundant market opportunities identified by Nalcor for lower Churchill River hydroelectric power. These opportunities have been created in the market place from the need to replace aging infrastructure, source non GHG-emitting electricity, optimize supply integrity (dispatchability), and accommodate persistent long term growth in power demands;
- Economic analysis based on demand, price forecasts, and project costs are attractive and suggest the Project can provide lasting fiscal benefits for current and future generations of the people of the Province as contemplated by the Energy Plan;
- Benefits from the Project include direct financial benefits from positive cash flow that grows to over $1.1 billion annually;
- The Project will provide benefits to Aboriginal groups through training opportunities, employment, business opportunities, and financial benefits.
- Other economy-wide benefits will accrue to the region (labour and business), the Province, and Canada from the Project as a result of employment and business opportunities, dividends, and taxes; and
- Nalcor has a well defined and rigorous risk management process that continuously reviews key elements that may challenge long term economic viability – and a gateway decision process that will mitigate real exposure to unfavorable conditions and possible outcomes from the Project.

It is evident the Project resource is significant enough to provide a competitive, long-term, clean, and reliable source of electricity at a reasonable price to the province and a number of other regional markets within Eastern Canada and the northeastern United States. Market demand is expected to be quite strong to meet renewable requirements, the replacement of aging infrastructure and new load growth within the timeframe of the Project. Given its scale, the Project represents one of the most important and realizable opportunities for Canada to meet its environmental commitments and curb greenhouse gas and other emissions in a meaningful way.

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IR# JRP.147

Alternatives to the Project

Requesting Organization – Joint Review Panel **Information Request No.: JRP.147**

Subject - Alternatives to the Project

References:

EIS Guidelines, Section 4.3.2.1 (Alternatives to the Project)

Related Comments / Information Requests:

CEAR # 285 (Hydro-Québec)
CEAR # 288 (Robin Goodfellow-Baikie)
CEAR # 289 (Innu Nation)
CEAR # 291 (Sierra Club Atlantic)

IR # JRP.26, 26S

Rationale:

Section 4.3.2.1 of the EIS Guidelines requires the Proponent to "include an evaluation of the thresholds for economic viability of the Project and considerations respecting the timing of phases and components of the Project. (…) shall also indicate under what circumstances a change in economic conditions may influence its selection of the preferred alternative." (p. 16)

In JRP.26 (e), the Panel asked the Proponent to provide the following information: "an evaluation of the thresholds for economic viability of the chosen alternative and considerations respecting the timing of phases and components of the Project, indicating under what circumstances a change in economic conditions may influence selection of the preferred alternative."

The Proponent's response was general in nature and did not adequately address the requirements of the EIS Guidelines.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.147**

Information Requested:

The Proponent is asked to revisit its response to JRP.26 (e) and provide the evaluation and quantification requested by the Panel and required by Section 4.3.2.1 of the EIS Guidelines.

Response:

The Lower Churchill Hydroelectric Generation Project (Project) is viewed as an important investment for Nalcor Energy (Nalcor) and the Province of Newfoundland and Labrador (Province). The economic viability of the Project is subject to ongoing and rigorous review, the conclusions of which have been consistent and supportive of pursuing development of this Project. The following provides additional details on Nalcor's evaluation of the thresholds for economic viability of the chosen alternative and considerations respecting the timing of phases and components of the Project. The following also describes under what circumstances a change in economic conditions may influence selection of the preferred alternative.

Fundamentals

In considering the Project as an investment, Nalcor will be in a position to move forward with construction of the Project when it has access to sufficient funds and Nalcor and its shareholder conclude that the Project's benefits outweigh its costs.

Funds to construct the Project are acquired from two sources: equity from the shareholders and debt from lenders. Equity by its nature is unsecured and debt from lenders would typically be secured by the assets and related cash flows comprising the Project. The Province is the sole shareholder of Nalcor, and thus is the sole current source of equity for the Project to date.

These facts introduce the requirement for parties to contemplate their own thresholds for risk in the Project, including economic viability:

1) Shareholder – The first threshold for economic viability is whether the equity investor is prepared to provide equity for the Project. The extent to which equity would be provided is dependent on the benefits that are projected to accrue from the Project, the amounts lenders are willing to advance to construct the Project and their investment expectations for equity providers, the shareholder's ability to invest (its fiscal position, and the cost of other sources of funds for the Province at the time), and its perception of the risks associated with investment in the Project.

   The Province will also consider a cost/benefit analysis to be relevant in determining the merits of such an investment, particularly as a result of the indirect and induced economic benefits of the Project.

2) Lending Community – The second threshold for economic viability is whether, and on what terms, lenders are prepared to advance debt financing in order to make up the remaining funds required to construct the Project. The desire of lenders to advance funds will be relative to their perception of risk and their thresholds for risk tolerance, which will be reflected in the terms of the financing.

3) Nalcor - Nalcor will then evaluate the availability and cost of financing (both equity and debt) combined with forecasted revenues, capital costs and operating expenses, and will assess its ability to meet its obligations to the shareholder and lenders.

In the first and second case, the precise thresholds for economic viability will be established by the equity and debt providers themselves, based on market and financial conditions, their ability to invest, and the risks and rewards associated with the Project as perceived at the date of Project Sanction, including the Project's perceived strategic importance. In the third case, Nalcor has a comprehensive investment evaluation process that will guide its decision to proceed with the Project. This has been described in Section 5.1 of the *Supplemental Report on Need Purpose, and Rationale* attached to the response to IR #JRP.146 and Section 3.3 of Volume 1 A of the EIS. Further elaboration on quantification and evaluation of Nalcor economic viability thresholds is below.

If the investment conclusions of the three parties described above are in alignment and their thresholds are met, then the Project will proceed. If not, then Nalcor will have to either repackage the project (change sequencing of Gull and Muskrat, for example), or continue to work to mitigate outstanding risks until such time as the Project can be financed.

Quantification and Evaluation of Nalcor's Core Threshold of Economic Viability

A key metric or threshold calculated by Nalcor's Investment Evaluation (IE) group is the target rate of return on equity. Nalcor bases its planning for the Project on a target rate of return on equity of 12 %, reflecting a target rate of return on equity developed in conjunction with PricewaterhouseCoopers (PwC), Nalcor's financial advisor for the Project. The targeted rate of return selected was consistent with PwC's research and experience with undertakings similar to this Project in terms of type and magnitude, and was commensurate with the perceived risks and opportunities for the development scenario. The target rate of return is also consistent with targets utilized by other hydro project developers for similar projects.

As the target rate of return on equity is based on a number of key variables, a sensitivity analysis was done to assess the stability of this expected result. This sensitivity analysis is presented in Section 5.7 of the *Supplemental Report on Need Purpose, and Rationale* attached to the response to IR #JRP.146 and concludes with some confidence that Nalcor's targeted rate of return on equity is largely attainable given some degree of variability in financial inputs.

One should recognize that "an evaluation of the thresholds for viability of the Project" is not a static evaluation. For the purposes of investment evaluation, Nalcor has established a target rate of return, or threshold for economic feasibility, at 12%. This rate is based on the advice of its internal Investment Evaluation group and Nalcor's financial advisor, is commensurate with the perceived risks associated with the Project at this time, and is comparable to the target rate of return established for other large scale export oriented hydroelectric projects.

The required rate of return will be assessed by lenders and equity holders at the time of sanction, and will be established at a level that is appropriate for the project risks and benefits that exist when construction starts. Nalcor's shareholder, the Government of Newfoundland and Labrador, may also elect to consider the strategic importance of the Project as well as other benefits, such as tax revenue, that accrue to it rather than to Nalcor. Since these benefits accrue to the shareholder rather than Nalcor, they would not be included in Nalcor's financial analysis, but are relevant to the shareholder, and may justify an adjustment to the required return on equity in current analysis. All of these factors may contribute to the selection of a lower target rate of return at the time when the investment decision is made.

Considerations Respecting the Timing of Phases and Components of the Project

Phasing of the Project is related to the two generation sites at Gull Island and Muskrat Falls, along with their associated transmission to Churchill Falls. The components of the Project refer to the individual elements within each phase such as reservoir clearing, powerhouse, dam, diversion tunnels, etc.

Timing of Each Phase

The project description presented in the EIS contemplates commencement of construction (sanction) of Gull Island along with transmission to Churchill Falls, and then sanction of Muskrat Falls along with transmission to Gull Island three to four years after the start of Gull Island. Gull Island's unit costs are lower than those of Muskrat Falls, so attention has been focused on the project phase with the most attractive economics. However, Gull Island requires substantially greater transmission capacity, a larger sales portfolio, and more construction capital than Muskrat Falls. Since the development of either phase of the Project is predicated on an affirmative investment decision for that phase, all of the revenues, costs, and financing considerations must be evaluated for each phase in conjunction with the risks assumed for that phase of the Project.

Three important considerations respecting the timing of Phases of the Project are Market Access, Sales, and Financing. Each of these is discussed in more detail below:

Market Access

Nalcor has identified two market access alternatives for the Project – one through the Hydro-Québec TransÉnergie system using HQT's OATT and the other through an HVdc transmission system through Newfoundland and into the Maritime Provinces. While both alternatives are expected to be achieved in the long term, the capacity availability from each alternative in the short term will affect the timing of the phases of the Project. An application for administrative review has been filed following the decision by the Québec Régie de l'énergie regarding complaints filed by Newfoundland and Labrador Hydro relating to transmission access from Hydro-Québec TransÉnergie (HQT). The application for administrative review has been made four years after the filing of the request for transmission service with HQT, and the timing and results this ruling and any subsequent appeal are beyond Nalcor's control.

The following transmission options exist, including:

1. 1100 to 2824 MW via HQT (application under appeal)
2. 740 MW via HQT (queued valid application with HQT)
3. 800 MW via Labrador – Island Transmission Link (under EA)
4. 500 to 1000 MW from Newfoundland to Nova Scotia (under study by Nova Scotia Power)

The construction of either phase of the Project will not start until a level of market access that supports at least the construction of either Gull Island or Muskrat Falls is achieved. Greater available transmission capacity will favour Gull Island first, and lesser available capacity will favour Muskrat Falls first.

Sales Portfolio

Marketing efforts are aimed at securing long, medium and short-term sales agreements with offtakers in the various identified markets (Section 3 of the *Supplemental Report on Need Purpose, and Rationale* attached to the response to IR #JRP.146). The terms and conditions of such agreements will be developed based on, and in conjunction with, the sequencing of the Project phases and the outcome of the market access issue. Clearly, robust sales will lead to support for Gull Island first. If the market does not respond as expected – and sales are slow – then the lesser level of sales will tend to support the smaller Muskrat Falls first alternative.

Financing Availability

Financing issues are also important to consider when determining the sequencing of the Project. Muskrat Falls, for example, is the least costly option and it may be easier to finance and get started in advance of Gull Island, whose financing will be larger and thus more complex. The cash flows from Muskrat Falls then could be used to help finance the more costly Gull Island phase of the Project. Therefore, if the financial markets are tighter than expected when the Project is sanctioned, then Muskrat Falls could be favoured as the first phase of the Project.

Nalcor is considering all options in a prudent manner and will make the most financially sound decision based on the analysis of these external factors and consistent with the Investment Evaluation function described in Section 5.1 of the *Supplemental Report on Need Purpose, and Rationale* attached to the response to IR #JRP.146. Nalcor's Gateway Process will ensure that requisite levels of due diligence are conducted at each stage of the development process before a commitment of significant funds is made.

From a technical perspective, both sites have had significant engineering field investigations undertaken, and either site could be constructed first. It should be noted that the sequencing of sites would not result in changes to the predicted environmental effects associated with each phase of the Project.

Components of the Project

The timing of the components of each phase of the Project will be finalized during the detailed engineering and design phase of the Project. The sequencing of components is as described in Section 4.3 Volume 1 A of the EIS.

IR# JRP.148

Reservoir Preparation

Requesting Organization – Joint Review Panel **Information Request No.: JRP.148**

Subject - Reservoir Preparation

References:

EIS Guidelines, Section 4.3.2.2 (Alternative Means of Carrying Out the Project), Section 4.3.4 (Project Description – Construction), Section 4.5.1 (Environmental Effects) and Section 4.6.1 (Mitigation)

Related Comments / Information Requests:

CEAR # 277 (Fisheries and Oceans Canada)
CEAR # 278 (Memorial University of Newfoundland – John D. Jacobs)
CEAR # 285 (Hydro-Québec)
CEAR # 289 (Innu Nation)
CEAR # 291 (Sierra Club Atlantic)
CEAR # 292 (Environment Canada)
CEAR # 307 (Government of Newfoundland and Labrador)

IR # JRP.6, 28, 33, 37

Rationale:

The Proponent has failed to adequately justify the proposed approach to reservoir clearing as required by the EIS Guidelines and failed to provide all of the information requested by the Panel.

Section 4.3.2.2 of the EIS Guidelines requires the Proponent to "analyze and compare the design alternatives for the Project in relation to their environmental and social costs and benefits, including those alternatives which cost more to build and/or operate but which result in reduced adverse environmental effects or more durable social and economic benefits" (p. 16-17). Section 4.3.2.2 (a) further states that "a selection of reservoir preparation strategies is necessary to address (…) concerns, including economic, technical and environmental considerations which are to be evaluated in order to select and justify the proposed mitigation measures" (p. 17). Section 4.3.2.2 (g) states that the EIS "shall consider a selection of reservoir management strategies, including consideration of scheduling/timing of filling, rate of flow release, and proposed mitigative measures (…)" (p. 18). Section 4.3.4 (a) requires that the Proponent describe "(…) clearing and harvesting strategy and methods (e.g. labour requirements, transportation to processing facilities) and methods for eliminating wood debris" (p. 19).

Also, Section 4.5.1 requires a comprehensive qualitative and quantitative analysis of the predicted environmental effects (positive and negative, direct and indirect, short and long term) on the VECs of each project activity or proposed alternative. Finally, Section 4.6.1 states that the EIS "(…) shall identify and discuss the proposed mitigation measures (…)", and section 4.6.1 (d) requires a description of the approach to determine, develop and maintain minimum flow requirements (…) including fish habitat maintenance (…)" (p. 36-37).

The Department of Natural Resources (CEAR # 307) states in its review of the response to JRP.33 that since Nalcor cannot "discuss this information request" or provide the information requested (various GIS maps showing proposed infrastructure for reservoir clearing) until early January 2010, they cannot complete their analysis of the adequacy of the reservoir preparation material until that time.

Fisheries and Oceans Canada (DFO) determined that while the responses to JRP.28 are generally adequate, additional information is still required. DFO states that in response to JRP.28 (a) "minor changes in timing [of reservoir impoundment] can have significant implications for fall-spawning fish species" (CEAR # 277, p. 3). The preferred period for impoundment (August to October) extends over two seasons as defined by the Proponent in its comparative analysis (June-August and September-October). However, the Proponent does not indicate why these three months would be preferable to either July or November.

In its review of JRP.28 (c), DFO also stated that the mean annual flows in the Lower Churchill prior to the Upper Churchill are significantly lower than the flows observed in the past 30 years and that the "[m]inimum flows based on these lower flows would result in flows that have not been seen in the past 30 years". DFO also suggested that a compensation flow based on 30% of more recent mean annual flows would be "significantly higher than the 500m3/s proposed" (CEAR # 277, p. 3).

Requesting Organization – Joint Review Panel **Information Request No.: JRP.148**

Information Requested:

The Proponent is asked to provide the following:

a. **A cost-benefit analysis of partial versus full clearing of the reservoir area;**

Response:

The Reservoir Preparation Plan (Nalcor 2010), hereafter referred to as the Plan, is appended to this IR Response. The Plan provides details and a full discussion of the reservoir preparation plan including the selected clearing alternative. The cost-benefit analysis conducted as part of the Plan includes economic and environmental considerations of partial versus full clearing. The following provides an explanation of the methodology and assumptions employed for conducting the requested cost-benefit analysis, and the resultant conclusions.

Costs

The costs associated with clearing are subdivided into three components:

- Clearing costs (capital cost);
- Debris Management (operating cost); and
- Schedule premiums (the cost of delays to obtaining first power).

Each of these components is considered below.

Clearing Costs

The first step in estimating the cost of clearing is to define the clearing methodology. The clearing process is defined as the cutting of trees within the areas designated for clearing and then transporting the trees to a location above the flood line. Only trees that have been defined as merchantable timber will be cut and moved above the flood line. Merchantable timber is defined as being 2.5 m or more in length with a top diameter not less that 9.1 cm and being of generally sound condition (i.e. no sap rot and less than 1 percent butt rot). Tree clearing will be completed with mechanical harvesters; removing the limbs and tops; using forwarders to move the de-limbed trees to the roadside; and trucking the logs to the nearest wood storage location. The tree tops, limbs and other vegetation, along with smaller deadfall on the forest floor (larger deadfall will be mechanically harvested where possible) is defined as non-merchantable timber and this material will be mechanically processed. The handling of this material is discussed further in response to IR# JRP148(b). Once the clearing methodology was determined, the next step in determining the cost of clearing was to determine the total volume of timber (both merchantable and non merchantable) that can be safely accessed, cleared and processed. Information from the following sources was used for this evaluation:

- LiDAR (Light Detection And Ranging) Survey and Orthophotography (2006);
- Bank Stability Study (AMEC 2008);
- Ecological Land Classification Study (Minaskuat 2008); and
- Reservoir Preparation Study (Enfor 1998).

The key outputs generated from the LiDAR and orthophotography included:

- Digital Elevation Model (DEM) - a grid-based model of elevation values created from the actual three dimensional location of each LiDAR data point;
- Forest type and canopy cover;
- Slope Analysis – a grid based model of topography created from the DEM;
- One metre contour lines – lines of equal elevation (1 metre intervals) created from the DEM; and
- High resolution photography – provided a detail view of the ground/forest cover.

As part of the 1998 Reservoir Preparation Study (Enfor 1998), an inventory was undertaken to assess the total volume of timber within the area to be inundated and adjacent to the new shoreline. For the forest inventory study, the area adjacent to the new shoreline was defined as those areas with an elevation within three vertical metres (m) of the full supply level (FSL). A limit on the horizontal distance that this area would extend from the new shoreline was later applied (i.e., 15 m from the new shoreline). The purpose of the inventory was to estimate the total timber volume within and adjacent to the expected flooded areas. The inventory followed the sampling procedure set out by the Newfoundland Forest Service for district-level forest management inventories. Using aerial photography, the area was classified into:

- Productive forest, consisting of various forest stand types;
- Non-productive forest; and
- Other land classes.

The productive forest class was further delineated into stand types on the basis of tree species, total stand age, and total tree height. The forest inventory data were geo-referenced.

Several ground truthing exercises were conducted to confirm the above information. For example, for the development of the forest inventory data, samples were collected from over 180 plots distributed throughout the area to be flooded. Members of a Nalcor reservoir preparation task force also visited the area in 2009 to confirm the accuracy of the forest inventory data. In addition, as part of on-going consultation with the Forest Services Branch of the Department of Natural Resources, the timber volumes are being further verified based on data collected by the Department of Natural Resources. The results of this verification exercise are not anticipated to change the overall result of the cost-benefit analysis as the initial forest inventory data was developed based on the methodology set out by the Forest Services Branch and incorporated data provided by the Forest Services Branch.

To facilitate the determination of the volumes associated with the reservoir clearing strategy selected, three reservoir zones were identified and evaluated (Figure 1):

- Ice Zone;
- Stickup Zone; and
- Flood Zone.

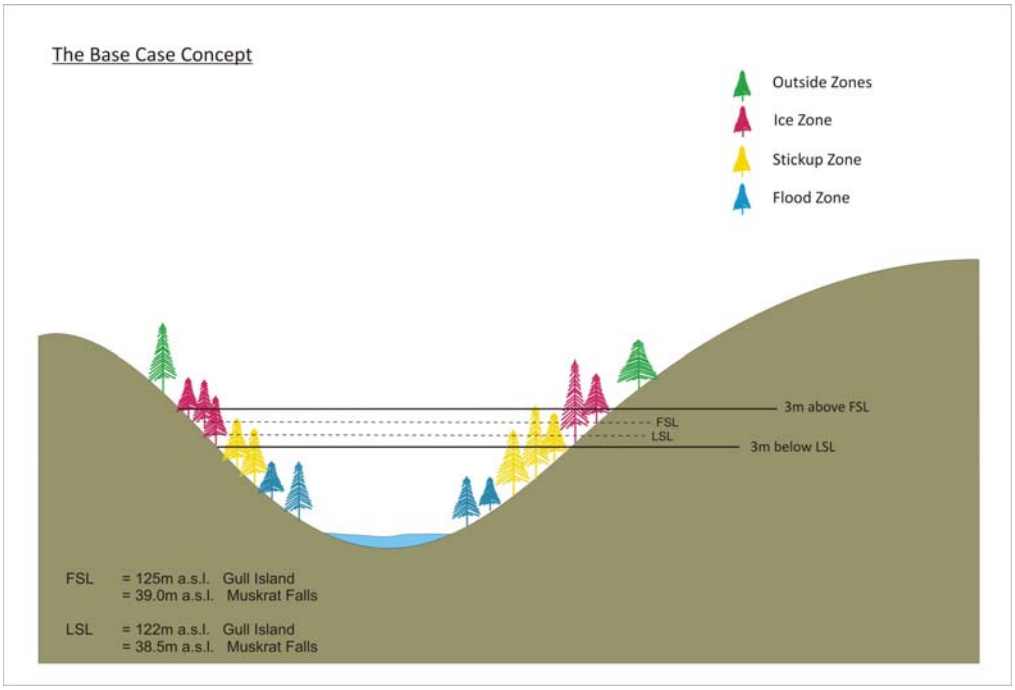

Figure 1 Reservoir Zones

The ice zone is defined as the band or zone along the shoreline on both the north and south banks of the reservoir between three metres above FSL (to a maximum of 15 m horizontally from the predicted new shoreline) and three metres below lower supply level (LSL). For the Gull Island reservoir this zone is between 128 m above sea level (masl) and 119 masl. For the Muskrat Falls reservoir this zone is between 42 masl and 35.5 masl.

As shown in Figure 1, the stickup zone is defined as the area below the ice zone where the base of a tree is below the ice zone; however, the top of a tree is sufficiently high to extend into the ice zone. These trees may be partially submerged when the reservoirs are at LSL or may be fully submerged just beneath the surface of the reservoirs. Trees in this zone can pose a hazard to navigation and may not be aesthetically pleasing. As well, ice formation around these trees when the reservoir is at LSL could result in trees being uprooted as the reservoir level rises which results in safety and navigation hazards.

The flood zone is the area below the stickup zone where the trees will be fully submerged after impoundment and the depth of submersion is sufficiently below the LSL (minimum of 3 m) such that it will not pose a hazard to navigation.

Full clearing would involve clearing of timber in all three zones, where it is safe to do so (slope ≤ 30%). Partial clearing would involve clearing of timber in the ice and stickup zones only, where it is safe to do so (slope ≤ 30%). The maximum slope upon which clearing operations could safely be conducted was lowered from the preliminary criteria provided in IR# JRP 6. This refinement was due to additional information regarding conditions in Labrador and equipment operation limitations gained through further analysis and discussions with the Forest Services Branch.

Standard forest harvesting best management practices and mitigation strategies would be applied to either clearing method to limit disturbance to the existing environment. For full clearing this would mean that a buffer zone (15 m) of undisturbed vegetation would be maintained along all existing tributaries and the main stem of the lower Churchill River to limit the potential for siltation resulting during pre-impoundment runoff events. For

partial clearing, this buffer zone would be maintained along tributaries within the flood zone but would be at least 15 m along the main stem, and in most cases, much greater as it would consist of the entire flood zone area, which would not be cleared.

The following steps were followed in conducting the timber volume analysis for the partial clearing alternative to provide data on timber volumes and accessibility for each forest stand throughout the reservoir zones.

1. The first step in the process was delineation of the zones of analysis. Arcview GIS software (with Spatial Analyst extension) was used to carry out the volume analysis. The ice zone polygon file was derived from 1 m contour lines, and was defined as all areas from 3m below LSL to 3 m above FSL (to a maximum of 15 m horizontally from the new shoreline). The stickup zone polygon file was derived from LiDAR data and was defined as all areas below the elevation of the ice zone where tree tops extended above the lower elevation limit of the ice zone.

2. The second step was to ensure that forest inventory data were available throughout the zones being analyzed. The original forest inventory was extrapolated to the edge of the ice zone by reference to high resolution digital orthophotographs in those areas where the original forest inventory did not extend fully to the edge of the ice zone. In those areas where the forestry inventory data extended beyond the upper edge of the ice zone, it was clipped to the edge.

3. The third step was evaluation of accessibility of forest stands within the zones. First, slopes were calculated by reference to the LiDAR Bare Earth data, and then classified into accessible slopes (≤ 30%) and inaccessible slopes (>30%). Forest inventory polygons were processed against the slope classes to identify proportions of forest stands that were accessible which was defined as “local accessibility”. In some cases, a forest stand, or part thereof, was locally accessible by reference to slopes within the stand, but was not accessible because surrounding slopes prevented construction of roads into the stand. This aspect of accessibility was defined as “global accessibility”, and was evaluated with reference to the location of proposed access roads (which were located with reference to slope data and analysis of zone polygons).

Based on this analysis, the timber volumes were determined and results are presented in Table 1. Based on the timber volume estimates, a detailed cost was developed for partial clearing.

Steps 1 and 2 above, plus the global accessibility element of Step 3, were repeated for the full clearing option to develop a preliminary estimate of timber volume. The local accessibility element of Step 3 was not performed as based on its application to partial clearing, it was not expected to change the timber volume estimate appreciably. In addition, some simplifying assumptions were made in the analysis of the full clearing alternative as follows:

- While a complete inventory of timber volume was made for the full clearing option, the unit cost per cubic metre of timber for full clearing was assumed to be the same as that for partial clearing. This assumption is considered reasonable as there are no significant differences in conditions between the areas to be cleared under full clearing and partial clearing.
- No additional road construction or basic infrastructure would be required for full clearing. This assumption tends to understate the cost of full clearing as, any requirement for roads or basic infrastructure further increases the cost of full clearing.

With these simplifying assumptions, the timber volume estimates were determined and the results are presented in Table 1. Based on these timber volume estimates, the cost was developed for full clearing.

The results of this analysis concluded that full clearing would result in an additional capital cost of approximately $200 million to the Project - $150 million for the Gull Island reservoir and $50 million for the Muskrat Falls reservoir.

Debris Management

From an operational perspective, the primary benefit of any reservoir clearing for the Project is to reduce the amount of material that will contribute to trash and debris at the generating facility. Floating trees and vegetation resulting from impoundment and reservoir stabilization during operations will move downstream and collect at the intake and spillway structures of the generating facilities. This becomes an issue during operations as trees, trash and debris builds up on the trashracks; reducing the available head and lowering the efficiency of the generating facility. Floating trees and vegetation can also obstruct the proper operation of spillway gates. Eventually the trash and debris will have to be cleaned from the intake facility and disposed of. Full clearing will decrease the volume of trash and debris affecting the generating facility and associated debris management costs. However as demonstrated in the following paragraphs this reduction is predicted to be minimal.

The main zones contributing to trash and debris generation are expected to be the ice and stickup zones. By definition, these are the zones that are subject to wind, wave and other natural erosion processes (such as ice) during reservoir stabilization and operations. Timber located within the flood zone is expected to have minimal contribution to trash and debris volumes. Once the reservoir is impounded much of the timber within the flood zone will become water logged and will not float. As well, timber within the flood zone will be fully submerged and will not be subject to wind and wave action or influenced by ice formation.

Table 1 Volume Summary for Full versus Partial Clearing

Reservoir	Clearing Option	Area Cleared (ha)	Additional Clearing (ha) [1]	Volume Cleared (1000 m^3)			Area Uncleared (ha)	Volume Remaining (1000 m^3)		
				Merchantable	Non Merchantable	Total		Merchantable	Non Merchantable	Total
Gull Island	Partial	1000	400	258	33	291	8300	1113	170	1283
	Full	3800	400	655	97	752	5500	722	107	829
Muskrat Falls	Partial	1800	500	470	58	528	2500	251	33	283
	Full	3300	500	601	75	676	1000	121	16	138

Note:
[1] Limited additional clearing is expected to occur outside the reservoir zones, related to; habitat enhancement (e.g. related to hardwood habitat as described in IR# JRP.102, access roads, and wood storage areas for both reservoirs. These activities are also reflected in volume cleared values.

Once safety and environmental constraints are applied (slope restrictions and buffer zone around water bodies), the same volume of timber will remain in the ice and stickup zones, regardless of whether full or partial clearing is carried out. If full clearing were to be implemented any additional clearing would only occur in the flood zone. Based on experience on the Le Grand Project in James Bay (Societe d'Energie de la Baie James 1988), a high level comparison of anticipated levels of debris (based on volumes remaining in the reservoir) and an associated cost for debris management have been developed (Table 2). As shown in Table 2, regardless of the level of clearing selected the anticipated difference in the volume of trash and debris will be minimal. The same basic level of trash and debris handling equipment will be required regardless of the clearing option selected. The increase in the cost of debris management under the partial clearing option due to the difference in the cost of handling the small increase in trash and debris from the flood zone is predicted to be minimal.

Table 2 Cost Estimate Debris Management (Full Clearing vs Partial Clearing)

Reservoir	Clearing Option	Volume Remaining in Zone (1000 m^3)		Level of Debris Generated (1000 m^3)			Cost of Debris Management ($50/$m^3$) (millions of dollars)
		Ice and Stickup	Flood	Ice and Stickup	Flood	Total	
Gull Island	Partial	466	817	179-465	41	220-506	11.0-25.3
	Full	466	363	179-465	18	197-483	9.85-24.15
Muskrat Falls	Partial	112	171	43-112	8	51-120	2.55-6.0
	Full	112	26	43-112	1	44-113	2.2-5.65

Because the difference in the cost ranges for partial and full clearing is negligible (i.e. the cost differential is not large enough to influence the selection of the preferred option) it is not considered further in this analysis.

Schedule Premium

A detailed schedule for partial clearing based on the volume analysis has been developed. For partial clearing, multiple work fronts and 24 hour a day operations will be required to ensure reservoir clearing is completed prior to impoundment. As indicated in Table 1 of this response, full clearing will require the removal of almost double the volume of timber as compared to partial clearing.

If full clearing were to be carried out prior to impoundment, given the limited area within which clearing operations can be carried out, increasing crew and fleet sizes and the number of work fronts, are likely to dramatically increase the unit cost of clearing operations. Alternately, interest during construction charges will be incurred and revenue will be lost when in-service for the facilities are delayed while full reservoir clearing operations are completed. A $200 million dollar premium is considered to be an optimistic estimate of these costs. These additional costs have not been included in this cost-benefit analysis as the actual cost increases are not known and expected Project revenues are preliminary. However, based on the final conclusion of the cost-benefit analysis that partial clearing is preferred, not including these costs would not change this conclusion and would only reinforce the selection of partial clearing as the preferred option.

Benefits

There are both quantifiable and non-quantifiable benefits associated with full or partial clearing. For example, the recovery of merchantable timber is considered a quantifiable benefit, while safe navigation and environmental benefits are considered non-quantifiable, and both are important considerations in the evaluation of these alternatives.

Recovery of Merchantable Timber

The reservoir clearing process will result in the generation of a raw material widely used in the forestry industry in the form of round wood logs. Consequently, the value of round wood logs has been selected as an appropriate measure of valuing the merchantable timber volumes recovered for purposes of the cost-benefit analysis. As shown in the following paragraphs, the additional value of the merchantable timber made available through full clearing is $17 million. If non-merchantable timber could be converted to wood pellets for no incremental cost, then an additional $3 million in value could be derived.

While the forestry industry has not been fully developed in Labrador, in an effort to identify parties interested in the development of the forest resource in Labrador, the Newfoundland and Labrador Department of Natural Resources has released an Expression of Interest with a close date of April 16, 2010 seeking proposals to develop forest resources. In the absence of firm proposals to develop secondary processing for timber made available from reservoir clearing operations, appropriate price references were sought.

Halifax Global Inc. noted in a 2006 report titled "Strategic Plan to Develop Labrador Secondary Manufacturing and Value Added Wood Products Industry" that the cost of wood delivered from Labrador to Island pulp mills was in the order of $70/m^3, including roughly $20/m^3 for barge transportation. The same report concludes that the cost of transport from the harvesting site to Happy Valley Goose Bay is $9/m^3 and harvester costs would also include an administrative fee of $8/m^3. If Newfoundland paper mills were prepared to pay $70/m^3, then the timber from reservoir clearing could be sold for $33/m^3 (i.e., $70 - $20 - $17). It should be noted that the wood referenced in the Halifax Global report was sold to the paper mill in Stephenville, which has since been shut down because it was no longer competitive.

A more recent market reference can be found in the Q4 2009 "North American Wood Fiber Review," which reports that round wood sold at maritime Canada mills for an average of $96 per dry metric ton, or approximately $50/m^3 (North American Wood Fiber Review 2009). In this case, the cost at the clearing site could be no more than $13/m^3 to be competitive (i.e., $50 - $20 - $17).

The production of wood pellets for fuel is also an emerging market, and historically wood pellet facilities have used waste material as feedstock. In many cases, this material is available for free or for a nominal cost. Demand for wood pellets is growing, and the potential exists for a facility to pay as much as a paper mill would pay for round wood. If this was the case, then a large scale wood pellet facility in Labrador could pay up to $50/m^3 for raw material. This establishes the value at $33/m^3 (i.e., $50 - $17).

The maximum price from these references is $33/m^3. Based on this price and the volume of timber removed the value of merchantable timber recovered is provided in Table 3.

Table 3 Value of Additional Recovered Timber (Full Clearing vs Partial Clearing)

Reservoir	Clearing Option	Volume Recovered (1000 m^3)		Value ($million)[1]
		Merchantable	Non Merchantable	
Gull Island	Partial	258	33	$9.6
	Full	655	97	$24.8
Muskrat Falls	Partial	470	58	$17.4
	Full	601	75	$22.3

Note:
[1] Based on a value of $33/m^{3}at a storage site

Additional discussion on indirect job creation through the establishment of secondary wood processing is discussed in the context of economy, employment and business in the following section.

Non Quantifiable Benefits

The following conclusions on environmental effects are based on the assumption that standard environmental mitigation for forestry operations will be applied.

- Atmospheric

  In terms of potential environmental effects on the Atmospheric Environment during construction, the partial clearing scenario is preferred. During the operations phase, the full clearing scenario is predicted to result in a negligible decrease in atmospheric effects. Considering the potential extended schedule requirements for full clearing which would delay offsets of Green House Gas (GHG) emitting energy sources, partial clearing is preferred for the Atmospheric Environment.

  Partial clearing would result in a decrease in fuel consumption and associated GHG emissions during the construction phase as opposed to full clearing. Similarly, there would be a decrease in the potential for generation of airborne dust.

  To predict and compare GHG emissions from the reservoir during the operations phase for the full and partial clearing scenarios, a Churchill River watershed carbon model was developed to consider all major carbon stocks, processes and fluxes. This carbon model was based on the original volume estimates for full and partial clearing prior to the safety and accessibility analysis. Based on the revised timber volumes provided in the safety and accessibility analysis, the difference from the original volume estimate was pro-rated to estimate the associated changes to GHG emissions for both the full and partial clearing methods. These values are provided in Table 4.

Table 4 Net Greenhouse Gas Emissions for the Project Using Intergovernmental Panel on Climate Change (2003) Tier 3 Calculation Methods

Emissions Calculation Method	Electricity Generation[A] (GWh/yr)		Total Tonnes (CO_2e/yr)		Emissions per kWh (g CO_2e/kWh)	
	Gull Island	Muskrat Falls	Gull Island	Muskrat Falls	Gull Island	Muskrat Falls
IPCC Tier 3 Net Emissions (Year 2 - No Clearing)	11,826	4,331	799,076	361,100	67.6	83.4
IPCC Tier 3 Net Emissions (Year 20 - No Clearing)	11,826	4,331	87,908	37,089	7.4	8.6
IPCC Tier 3 Net Emissions (Average –first 50 years - No Clearing)	11,826	4,331	194,584	85,691	16.5	19.8
IPCC Tier 3 Net Emissions (Average - first 100 years - No Clearing)	11,826	4,331	141,246	61,390	11.9	14.2
IPCC Tier 3 Net Emissions (Year 2 - Full Clearing)	11,826	4,331	710,850	321,243	60.1	74.2
IPCC Tier 3 Net Emissions (Year 20 - Full Clearing)	11,826	4,331	86,125	36,337	7.3	8.4
IPCC Tier 3 Net Emissions (Average - first 50 years - Full Clearing)	11,826	4,331	168,000	73,700	14.2	17.0

Emissions Calculation Method	Electricity Generation[A] (GWh/yr)		Total Tonnes (CO_2e/yr)		Emissions per kWh (g CO_2e/kWh)	
	Gull Island	Muskrat Falls	Gull Island	Muskrat Falls	Gull Island	Muskrat Falls
IPCC Tier 3 Net Emissions (Average - first 100 years - Full Clearing)	11,826	4,331	127,100	55,000	10.7	12.7
IPCC Tier 3 Net Emissions (Year 2 - Partial Clearing)	11,826	4,331	732,750	331,128	62.0	76.5
IPCC Tier 3 Net Emissions (Year 20 - Partial Clearing)	11,826	4,331	86,566	36,523	7.3	8.4
IPCC Tier 3 Net Emissions (Average - first 50 years - Partial Clearing)	11,826	4,331	171,400	75,200	14.5	17.4
IPCC Tier 3 Net Emissions (Average - first 100 years - Partial Clearing)	11,826	4,331	129,000	55,900	10.9	12.9

Note:
[A] Electricity generation was based on a generating capacity factor of 2,250 MW for Gull Island and 824 MW for Muskrat Falls, and an assumed capacity factor of 60 percent (Muller and George 1985)

As shown in Table 4 GHG emissions from the full and partial clearing scenarios are similar to one another. The GHG emissions from the Project will be low regardless of the clearing option selected (in relation to industry norms and in relation to the provincial, regional or national GHG emission totals (CEA Agency 2003)) as the reservoirs' configuration (deep and narrow) and location (northern climate) are governing influences. As a result, the level of clearing implemented will have minimal influence on overall levels of carbon degradation and GHG emissions. The predicted values of emissions for the clearing scenarios are provided in Figures 2 and 3.

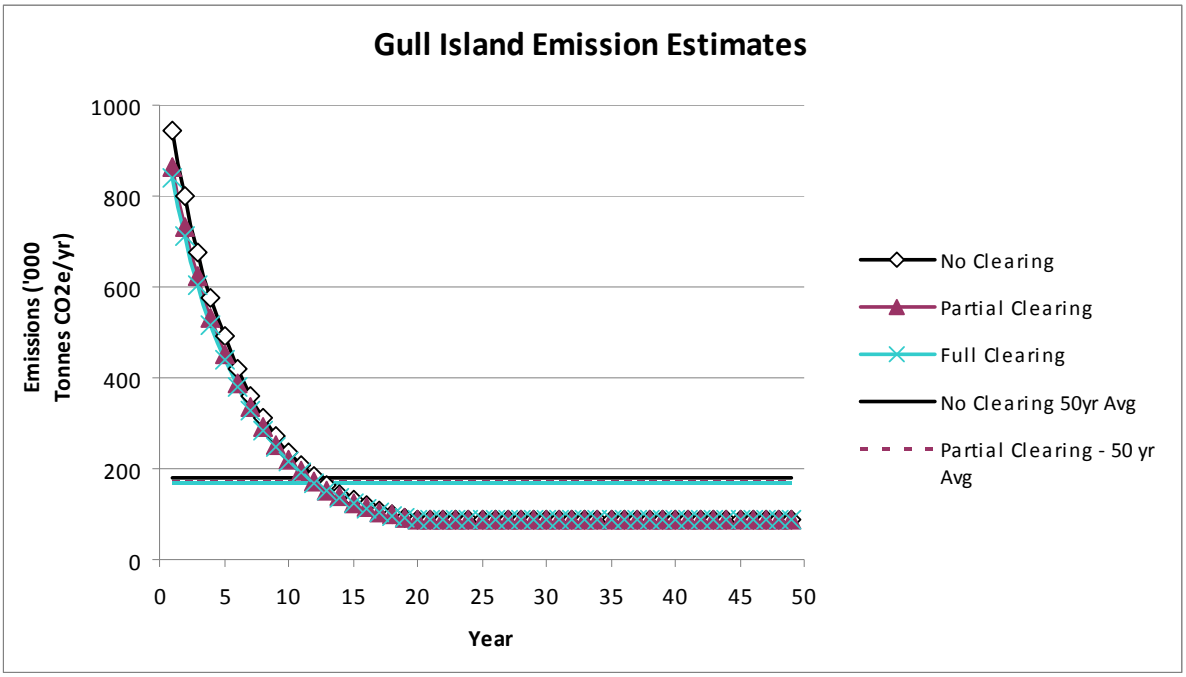

Figure 2 Gull Island CO_2e Emissions for Clearing Scenarios

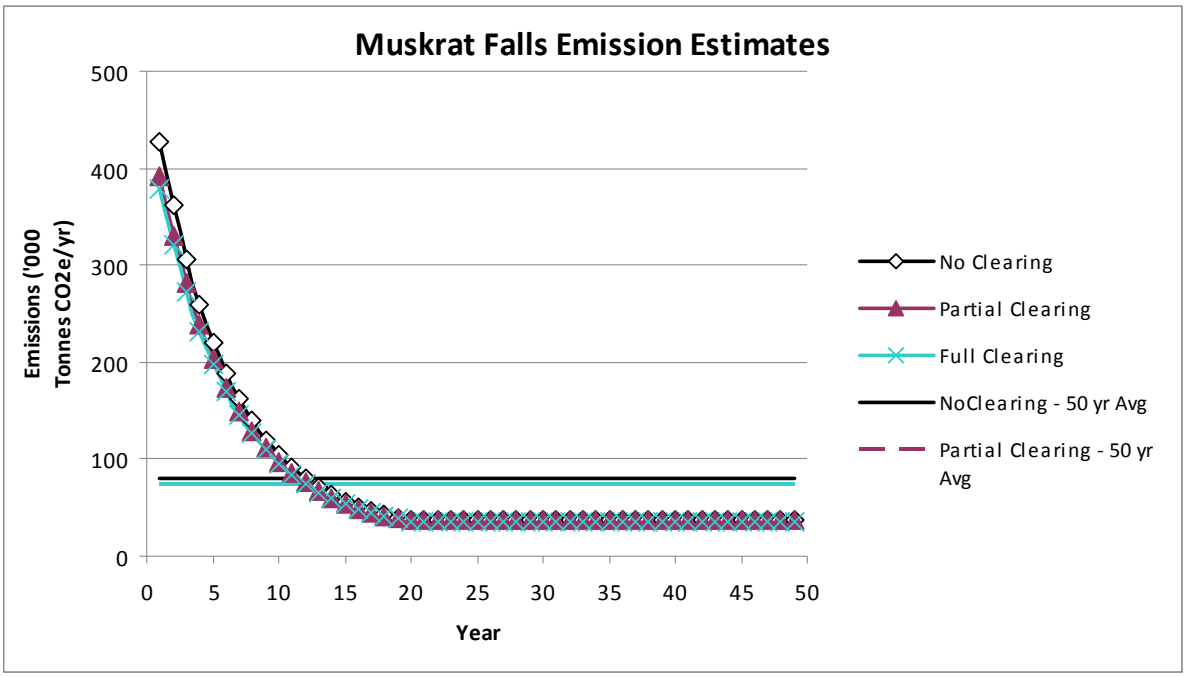

Figure 3 Muskrat Falls CO_2e Emissions for Clearing Scenarios

- **Fish and Fish Habitat**

During the operations phase of the Project, environmental effects from reservoir clearing on Fish and Fish Habitat will be the same regardless of the selected clearing option. Once impoundment occurs the fish habitat within the existing tributaries below the full supply level will be inundated. However, during the construction phase partial clearing is preferred.

Forest cover is important for the protection of Fish and Fish Habitat. The shading provided by riparian vegetation and the buffering offered by forest cover adjacent to rivers and streams helps regulate water quality and temperature through reduction of soil erosion, and moderates water level changes during periods of high run off (Scruton et al. 1997). The tributaries flowing into the Churchill River are important habitat supporting both resident fish populations and the recruitment of fish populations for the main stem of the Churchill River. It is important to maintain the existing productive capacity of the tributaries to contribute to the successful population and productivity of the newly-created reservoirs which will include engineered fish habitat. During the construction phase it is important to protect Fish and Fish Habitat during the period of time between when reservoir preparation begins, and impoundment occurs.

While both full and partial clearing alternatives include a buffer zone of undisturbed vegetation to remain adjacent to all water-bodies, only partial clearing includes extensive forest cover to remain throughout the flood zone below the LSL which is of benefit to protecting fish habitat during the construction phase. The summary in Table 1 shows substantially larger areas of uncleared forest habitat to remain in both Muskrat and Gull Island reservoirs as a result of partial clearing. The additional buffering capacity of this forest cover should help maintain more stable banks and minimize the amount of exposed soil that would be subject to erosion during the construction phase.

During the construction phase, full clearing is expected to have greater adverse effects on fish and fish habitat because the potential for erosion is substantially increased as a result of timber removal,

on-site mulch disposal and the exposure of mineral soils to run off events. In addition, while full clearing includes a relatively small increase in new access roads (5%), there are extensive skidder and harvester trails required within the flood zone. The resulting increased erosion may lead to increased sedimentation and nutrient loading of water-bodies that could adversely affect water quality through increased turbidity and decreased dissolved oxygen levels, particularly in smaller tributaries. Given that reservoir preparation is expected to occur over several years, certain sections of fully cleared lands may be left exposed to erosion and severe run off events for extensive periods of time, which will increase the likelihood of degradation of fish habitats prior to reservoir impoundment.

- **Terrestrial Environment**

With respect to the Terrestrial Environment, the presence of the reservoirs and surrounding vegetation will be similar with either of the clearing scenarios post-impoundment. However, several species of wildlife could have different abundances and distribution, in the years following the formation of the reservoirs depending upon whether full or partial clearing is implemented. Of particular importance for this comparison are those species with a relatively limited range within riparian habitats (e.g., wetland sparrows) and/or those that occupy riparian habitats seasonally (e.g., moose).

The preferred alternative of partial clearing was selected, in part, due to the ability to leave important refugia such as existing riparian habitat in place while areas are being cleared to allow new riparian habitat to establish above the FSL post impoundment (Figure 1). The progress of the riparian habitat development will vary from approximately 2-7 years (from the start of reservoir clearing until impoundment) and thus offer varying degrees of suitable alternative habitat during this time frame. The removal of forest cover (up to 15 m from shoreline) in the full clearing scenario may result in a greater loss of habitat at the earlier stages of the Project, displacement of wildlife, and lowered abundance through decreased productivity and increased mortality through predation and hunting. While these Project effects will also occur with the partial clearing scenario, the magnitude would be less than with the full clearing scenario.

- **Economy, Employment and Business**

Reservoir clearing activities will create economic, employment and business opportunities. These benefits will be realized for either clearing option, with a greater increase and/or longer duration associated with full clearing. However, regardless of the clearing option selected, local businesses and services will benefit through provision of required materials and services.

As presented in the response to IR #JRP.6, the estimated employment associated with full clearing will be 20% greater than that for partial clearing. Full clearing will provide an estimated 1,580 person-years (approximately 160 average person-years annually) of employment as compared to an estimated 1,300 person-years (approximately 130 average person-years annually) of employment associated with partial clearing.

In terms of indirect benefits from reservoir clearing, Nalcor Energy is fully engaged with the Forest Services Branch and is fully committed to supporting their efforts in developing secondary wood processing in Labrador regardless of the clearing option selected. To this end Nalcor Energy will be working with the Department in the current request for Expressions of Interest (EOI) for secondary wood processing in Labrador. Nalcor Energy will meet with potential wood processors to provide information on the volumes of timber cleared and the location of material.

The labour force requirements for secondary processing will become available upon finalization of the EOI process. Employment will increase for either clearing option, with a greater increase and/or longer duration associated with full clearing as full clearing would provide more raw material.

However, implementing the partial clearing option would not preclude clearing of additional material within the flood zone by a secondary wood processor, prior to impoundment, provided safety and Project schedule are not compromised. This activity would also be facilitated by the Project as harvesters would have access to roads and bridges constructed for reservoir clearing.

- **Communities**

Regardless of the selected option (full vs. partial clearing), clearing activities will result in negligible increased demand on infrastructure and services over the duration of clearing activities. Clearing activities will be limited to within the Project area, with limited use of the Trans Labrador Highway or other infrastructure.

In terms of Community Health, clearing of the reservoir has the potential to modestly reduce peak fish mercury levels in fish, by reducing decomposition rates and the associated production of methylmercury (MeHg). However, regardless of whether full or partial clearing is implemented reservoir clearing will result in effectively the same modest reductions (within the level of accuracy possible for predictions) in peak fish mercury concentrations (as compared to peak mercury levels calculated for a no clearing scenario), on the order of 10% for full or partial clearing.

The primary cause of increased MeHg levels in new reservoirs is increased decomposition in flooded areas, resulting in more activity by microbes that methylate mercury. The ecosystem becomes more efficient at converting inorganic mercury into MeHg. Estimates of readily degradable carbon pools in vegetation and soils can be used to provide estimates of the potential for reservoir clearing to mitigate increases in decomposition and associated increases in fish mercury levels. For the Lower Churchill Project, estimates of GHG emissions (tonnes CO_2e/yr) have been made for scenarios with no clearing, partial clearing and full clearing (Table 4). These differences in estimated GHGs were used to approximate differences in peak decomposition and MeHg production rates. For the purposes of this estimate, GHG estimates for Year 2 (post flood) were used as an indicator of peak rates of decomposition and peak fish MeHg levels that would follow. With no clearing, emissions are estimated to be 1,160,176 tonnes CO_2e/yr for the combined reservoirs (799,076 Gull Island, 361,100 Muskrat Falls). With full clearing, emissions are estimated to be 11% lower than no clearing in Year 2. With partial clearing, emissions are estimated to be 8% lower than no clearing in Year 2. Thus reservoir clearing is predicted to result in a modest reduction in peak fish mercury concentrations, on the order of 10% for full or partial clearing as compared to peak mercury level concentrations for no clearing.

- **Cultural Heritage Resources**

The effect of reservoir clearing on Cultural Heritage Resources will be the same regardless of whether full or partial clearing is selected.

Historic and Archaeological Resources will be recovered through 1) systematic data recovery (SDR), 2) additional field recording (AFR), and 3) systematic field recording and subsurface sampling (SFR and SS) (Section 6.5.5.1 of Volume III of the EIS; Table 6-3 of Volume III of the EIS). The locations of these sites have been identified, and will be recovered regardless of the clearing option implemented. In addition, a Historic and Archaeological Resources Contingency and Response Plan will be in place so that all Project personnel are aware of the procedures to follow if Historic and Archaeological Resources are discovered inadvertently during Project construction or operation and maintenance (Section 6.7 of Volume III of the EIS).

- **Land and Resource Use**

Regardless of the clearing option selected, the same level of navigability will exist on reservoirs. By definition, the ice and stickup zones will be the main areas in the reservoir that will contribute to

floating trash and debris during operations. Once safety and environmental constraints are applied, the same areas will remain uncleared in the ice and stickup zones regardless of the clearing option selected. The trees in the flood zone will have small contribution to floating trash and debris as shown in Table 2. As well, by definition, trees in the flood zone are sufficiently submerged below the low supply level as to not be a hazard to navigation.

Cost-Benefit Summary

A summary of the incremental costs and benefits for full clearing is provided in Table 5. Incremental costs and benefits are provided due to the commercial sensitivity of the capital cost estimates for partial clearing.

Table 5 – Summary of Cost-Benefit Analysis of Full versus Partial Clearing

Consideration	Partial Clearing	Full Clearing
Capital Cost	Baseline	Adverse. Full clearing will increase clearing costs by $200 million
Operating Costs	Baseline	Negligible difference
Schedule Risk	Baseline	Not quantified, but adverse.
Merchantable Timber Recovery	Baseline	Positive. Full clearing will harvest additional merchantable timber with a value of $17 million
Non-Merchantable Timber Recovery	Baseline	Positive. Full clearing will harvest additional non-merchantable timber with a potential value of $3 million if converted to wood pellets
Atmospheric Emissions	Baseline	Adverse. Vehicle emissions and dust will be greater than with partial clearing because of increased transportation requirements and additional road traffic.
GHG Emissions	Baseline	Similar to baseline
Aquatic Habitat	Baseline	Adverse. The larger clearing area removes buffer areas adjacent to habitat.
Terrestrial Habitat	Baseline	Adverse. Full clearing removes a refugia area during construction. Full clearing also increases the potential for erosion from the flood area and sediment deposit into the river during the construction period.
Economy, Employment, and Business	Baseline	Positive. Employment is 20% greater than for partial clearing. (Refer to response for IR#JRP.6)
Communities	Baseline	Neutral. Community health effects are neutral as methylmercury concentrations are similar for both full and partial clearing.
Cultural Resources	Baseline	Neutral. Sites locations have been identified and will be received recovered in both scenarios
Land and Resource Use	Baseline	Neutral. River navigability will be maintained in both the full and partial clearing scenarios.

The incremental economic cost of full clearing over partial clearing is ten times the value of the economic benefit derived. In considering environmental effects, the biophysical effects of full clearing are all adverse. The full clearing alternative also introduces considerable cost and schedule risk for the Project which have not been factored into the analysis, but if they were they would reinforce the conclusion that partial clearing is the preferred clearing alternative.

It should also be noted partial clearing makes a substantial amount of timber available for other uses, which could be the catalyst for some secondary forestry industry in central Labrador. In the event that timber in the flood zone is usable by a third party, Nalcor Energy will cooperate to facilitate the utilization of the timber by the third party.

To summarize, the economic cost of clearing the additional timber in the flood zone far outweighs its value as a resource, and environmental effects are generally adverse. As a result, on the whole, the costs of full clearing significantly outweigh the benefits.

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Requesting Organization – Joint Review Panel **Information Request No.: JRP.148**

Information Requested:

The Proponent is asked to provide the following:

b. Additional information on the preferred options for storage and eventual disposition of merchantable timber and identification of the preferred option for disposal of slash and implications on methyl mercury, along with a discussion of the advantages and disadvantages of this approach;

Response:

The preferred option for storage and eventual disposition of merchantable timber is to move the timber to an accessible designated pile down area, consistent with Provincial regulations. These designated wood storage sites will be lay down areas and will be located within the Project area, above the FSL of the reservoir. Although the preliminary locations of the wood storage yards have been determined, the locations will be finalized in the detailed design phase. The preliminary locations are included in the Reservoir Preparation Map Book which is included as part of this response as an attached report (Nalcor, 2010).

This merchantable timber will be available for removal by a secondary wood processor. Pre-impoundment, these areas could be accessed via the reservoir clearing roads. Post-impoundment, a secondary wood processor, or other land and resources user, could access these areas via a barge (the water velocity on the reservoir will be lower than the river velocity pre-impoundment, thus allowing safe access by barge); in winter via snow roads; or over the stable ice cover that will form on the reservoirs. The provision of access infrastructure post impoundment would be the responsibility of the wood processor or land and resource user. Beyond the access roads that will be constructed for the purpose of reservoir preparation, additional access will not be provided by Nalcor Energy.

The preferred alternative for disposal of slash (non-merchantable material) is mulching. However, burying of non-merchantable timber may be carried out in select areas where there is excessive windfall on the forest floor. The locations of these areas will be determined during reservoir clearing operations. Mulching will not require material to be gathered up and transported to collection points and will minimize the amount of non-merchantable material that could interfere with the operations of the generating facility post impoundment. Mulching will be done with a large, purpose built disc-type hammering device to break up the woody material so that it will lay flat on the forest floor and tend to become water logged from rain and snow cover which is expected to accelerate the rate of decomposition. The time between mulching and impoundment will be 1-2 years at a minimum and will be in the range of 2-6 years in the majority of the cleared area.

The implication of the selected method for the disposal of slash on methylmercury is small as it was estimated that this material will account for less than 4% of the total amount of material contributing to methylmercury creation, based on the following:

- As stated in IR# JRP.148a the primary cause of increased methylmercury (MeHg) levels in new reservoirs is increased decomposition in flooded areas, resulting in more activity by microbes that methylate mercury. The presence of readily degradable carbon pools in vegetation and soils contributes to increases in decomposition and associated increases in fish mercury levels. However, the portion of the carbon pool in vegetation (both merchantable and non merchantable) is lower than the portion in the soil. In a study conducted by Hydro Quebec in 2007 (Hydro Quebec, 2007)

vegetation accounted for 13 to 22% of the initial pool of degradable carbon, leaving 78 to 87% in the soil layer;

- In cleared areas, merchantable timber will account for almost 90% of the vegetation present (and a similar portion of the degradable carbon) and will be removed;
- Of the 10% vegetation remaining (i.e. non-merchantable timber) it was assumed that all of this material would decompose in the early years after flooding. The total volume of cleared non-merchantable material for Gull Island and Muskrat Falls reservoirs is 91,000 m^3 for the partial clearing scenario. It was estimated that this volume would contain roughly 41,000 tonnes of carbon. This mass of carbon, if fully decomposed, is approximately 4% of the estimated 1,063,878 tonnes CO_2e/yr for the combined reservoirs and would represent a similar portion of it's overall contribution to peak mercury levels;
- In addition, some of the non-merchantable material included degradable carbon estimate will be above the FSL and will not actually be a source of degradable carbon in the reservoir; and
- Mulching of non-merchantable material from 2 to 6 years prior to flooding will also result in a portion of this carbon pool decomposing prior to flooding. Pre-flood decomposition would not contribute to increases in fish mercury levels.

Overall, it was concluded that the method of disposal of cleared non-merchantable material will not have a significant effect on fish mercury concentrations. Other advantages and disadvantages of mulching as compared to other methods of disposing of slash are summarized in Table 1.

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Hydro-Québec. 2007. Complexe de la Romaine Étude d'impact sur l'environnement. Volume 3 - Milieu biologique (1 de 2).

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Table 1 Comparison of Approaches for Disposal of Slash

Consideration	Approach			
	Removal Above the Flood Zone	**Burial**	**Burning**	**Mulching**
Technical Feasibility	Removal of slash from the flood zone would involve transporting it over long distances to prepared pile down areas. To collect slash and move it would be very difficult, and not technically feasible.	The large scale burying of slash is not a technically feasible option because it would require a major collection effort to minimize the ground disturbance. Small scale burying of slash may be a technically feasible option in areas where slash is excessive.	On other projects there were problems with trying to burn slash. Excessive precipitation and humidity made burning difficult and created a fire hazard when conditions were ideal for burning. Burning only reduces the biomass to one third its volume; the remaining biomass would still need to be buried.	The preferred alternative is mulching. Mulching is considered the most technically feasible approach, since material collection will not be required, and will minimize the amount of slash that will become a problem as the mulch will not float after impoundment (Nalcor, 2010).
Economic Feasibility	Removal could be accomplished if the material was bundled. This would not be economically feasible unless a secondary wood-processor were to undertake this exercise as part of a wood pellet operation.	Due to irregular ground conditions and, based on the field visit conducted in October 2009, there are extensive areas of wind fallen trees. As a result, burying this material would require moving substantial volumes of additional material and would not be economically feasible. Small scale burying of slash may be an economically feasible option in areas where slash is excessive.	Burning is economically feasible.	Since material collection will not be required mulching is also considered the most economically feasible approach.
Atmospheric Effects	If slash were to be removed above the flood line a fire hazard may be created in the dry summer season (due to the piling of slash in windrows). If forest fire were to occur air quality would be affected. The removal of slash to above the flood line would result in a decrease to GHG emissions from the reservoir during operations but this amount would be small in relation to the total GHGs.	Atmospheric emissions and GHG emissions from the Project would not increase, provided that the bottom of the reservoir allows for wood waste to be buried sufficiently deep to induce anaerobic conditions and to adequately reduce soil oxygen content.	Burning will lead to increased air emissions from the Project due the burning of the material and will increase the potential for a forest fire and the associated emissions.	Similar to mercury the main source of decomposition (and GHG emissions form the reservoir) is the soil. The additional GHGs from the portion of mulch that that is submerged and has not decomposed mulch would be small in relation to the total GHGs.

Consideration	Approach			
	Removal Above the Flood Zone	**Burial**	**Burning**	**Mulching**
Aquatic Effects	The removal of slash above the flood zone would reduce woody debris within the reservoirs. While the volume of water through the reservoirs limits the potential for anoxic conditions to occur, any remaining material will slowly decompose and could potentially depress oxygen concentrations within deeper portions of the reservoirs.	There would be no increase to aquatic effects from the Project provided that erosion control is implemented where there is any risk to soil cover, and burial depths are adequate to prevent oxygen depletion of sediments.	Burning slash would not increase aquatic effects from the Project.	During the operations phase of the Project, submerged mulched material would continue to decompose and interact with the aquatic environment. During operations decomposition of material within the water column would utilize dissolved oxygen and potentially decrease its bioavailability. Given the water volume of the proposed reservoirs, as well as the high flushing rate, the limited quantity of mulch decomposition is not expected to change water quality throughout the reservoir, and any reduced dissolved oxygen which may develop is likely to be localized and temporary.
Terrestrial Effects	The removal activity would cause a certain level of human, noise and other disturbance. There would be some additional disturbance to wildlife species due to the storage of areas. There are no biophysical advantages in terms of nutrient cycling or other ecological considerations with removal as opposed to the other alternative to handle slash.	Burial would occur within the area of the inundation and hence not result in additional disturbance beyond the physical footprint of the Project. However, the burial option does not allow for any return of nutrients and organic material to the forest ecosystem.	Burning would occur within the area of the inundation and hence not result in additional surface disturbance although emissions and the potential for uncontrolled fire would increase. As the ash material would be left in place, there would be limited opportunity for the return of nutrients and organic material to the forest ecosystem.	Mulching would occur primarily within the area of inundation. As the material would be left in place within the area to be impounded, there would be no biophysical advantages in terms of nutrient cycling or other ecological considerations with mulching as opposed to the other alternatives to handle slash.

Consideration	Approach			
	Removal Above the Flood Zone	**Burial**	**Burning**	**Mulching**
Socio-Economic Effects	If the slash was collected by a secondary processor, there would be socio-economic advantages for removal of slash as a result of increased indirect employment. The remainder of the socio-economic effects would not likely be measurably different regardless of the disposal method selected for slash.	For the burial option slash would not be available for use by a secondary wood processor. The remainder of the socio-economic effects would not likely be measurably different regardless of the disposal method selected for slash.	For the burning option slash would not be available for use by a secondary wood processor. The remainder of the socio-economic effects would not likely be measurably different regardless of the disposal method selected for slash.	If the mulched material is collected by a secondary processor, there would be socio-economic benefits as a result of increased indirect employment. The remainder of the socio-economic effects would not likely be measurably different from those assessed in the EIS.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.148**

Information Requested:

The Proponent is asked to provide the following:

c. **A copy of the referenced report and material being prepared for the Department of Natural Resources on the preferred disposal methods and the environmental effects of burying wood waste as opposed to removing it from the site;**

Response:

A copy of the referenced report is attached and includes a discussion of the preferred disposal methods for wood waste and the associated environmental effects. Due to the commercially sensitive nature of contracting information and detailed cost estimates these appendices have not been provided the attached report.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.148**

Information Requested:

The Proponent is asked to provide the following:

d. Copies of the GIS maps showing proposed infrastructures for reservoir clearing;

Response:

Copies of the GIS maps showing proposed infrastructure for reservoir clearing have been provided as part of this response.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.148**

Information Requested:

The Proponent is asked to provide the following:

e. **A more detailed description of the effects of impoundment on fish and fish habitat by individual month. If the Proponent is committing not to carry out impoundment during certain months, these may be omitted;**

Response:

The optimal timing of impoundment would begin in August prior to most spawning of fall spawning species. This would minimize disturbance and maintain sustainable fish populations by protecting as many life-cycle stages as possible both within and downstream of the reservoirs. A compensation flow of 30% Mean Annual Flow (MAF) will be provided to maintain downstream fish habitat during impoundment for fish to spawn and eggs to develop. With initiation in August, it would be anticipated that impoundment of Gull Island reservoir would be completed by October. Muskrat Falls reservoir would be impounded much quicker and would likely be completed by September. Provided below is a description of the effects of impoundment on fish and fish habitat for fish within and downstream of the reservoirs.

The goal of minimizing disturbance and maintaining sustainable fish populations by protecting as many life-cycle stages as possible during impoundment was incorporated into the development of the most effective timing of impoundment. While the information request relates to a description of the effects of impoundment on fish and fish habitat by individual month, the potential effects are relative to life-cycle stage and the time period(s) associated with each. Therefore, the detailed description provided below is based on the various fish life-cycle stages, described with a monthly breakdown where it assists in the description.

The primary parameters that will affect fish and fish habitat during impoundment are:

1. The length of time required to fill the reservoirs (and hence the length of time at downstream compensatory flows); and
2. The potential effect on sensitive fish life-cycle stages.

The preferred inundation schedule from an aquatic effects perspective and disregarding other technical, economic and environmental considerations would be one that minimizes both of these potential effects listed above to the extent possible, both downstream and within the reservoirs.

The four fish life-cycle stages used by Fisheries and Oceans Canada (Newfoundland Region) are spawning, young-of-year, juvenile and adult (see Grant and Lee 2004). As stated in IR response IR# JRP.28, non-mobile life-cycle stages would be most susceptible to effects related to inundation as they cannot respond to habitat reduction/dewatering. Table 1 presents a monthly summary of interactions of sensitive fish life-cycle stages to reduced river flow during impoundment. In general, the most sensitive life-cycle stages are those that are non-mobile, associated with spawning (i.e., egg incubation/development and hatching) that cannot react to changes in water levels and/or flows. The extent of the effect on these stages are more sensitive downstream of the reservoirs, as eggs that are incubating within the reservoir footprint will not be dewatered during inundation.

Table 1 Sensitive Life History Stages of Aquatic Fauna for Reservoir Impoundment

Species	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Ouananiche	I	i	i	i	i	i	i	i	i	h	h							s	s	s	s	s	i	i
Brook Trout	I	i	i	i	i	i	i	i	i	h	h						s	s	i	i	i	i	i	i
Lake Trout	I	i	i	i	i	h	h	h									s	s	s	s	i	i	i	i
Lake Whitefish	I	i	i	i	i	i	i	i	i	h	h							s	s	s	i	i	i	i
Round Whitefish	I	i	i	i	i	i	i	h	h	h									s	s	s	s	s	s
Northern Pike								s	s	h														
Lake Chub											s	s	s	h										
Longnose Dace											s	s	h	h										
Pearl Dace									s	s	s	h	h											
Longnose Sucker											s	s	h											
White Sucker											s	s	h											
Burbot	S	s	s	s	s	s	h	h	h	h	h	h											s	s
3-spine Stickleback												s	s	s	h									
Sculpin										s	s	i	h											

Low Interaction
Moderate to High Interaction (s – spawning; i – incubation; h - hatching

As shown, there are two general spawning strategies employed by species within the lower Churchill River system; spring spawning and fall spawning.

Spring spawners typically begin activities (e.g., migration, site selection and egg deposition) after ice cover is broken and water temperatures and daylight hours begin to increase. Species that utilize spring spawning include Northern pike, Longnose and White suckers, and most of the smaller prey species. Due to increasing water temperatures during the spring, eggs laid require relatively less time to develop and hatch.

Fall spawners typically begin activities as water temperatures and daylight hours decrease. Species utilizing a fall spawning strategy in the lower Churchill River include the salmonid group (e.g., ouananiche, brook trout, lake trout and whitefish). Because water temperatures are decreasing in the fall, eggs require much more time to develop and therefore, hatching typically occurs in the spring after a relatively long incubation period.

In this respect, most species life-cycle stages are mobile during late summer (August); however, with the possible exception of May or June, reservoir inundation cannot be completed in a single month, especially during the time period when flows are typically the lowest. Impoundment during the summer low-flow period would increase the duration of impoundment activities. Estimated inundation timeframes with compensation flow are presented in Table 7 within IR response IR# JRP.28 and indicate that inundation of Gull Island reservoir will take between 28-34 days during the spring freshet (May-June) and 48-54 days in the summer low flow period (July-August). In addition to considering the timing of impoundment to offer the best protection for fish, the duration of reduced water can also have an effect; generally the shorter the time period the better. While the period of July to September would have the least overlap with non-mobile life-cycle stages, the time to impound would be the longest, and hence, fish downstream of the reservoirs will be subject to extended low-flow periods. In addition to low flows, this is also the time period when water temperatures would be highest and most stressful for fish. This would affect fish within the reservoirs less as water levels would rise during impoundment.

It should be noted that while mobile life-cycle stages are more capable of responding to reduced water flows, the potential for stranding of fish downstream of the reservoirs has also been considered in the effects of

impoundment and best timing. Many species may not move quickly enough to deeper refugia habitat or may move into deeper pockets of water that become isolated and small. In this respect, mitigations such as fish relocation activities will be initiated to collect and relocate stranded fish to suitable locations, to the extent possible.

References

AMEC. 2001. HADD Determination Methodology, Churchill River Power Project (LHP00-07) Churchill River, Labrador. Prepared for Newfoundland and Labrador Hydro, St. John's, NL.

Grant, C.G.J. and E.M. Lee. 2004. Life History Characteristics of Freshwater Fishes Occurring in Newfoundland and Labrador, with Major Emphasis on Riverine Habitat Requirements. Can. Manuscr. Rep. Aquat. Sci. 2672: xii+262p.

McCarthy, J.H., C.G.J. Grant and D.A. Scruton. 2007 - Draft. Standard Methods Guide for the Classification and Quantification of Fish Habitat in Rivers of Newfoundland and Labrador.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.148**

Information Requested:

The Proponent is asked to provide the following:

f. A rationale as to why pre-upper Churchill flow levels were used as the baseline for calculating minimum flows during impoundment; and

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Response:

Pre-upper Churchill flow levels were not used as the baseline for calculating minimum flows during impoundment. The winter low-flows identified in the IR# JRP.28(c) response related to the pre-upper Churchill Development were not used in calculations to obtain the minimum flow, but rather were presented to show that flows of this magnitude (i.e., 534 m^3/s) have been experienced within the river system.

The minimum flow estimation was based on the Mean Annual Flow of the existing river at the location of the Gull Island dam (i.e., 1,780 m^3/s – see page 2-17 Volume II A of the Environmental Impact Statement). Tennant's Montana fixed flow method (Tennant 1976) and a document compiled by Fisheries and Oceans Canada (DFO) and the provincial government of Newfoundland and Labrador to understand and address instream flow needs within the province (Gosse et al. no date) were used to determine the minimum flows during reservoir filling:

$$1{,}780\ m^3/s \times 30\% = 534\ m^3/s$$

While IR# JRP.28(c) stated that the approximate flow would be 500m^3/s, the actual value is 534 m^3/s.

References

Gosse, M.M., Brown, D. Scruton and A. Beersing. No Date. A Common Approach to Understanding Instream Flow Needs Assessment in Newfoundland and Labrador. Department of Fisheries and Oceans, St. John's, NL and Government of Newfoundland and Labrador Department of Environment, Water Resources Division, St. John's NL. 10pp., 3appendices

Tennant D. L. 1976. Instream flow regimes of fish, wildlife, recreation, and related environmental resources, In: J.F. Osbornes and C.H. Allman (eds) Instream Flow Needs Symposium, Vol II Bethesda MD: American Fisheries Society.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.148**

Information Requested:

The Proponent is asked to provide the following:

g. **Additional information on the potential for increased sedimentation of the reservoirs during impoundment and what mitigation is proposed.**

Response:

An increase in sedimentation (i.e., the processes of erosion, transport, and deposition of sediment) is often associated with newly formed reservoirs because new shorelines created by inundation begin to erode as they become stabilized. The eroded sediments from this, and upstream sources, settle out in the slower moving water of the reservoir. During the process of impoundment, however, the potential for increased sedimentation in the Gull Island and Muskrat Falls reservoirs is predicted to be low, especially if the time it takes to create the reservoir is relatively short.

The degree of sedimentation during impoundment is highly dependent upon multiple factors including:

- Erodibility of bank material;
  - Wave energy
  - Shoreline composition (also effects transport ability and settling velocity)
  - Shoreline geometry
- Slope failures (mass wasting); and
- Bottom substrate/Channel morphology
  - Frictional forces (affects water velocity)

Each of these factors is further influenced by the rate of reservoir impoundment. These processes and reservoir specific conditions are discussed further in the following paragraphs.

<u>Erodibility of Bank Material</u>

Well developed shorelines typically experience relatively slow erosion rates, due partially to the existence of offshore bars, which are typically associated with well established shorelines. The presence of the bar helps to reduce potential wave energies along the shoreline (Newbury and McCullough 1984). During reservoir impoundment it is unlikely that there will be any offshore structure available to buffer against wave action therefore the slopes of the impounded reservoir will be exposed to the full wave potential, which in reservoirs is predominantly wind driven (Kachugin 1963; AMEC 2008). During impoundment, the surface area of the water will increase, allowing for a greater overall distance over which the wind can generate and increase the size of waves (i.e. greater fetch). This typically results in larger waves within a reservoir when compared to pre-reservoir conditions. An increase in wave energy along a newly exposed stretch of shoreline will increase the amount of bank erosion, and thus allow new material to enter the developing reservoir. The rate of reservoir impoundment will also influence how much new material actually gets eroded.

The rate of water level rise during the filling of each reservoir will be relatively quick. Rate estimates for the Gull Island reservoir are as high as 21-27 m per day initially, with a minimum rate near 1 m per day as the inundation nears completion. Likewise, the Muskrat Falls reservoir fill rates are estimated to begin at 9-12 m per day with a final fill rate near 1 m per day as the reservoir is completed. These rapid fill rates will limit the amount of time the rising water level will have to interact with the shoreline and the effects of increased bank erosion due to fluvial erosion, i.e., wave scour and water flow velocity, are predicted to be minimal.

Slope Failures (Mass Wasting)

The banks along the lower Churchill River are generally high and steep, and in many cases are prone to natural slope failures. With an increase in water level, hydrostatic pressure exerted by the water body can work to add stability to the bottom portions of the bank as a reservoir fills. On the other hand, the increased weight within the bank itself due to saturation as the reservoir matures may have the reverse effect. As a whole, the banks initially become more unstable as a result of wave and water velocity effects acting on the newly exposed banks due to reservoir filling. The result of these erosional forces acting upon the new shoreline, which will essentially erode portions of the bank at the water's edge, could potentially lead to an increase in bank failures from undercutting effects. This would lead to new sediments being released into the reservoir system and would likely continue until a stable shoreline is created post impoundment. More information on the effects of reservoir creation (Muskrat Falls only) is presented in IR response IR# JRP.159.

Bottom Substrate/Channel Morphology

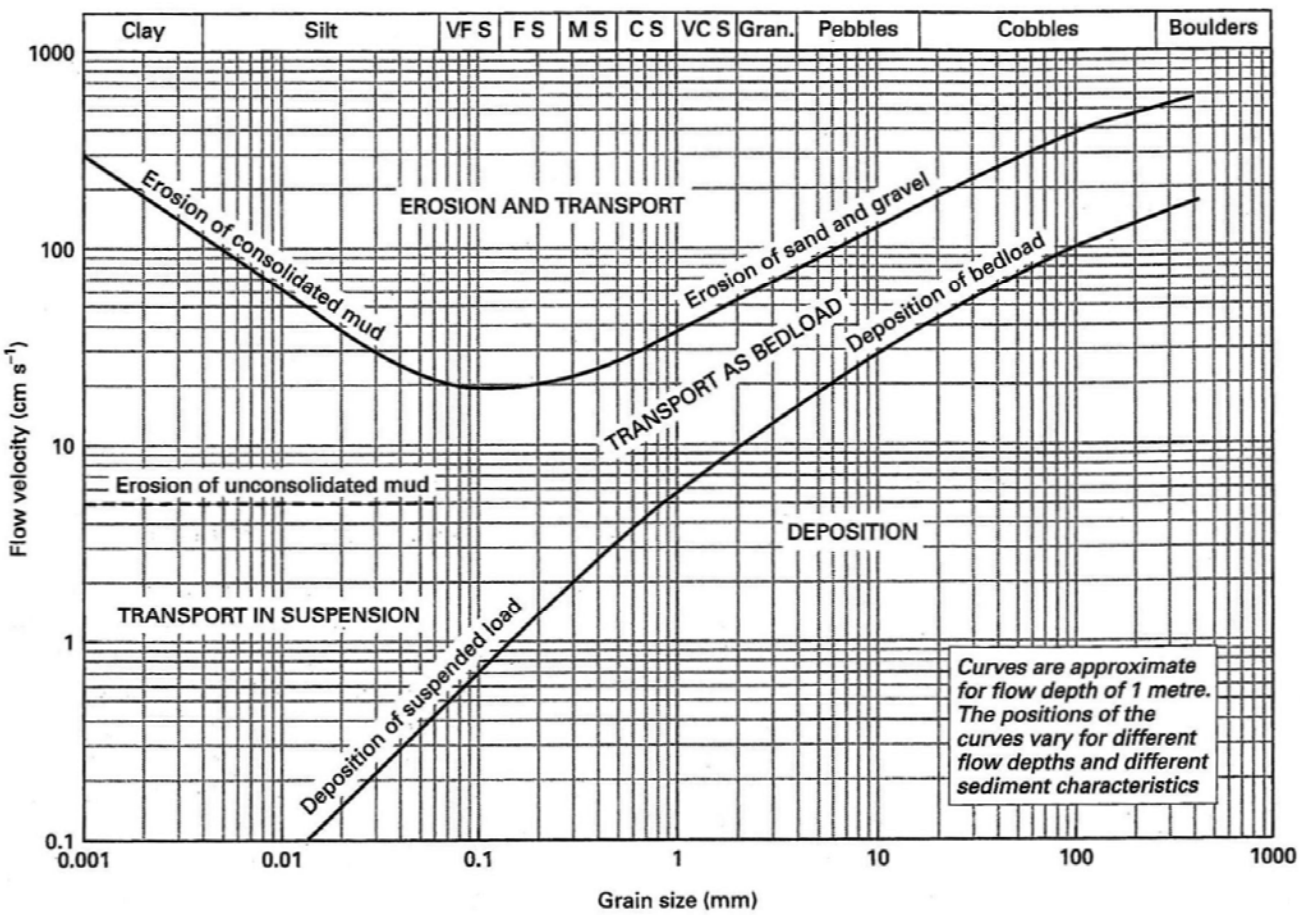
An increase in the transport and deposition of sediment in suspension and as bedload, during impoundment, is highly dependent upon the bottom substrate and channel morphology, as well as the velocity of water flow in the reservoir throughout impoundment.

- **Muskrat Falls Reservoir**

  Based on the soil types within the proposed Muskrat Falls reservoir and presented by AMEC in their 2008 slope stability report. It can be concluded that the slopes affected during inundation will be predominantly comprised of E4 and E5 soil types (see Table 1). For the most part both soil types are comprised of a very high percentage of easily transportable materials, i.e., sand, silt, and clay. Depending on the water velocity at each impoundment stage, all of these materials could potentially become suspended and transported within the water column. For instance, water velocities of approximately 1.0 m/s can transport the coarser size fractions of sand in suspension. At slower velocities, it would be deposited or potentially transported by bedload (see Figure 1). Again using coarser sands as an example, deposition would not typically occur until water velocities decrease to approximately 0.1 m/s. However, based on the slow velocities anticipated within Muskrat Falls reservoir during impoundment, i.e., order of magnitude of 0.01 m/s, it can be stated that the slit and clay size fractions, as well as some very fine sand would be transported in suspension once they enter the system with their rate of deposition depending on their settling velocity. At such low velocities, sediments larger than approximately 0.15 mm, would not likely be transported in suspension, or as bedload and would quickly be deposited; again the rate of deposition would be dependent on their settling velocity. Minaskuat (2008) determined the settling rate for silt and clay to be 21 and 0.6 meters per day, respectively. This means that silt will settle out of the water column at a much faster rate than clay, and because sand is of a larger grain size than silt, it will likely have a faster rate than that reported above.

Table 1 Soil classification and estimates of substrate composition within each, Churchill River (from AMEC 2008)

Class	Description	Estimated Substrate Composition	Habitat Classification
E1	- Blocky colluvial deposits - Terrain dominated by competent Bedrock	95% Bedrock 5% Boulder	Littoral Coarse
E2	- Morainal veneers (most rubbly colluvial deposits with high coarse fragment content)	35% Bedrock 55% Boulder 10% Rubble	Littoral Coarse
E3	- Morainal blankets - Glaciofluvial gravels - Soft, friable bedrock	30% Boulder 20% Rubble 25% Cobble 20% Gravel 5% Sand	Littoral Medium
E4	- Some morainal blankets steeper than 60%, or steeper than 30% if gullied or poorly drained - Fine textured lacustrine (silts and clays), glaciolacustrine, glaciomarine, glaciofluvial or aeolian silts, slopes less than 15% - Colluvial deposits derived from the above material with the same slope or moisture criteria - Colluvium derived from soft, friable rock steeper than 60% or steeper then 30% if gullied	5% Gravel 90% Sand 5% Clay	Littoral Fine
E5	- Fine textured lacustrine (silts and clays), glaciolacustrine, glaciomarine, glaciofluvial or aeolian silts, slopes steeper than 15%, or gullied or poorly drained - Glaciofluvial or fluvial sands with low bulk density, steeper than 30% or gullied or poorly drained - Peat, organic sols or tufa on sloping ground - Colluvial deposits derived from the above materials with the same slope or moisture criteria	40% Sand 40% Clay 20% Organics	Littoral Fine



Source: Nicholes, G. 1999. Sedimentology and Stratigraphy, Blackwell Science Ltd.

Figure 1 Hjulström Diagram, Showing the Relationship Between the Velocity of Water Flow and the Transport of Loose Grains

The net effect on the system during impoundment of the Muskrat Falls reservoir will likely be an increase in the amount of clay and silt that is transported in suspension, as well as deposition of sand and any larger sediments on the river bottom in localized areas, i.e., sediments larger than very fine sand would not be transported far from their source and deposition would be localized. It should be noted that due to the quick rate of filling, the quantity of material that would become eroded and enter the system and thus available for transport and deposition is predicted to be minimal; the one exception would be a potential slope failure which would have the potential to introduce a larger quantity of material into the system.

- **Gull Island Reservoir**

Again with reference to AMEC's 2008 report, the soil types present within the Gull Island Reservoir during inundation can be classified as E2 and E3 soils (see Table 1). Of these two soil types, and in the context of the water velocity expected within the area of the Gull Island reservoir during inundation (estimated average of 0.03 m/s), sand is the only material type that could be transported. Furthermore, it would only be the medium size fraction of sand and smaller that could potentially be transported as either bedload or suspended load respectively (see Figure 1).

This would mean that the vast majority of the material, once eroded, would be deposited close to the source. Depending on the stage of reservoir impoundment and the amount of material present, the larger substrate (large cobble, rubble, and boulder) could potentially act to armor the banks against further erosion. Figure 2 shows an example of larger shoreline material armoring a portion of the existing lower Churchill River as smaller substrates are moved by suspended or bedload transport.

Again, due to the quick rate of filling, the quantity of material exposed to erosion, and thus available for transport and deposition, is predicted to be minimal. The one potential exception would be a slope failure, similar to that mentioned above. Erosion within the reservoir would have negligible effect on bedrock.

Figure 2 Armouring of Shoreline Substrates, Lower Churchill River

Mitigation Measures

Limited options exist to mitigate increased erosion and sedimentation effects during reservoir filling. Methods described in the literature relate to erosion in reservoirs once they are filled and operating as this is when the majority of erosional forces and processes occur (see Proctor and Redfern 1980; Newbury and McCullough 1984; Bestman 1992; Allen 2001; Shin and Oh 2007).

The main mitigation measures which have been attempted with other projects have been to leave trees within the flooded zone as an artificial bar in an attempt to dissipate wave energy, and to artificially armor the shoreline to reduce the erosion of finer material.

The partial clearing option can also be considered a form of mitigation, as the uncleared areas in the flood zone will not be as susceptible to erosion and sedimentation effects during construction.

Given the short periods for reservoir impoundment, no mitigation measures are proposed to avoid sedimentation during impoundment.

References

Allen. H. 2001. Shoreline Erosion Control Plan, Lake Thunderbird, Cleveland County, Oklahoma. Prepared for Oklahoma Water Resources Board, Oklahoma City, Oklahoma. C9-996100-08.

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Baxter, R.M. 1977. Environmental effects of dams and impoundments. *Annual Review of Ecology and Systematics*. 8: 255-283.

Bestman, L. 1992. Bioengineering Technique of Reservoir Shoreline Erosion control in Germany. REMR Technical Note GT-SE-1.5. REMR Research Program, Germany.

Hecky, R.E. 1984. Thermal and optical characteristics of Southern Indian Lake before, during, and after impoundment and Churchill River diversion. *Canadian Journal of Fisheries and Aquatic Sciences*. 41: 579-580.

Kachugin, E.C. 1963. Some Patterns in the Reworking Process of Reservoir Banks. In: *The Stability of Slopes* [I.V. Popov and F.V Kotlov eds.]. Transactions (TRUDY) of the F. P. Savarenskii Hydrogeology Laboratory; v.35.

Minaskuat Inc. 2008. Lower Churchill Hydroelectric Generation Project; Water and Sediment Modeling in the Lower Churchill River. Environmental Baseline Report LCP#535725. Report prepared for Newfoundland and Labrador Hydro, St. John's, NL.

Newbury, R.W. and G.K. McCullough. 1984. Shoreline erosion and restabilization in the Southern Indian Lake Reservoir. *Canadian Journal of Fisheries and Aquatic Sciences*. 41: 558-566.

Proctor & Redfern Limited. 1980. Lower Churchill Hydroelectric Project Reservoir Preparation study - Final Report. Report prepared for Lower Churchill Development Corporation Limited, St. John's, NL.

Sekely, A.C., D.J. Mulla, and D.W. Bauer. 2002. Streambank slumping and its contribution to the phosphorus and suspended sediment loads of the Blue Earth River, Minnesota. *Journal of Soil and Water Conservation*. 57(5): 243-250.

Shin. E.C. and Y.I. Oh. 2007. Coastal erosion prevention by geotextile tube technology. Geotextiles and Geomembranes 25 (2007) 264-277.

JRP.148
Supplemental Information
Reservoir Preparation Maps for Gull Island

(Click above link to go to file)

JRP.148
Supplemental Information
Reservoir Preparation Maps for Muskrat Falls

(Click above link to go to file)

IR# JRP.149

Project Operating Regime (Water Levels)

Requesting Organization – Joint Review Panel **Information Request No.: JRP.149**

Subject - Project Operating Regime (Water Levels)

References:

EIS Guidelines, Section 4.3.1 (Need, Purpose and Rationale of the Project), Section 4.3.5 (Operation and Maintenance) and Section 4.5.1 (Environmental Effects)

Related Comments / Information Requests:

CEAR # 277 (Fisheries and Oceans Canada)
CEAR # 285 (Hydro-Québec)
CEAR # 289 (Innu Nation)

IR # JRP.28, 32

Rationale:

The Proponent has not provided sufficient information on how the required Water Management Agreement could impact the Project and how seasonal fluctuations in reservoir operating levels may impact fish and fish habitat.

Section 4.3.1(g) of the EIS Guidelines raises the issue of "in-stream flow variability" and other risk factors relevant to the decision to proceed with the Project. Section 4.3.5 (a) provides a detailed list of points to be discussed in order to describe the Project's operating regime and Section 4.3.5 (e) requires that the Proponent describe "all other requirements to operate the Project, including leases, water rentals and insurance" (p. 23). While the Proponent provided some information on the operating regime, little information is presented in the EIS or in the response to JRP.32 regarding the current status of the case before the Newfoundland and Labrador Board of Commissioners of Public Utilities (the Board) regarding the Water Management Agreement, and how an unfavourable outcome could impact the Project's viability.

Section 4.5.1 requires the Proponent to consider the effects of the Project on fish and fish habitat. Fisheries and Oceans Canada (DFO) determined that, while the responses to JRP.28 are generally adequate, additional information is still required. DFO states that, in the response to JRP.28 (e), there is no description of potential impacts associated with annual fluctuation in reservoir operating levels and during normal operation of the reservoirs: "[t]he proposed drawdown of up to 3 m each spring may seriously harm or destroy eggs that would be laid during the previous fall by some species in shallow waters" (CEAR # 277, p.3).

Requesting Organization – Joint Review Panel **Information Request No.: JRP.149**

Information Requested:

The Proponent is asked to provide the following:

a. **An assessment of the role of the pending Water Management Agreement with respect to risks to Project viability and environmental implications;**

Response:

The Water Management Agreement (WMA) has been concluded and terms were established by the Board of Commissioners of Public Utilities (the Board) in Order PU8(2010) on March 9, 2010. The approved terms are favourable and consistent with the version Nalcor Energy (Nalcor) filed with the Board. Therefore, Nalcor's expectations of the Project operating regime held throughout preparation the Environmental Impact Statement (EIS) have been unaltered by the decision of the Board and the effects predicted relative to Project operating regime remain valid.

The WMA plays an important role in mitigating risks to Project viability and environmental implications of the Project.

As indicated in Section 4.5.1.1, Volume 1A of the EIS, the *Electrical Power Control Act* requires the establishment of a WMA between operators on the Churchill River. Since the Churchill Falls generating facility and the Gull Island and Muskrat Falls generating facilities ("Lower Churchill facilities") share the same body of water, the rate of production at the Lower Churchill facilities is dependent on the release of water from the upstream facility at Churchill Falls, which in turn depends on CF(L)Co electricity sales. If Nalcor's sales from the Lower Churchill Facilities were not synchronized with sales by CF(L)Co, then Nalcor would either have to reschedule sales to coincide (after a delay for transit from Churchill Falls to the Lower Churchill), or draw down the reservoir. Alternately, during periods of high inflow, spillage may also occur if suitable markets cannot be found.

The WMA allows the Project to operate as described in Section 4.5.1.1 (Gull Island) and 4.5.2.1 (Muskrat Falls), Volume 1A of the EIS – which essentially tends to moderate peak flows and support low flows. Figure 1 illustrates this influence of the WMA on flows at Muskrat Falls in typical "dry", "wet" and "average" years. The more obvious period of moderation is in the spring when peak freshet inflow is retained for controlled release throughout the year. Throughout the balance of the year, the difference between the situation with and without the WMA is much smaller.

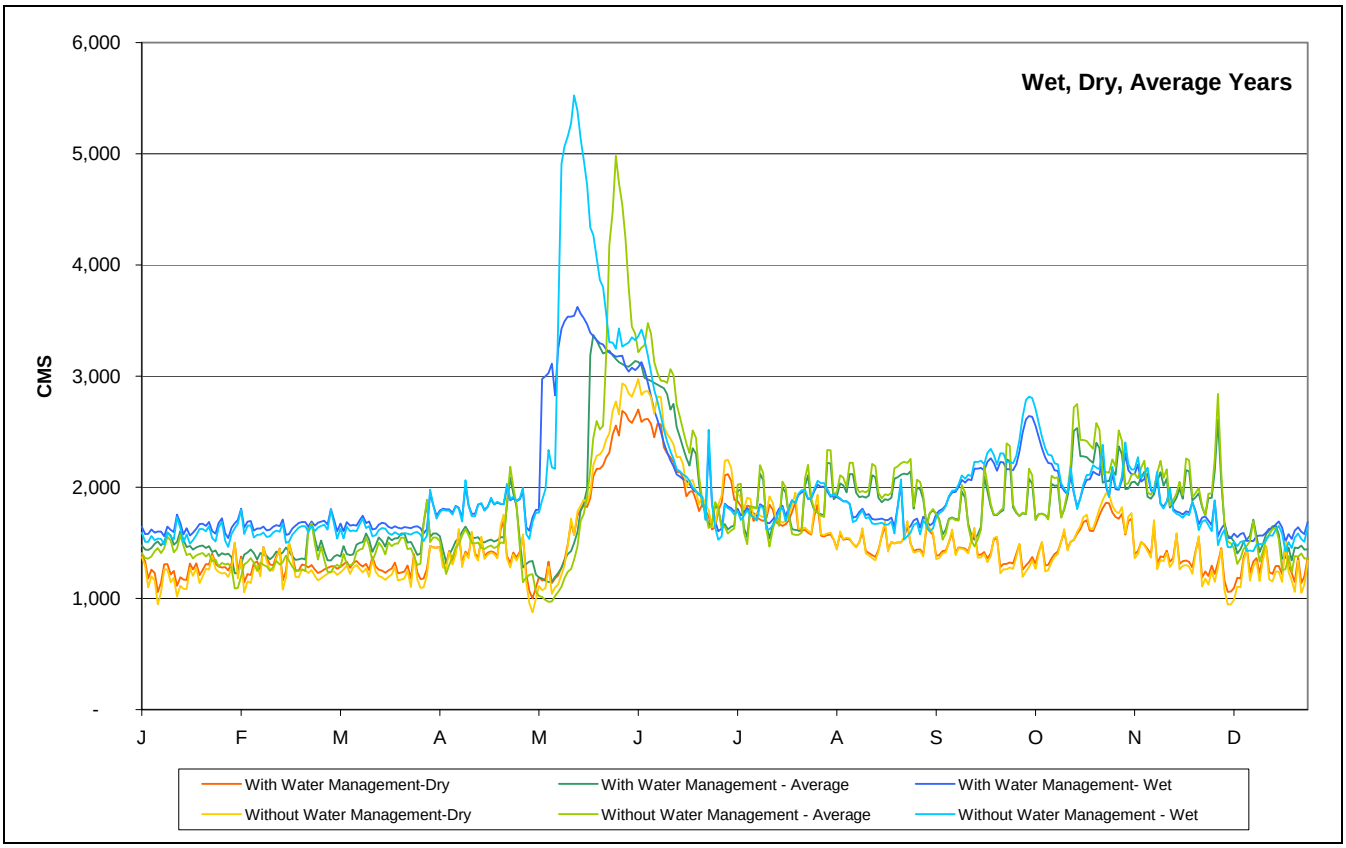

Figure 1 The Influence of the WMA on Flow at Muskrat Falls (Dry, Wet and Average Years)

As described in the EIS, the reservoirs will be operated as close to full supply level (FSL) as possible, with the potential to reduce reservoir levels in the spring to capture the peak freshet. This is consistent with the operating regime presented in the EIS.

The WMA will allow the maintenance of existing flow conditions downstream of Muskrat Falls. Figure 2 provides an overview of the mean, minimum and maximum daily flows at Muskrat Falls since the operation of the Churchill Falls facility. Future flow conditions downstream of Muskrat Falls will continue to occur between these limits.

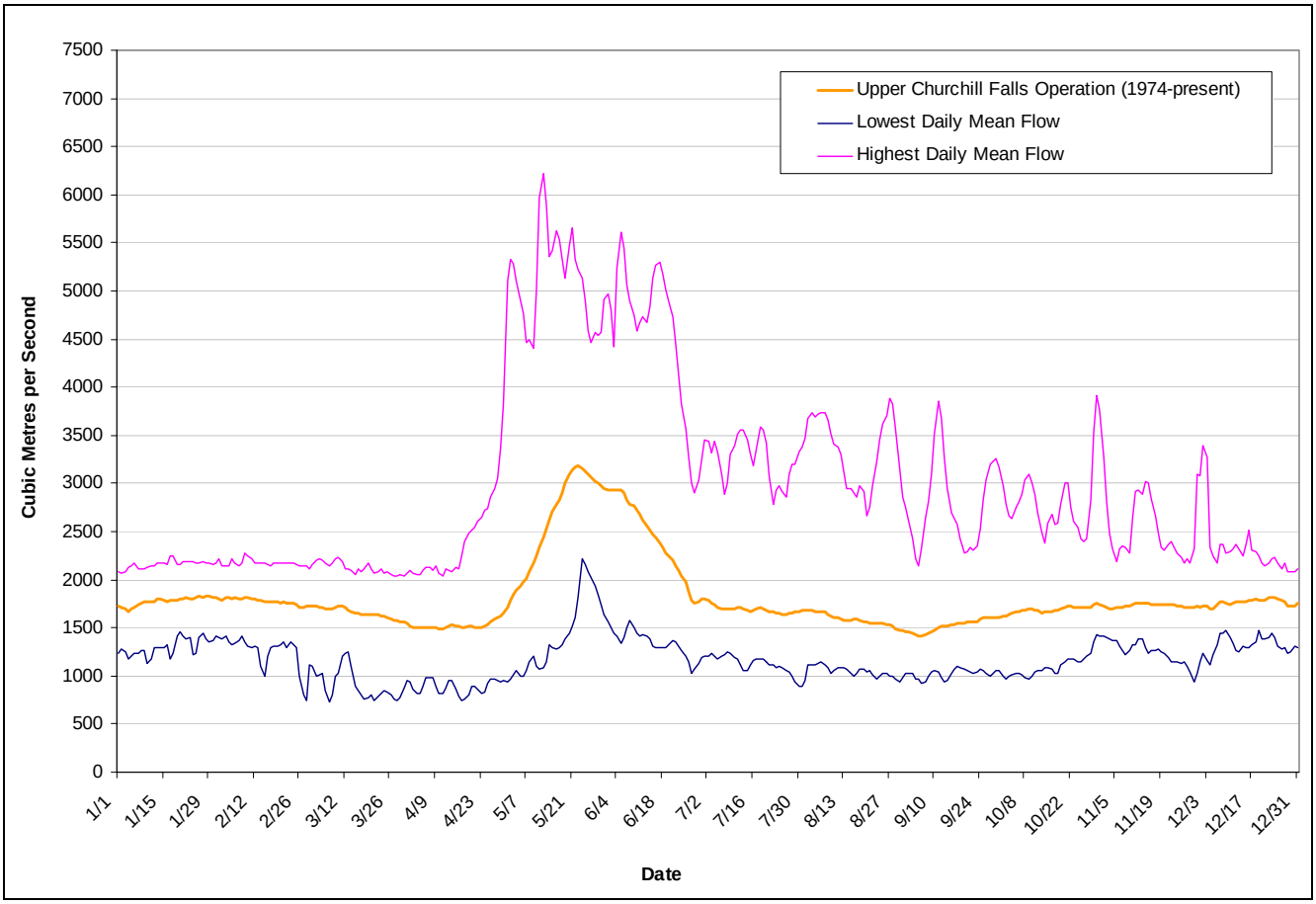

Figure 2 Mean, Minimum and Maximum Daily Flow at Muskrat Falls since the Operation of the Churchill Falls Facility, 1974-2008

The moderating effect on drawdown also occurs over a short term horizon - on an hour by hour basis. When inflows into the lower Churchill reservoirs are greater than those needed at lower Churchill facilities, the WMA will operate so as to increase production at lower Churchill, while simultaneously decreasing production at Churchill Falls. This control over production will cause water to be stored at Churchill Falls, inflows into the lower Churchill reservoir to be reduced and outflows from the lower Churchill facilities to be increased, thereby avoiding increases in water level and spillage in the lower Churchill reservoirs. Conversely, when inflows to the lower Churchill reservoirs are less than that required for production, production can be increased at Churchill Falls and decreased at lower Churchill. This increases inflows into the lower Churchill reservoirs and reduces outflows, thus reducing reservoir drawdown.

The operation of the WMA decreases the probability of spill and mitigates the risk that insufficient inflows will arrive from Churchill Falls to meet lower Churchill production needs. Consequently, the WMA increases the predictability of the operating regime, which in turn reduces in-stream flow variability, and therefore reduces the environmental implications of the Project.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.149**

Information Requested:

The Proponent is asked to provide the following:

b. An assessment of how demand fluctuations, seasonal operating conditions and transitional operating conditions (i.e. for the four year period between the time that Gull Island begins to produce electricity and Muskrat Falls comes online) are to be managed in terms of water flow, and how these fluctuations will impact the river system; and

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Response:

This question is interpreted to mean that a description is requested of how any fluctuations in water flow resulting from changes in production levels, seasonal operating conditions, or any transitional operating conditions may impact the river system.

In considering these effects of demand, seasonal operating conditions and transitional operating conditions, the current state of the river flow will be compared to the state after construction of the generating facilities on the river.

While flow on the Churchill River has been regulated since the commissioning of the Churchill Falls generating facility in the mid 1970's, flows on the Churchill River are quite variable. This is shown in Figure 3:

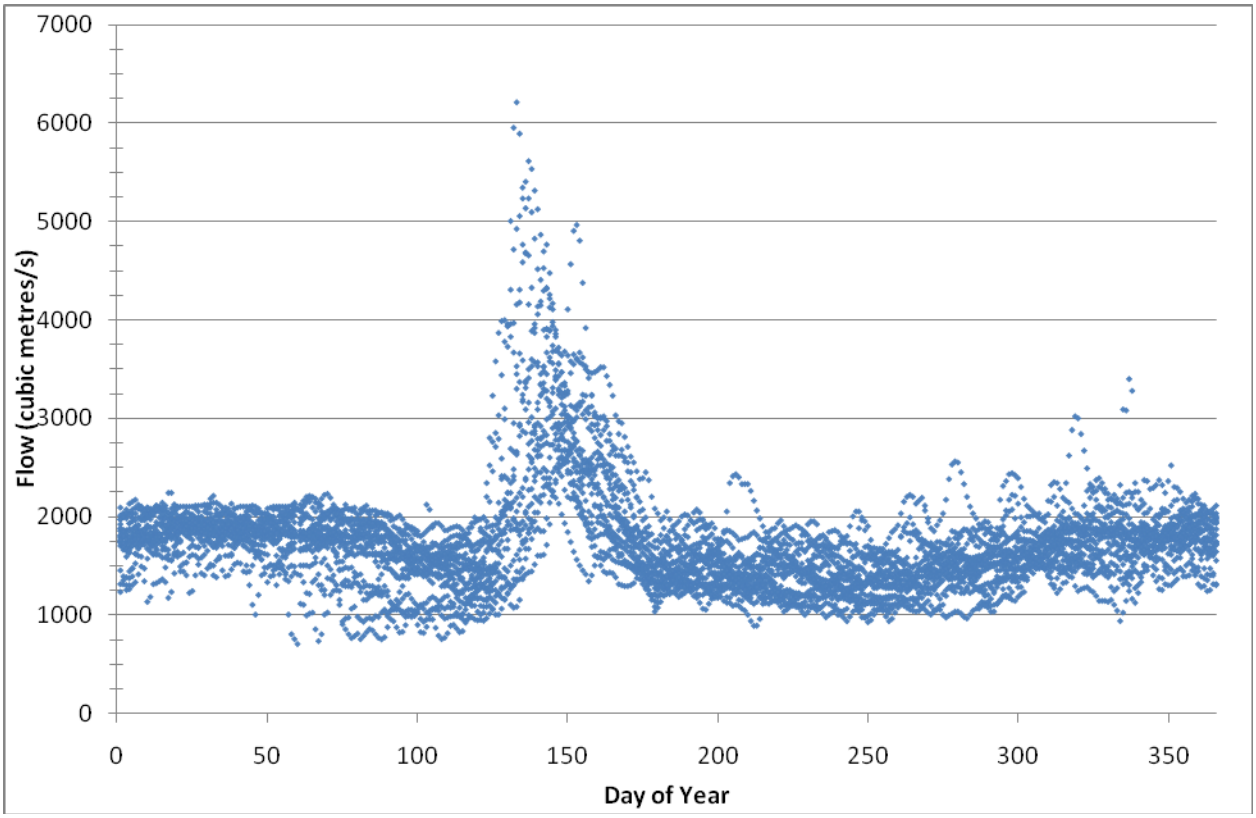

Figure 3 Daily Flow at Muskrat Falls since the Operation of the Churchill Falls Facility, 1974-2008

With the commissioning of generating facilities on the lower Churchill River, the river will be further regulated, and while flows downstream of a generating facility will vary on an hourly basis, they are expected to continue to vary within the limits of fluctuation that currently exist on the river.

Flows on the lower Churchill River are currently dependent on production at Churchill Falls and uncontrolled inflows below Churchill Falls, and are not currently managed. They are, rather, the result of upstream releases for power production and inflows from precipitation. The only restriction on production from the Churchill Falls facility is the one that has been previously described in the response to IR# JRP.32 – a minimum release of approximately 475 m^3/s.

The lowest recorded flow at Muskrat Falls since 1974 is 700 m^3/s, and this number reflects both local inflows downstream of Churchill Falls as well as the practical reality that Churchill Falls has not reduced output to minimum for any substantial period of time. To the contrary, its average production release is in the order of 1,400 m^3/s.

In summary, flows on the river are already variable, but the Project will not further increase the variability of those flows. The combination of the limited storage available at lower Churchill sites combined with the operating objective of maintaining reservoirs at full supply level requires that water be released at the same rate at which it enters. Furthermore the operation of the Water Management Agreement will serve to reduce water flows when flows are higher than required for sales requirements and increase them when flows are low. This will act to moderate fluctuations in flow.

The operation of the Water Management Agreement is also subject to operational limits of the turbine generator sets, as each facility has an operating envelope and unit limitations that restrict the operational flexibility of each plant. The dispatch of each plant will be established so that the combined demand requirements for Nalcor and CF(L)Co are met in the most efficient manner.

The operating envelope for the lower Churchill facilities will be:

Gull Island

Low supply level	122.0 m above sea level (ASL)
Full supply level	125.0 m ASL
Minimum turbine flow (2 units at 70% of rated output)	800 m^3/s
Maximum turbine flow (5 units at 98% of rated output)	2900 m^3/s

Muskrat Falls

Low supply level	38.5 m ASL
Full supply level	39.0 m ASL
Minimum turbine flow (2 units at 55% of rated output)	700 m^3/s
Maximum turbine flow (4 units at 98% of rated output)	2600 m^3/s

The minimum flow downstream of either Gull Island or Muskrat Falls will not be materially different than the minimum flow that has occurred since 1974. As a result of these operating constraints, minimum flows during the transitional period when only one facility is in service will be comparable to the minimum flows that have occurred on the river since Churchill Falls was placed in service.

The following sections discuss the variables raised specifically in the information request.

Demand Fluctuations

While, the ability to ramp production up and down is an important attribute of hydroelectric facilities, both Gull Island and Muskrat Falls have an operating envelope as described above. Operation within the operating envelopes will ensure that the minimum flows historically seen on the river are maintained.

Seasonal Operating Conditions

Any seasonal operating constraints that may be imposed are expressly considered when production is coordinated between the facilities. Following are examples of seasonal operating conditions:

- During early winter, constant Lower Churchill Facilities reservoir levels will likely be required to encourage the development of a stable ice cover. Dispatch will take place across Churchill Falls and Lower Churchill Facilities to facilitate this.
- The forecasted spring reservoir drawdown at lower Churchill will be achieved by increasing production at lower Churchill and increasing water storage above Churchill Falls prior to the spring thaw.

In each case, attention to the reservoir level is more important than maintaining a specific flow on the river.

Transitional Operating Conditions

Given the operating envelope of each facility, transitional operating conditions are not a concern.

Releases from Gull Island into the river downstream will be at least 800 m^3/s – the lower end of the plant operating envelope. This flow rate is slightly greater than the historical minimum flow on the river at Muskrat Falls, so minimum flows downstream of Gull Island will be maintained.

Releases from Muskrat Falls into the river downstream will be at least 700 m^3/s, which is also at least the historical minimum flow on the River at Muskrat Falls.

In either case, the release from either generating facility is at least the historical minimum flow on the Churchill River. Compensation flow will be provided during impoundment, as referenced in IR #JRP.148 f.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.149**

Information Requested:

The Proponent is asked to provide the following:

c. **A more detailed description of the impacts of proposed annual reservoir drawdown and related mitigation measures on fish and fish habitat.**

Response:

The proposed annual drawdown of the Gull Island reservoir has been described in the responses to IR# JRP.28 and IR# JRP.84. As previously noted, the overall variability in water level fluctuation is similar to existing conditions, both with respect to flow and level variability. (See IR# JRP.84 for a description of the predicted range in fluctuation and comparison to the existing regime). As summarized in IR# JRP.84, the lower Churchill River currently experiences variation in river water levels and the degree of variation is dependent on the location along the river. Although water levels in some locations currently vary up to 2.2 m, most of the river ranges between 0.5 and 1.6 m, with peaks typically occurring in May, and lows in September. The power production from the Churchill Falls facility also currently produces short-term fluctuations in water levels on a daily and weekly basis. With the creation of the Gull Island and Muskrat Falls reservoirs, there will be little variability in reservoir water level throughout most of the year, except for the late winter/early spring drawdown which could bring each reservoir to its Low Supply Level (LSL) (i.e., 122 m and 38.5 m elevations for the Gull Island and Muskrat Falls reservoirs, respectively).

The drawdown of the Gull Island reservoir prior to the spring freshet has been considered in the likely changes in fish habitat. Because the drawdown will occur prior to the spring freshet, it would most likely affect non-mobile life-cycle stages of fall spawning species such as salmonids that lay their eggs in the fall and which hatch in the spring (see IR# JRP.148e for a description of the potential effects of dewatering). Eggs deposited in areas that would be de-watered during the reservoir drawdown would most likely be lost due to desiccation and/or freezing. It should be noted that the reduction of water flow and decreases in water levels (hence, effects to fish habitat throughout the winter months) is a natural phenomenon in many unregulated rivers. It currently occurs in the lower Churchill River as well as a result of flow regulation by the Churchill Falls facility during the winter months. The annual variability within the lower Churchill River, particularly through the winter/late spring period (November-May) is evident in Figure 3. The concern related to the impacts of proposed annual reservoir drawdown on fish and fish habitat has been recognized and considered in the development of the Fish Habitat Compensation Strategy. For example, areas selected for physical compensation works associated with spawning and juvenile rearing, particularly fall spawning species, are being designed such that they will remain watered and viable during any drawdown to the LSL of each reservoir (i.e., 38.5 and 122.0 m ASL for Muskrat and Gull Island reservoirs, respectively). Additional information regarding the design of Fish Habitat Compensation is described in the Fish Habitat Compensation Strategy (IR# JRP.153). The impacts to fish and fish habitat resulting from drawdown are predicted to not likely be significant, as described in Section 4.15, Volume IIB of the EIS.

IR# JRP.150

Decommissioning

Requesting Organization – Joint Review Panel **Information Request No.: JRP.150**

Subject - Decommissioning

References:

EIS Guidelines, Section 4.3.6 (Decommissioning)

Related Comments / Information Requests:

CEAR # 291 (Sierra Club Atlantic)

IR # JRP.40

Rationale:

With respect to decommissioning, the EIS Guidelines require the following from the Proponent: "[t]he EIS will present an approach for the decommissioning phase of the Project, which sets out a commitment to address: environmental planning and mitigation measures; socio-economic mitigation measures; and public health and safety procedure" (p. 23).

Requesting Organization – Joint Review Panel **Information Request No.: JRP.150**

Information Requested:

The Proponent is asked to provide the following:

a. **Although the Proponent indicated that there are no plans to decommission Project-related facilities, the Proponent is asked to provide an overview of the range of options that exist for decommissioning hydroelectric facilities, including information on environmental planning and mitigation measures, socio-economic mitigation measures, public health and safety procedures and costs (order of magnitude estimates).**

Response:

Past history indicates that it is unlikely for large hydroelectric developments to be decommissioned after the 50 to 100 year life of the hydropower generating facilities. There are examples of dams being decommissioned; however, these dams are orders of magnitude smaller than the Lower Churchill Hydroelectric Generation Project (Project).

In most instances, large hydro facilities are given new life through refurbishment of the generating equipment, or in some cases, brand new powerhouses are built near the old facility. Either of these scenarios will most likely be the case for the Project, since hydropower will likely remain an economically attractive and environmentally sustainable means of generating electricity well into the future. In view of the substantial revenue stream that would be forgone by decommissioning and the significant cost of the decommissioning, Nalcor Energy (Nalcor) believes that decommissioning is a very unlikely event in comparison to continuing to operate and maintain the Project. Note that the first hydroelectric facility built in the Province at Petty Harbour in 1900 and the facilities constructed in Bay d'Espoir and Churchill Falls in the 1960's are still in service today with no plans for decommissioning.

However, a range of options is available for decommissioning. These options are outlined below and are discussed in detail in a report completed by Hatch (Hatch 2010) (Appendix B):

- Complete removal: This option involves reservoir draining and complete removal of the powerhouse, water retaining structures and other constructed facilities in an attempt to return the river elevations to pre-construction water levels and return the Project areas and the river to as close to preconstruction conditions as practical. If this option was adopted, careful planning and design would be undertaken as part of preparation of the decommissioning strategy to establish aspects such as: timing and sequencing of reservoir draining and in-stream construction activities; whether or not the dam would be removed all at once or through staged demolition over a period of time; how the sediment deposited behind the dam would be managed; and, how the river, including aquatic and terrestrial habitat would be rehabilitated. Overall, this option is anticipated to be the most expensive option to implement.
- Partial removal: This option would be similar to complete removal, but may be more cost-effective. This option would involve draining of the reservoir as a means to return the river to its pre-dam water levels and the river (but not the whole Project site) to as close to preconstruction conditions as practical, but major portions of the dam structure that are not in the main river channel would remain in place and these structures would require special treatment to avoid negative effects to the public and the environment. As long as these remaining structure(s) would not affect the

hydraulic conditions or the sediment transport characteristics of the river and/or create an unacceptable hazard to the local communities and the environment, they could be left in place. This option is anticipated to provide the same degree of river restoration opportunity as Option 1, but is expected to cost less since the overall demolition cost would be lower.

- Conversion to a self-regulating facility: This option would involve decommissioning of the Project generating structures and discharge regulating gates/valves, and retention of all or some portion of the dams and reservoirs. This would be accomplished by removing all gates/valves and modifying the spillways, and dam structures in the main river channel, to turn them into overflow spillways such that the water would flow unhindered over these structures. This option considers that although it is conceivable that the useful life of the Project for hydropower generation might end, the dam and reservoir might still have other beneficial uses. During the 50 to 100 years of operation, there could be recreational activities established on the reservoirs as well as productive aquatic and terrestrial habitats. If so, the complete removal of the dams and reservoirs would negatively affect these recreational uses and/or displace established environmental features. This option would be relatively easy to implement at the Muskrat Falls site since the two dams at this location are concrete structures and it could be possible to convert them to overflow spillway structures. However, the conversion of the Gull Island Dam would be more difficult because it is a concrete-faced rock-fill dam and would require major works to protect the downstream face of this dam. As a result, a separate overflow spillway would probably be required. Overall, this option may have the least environmental (i.e., sediment removal) and social (i.e., loss of recreational use) effects since the reservoirs would remain, but would result in long term operating and maintenance costs because the dams would remain in perpetuity.

Planning and Mitigation Measures for the Biophysical Environment

If undertaken, dam decommissioning would comply with the regulatory requirements in place at that time. Based on regulatory requirements, this would require the completion of an environmental assessment. This would likely also include developing an overall planning strategy for the decommissioning that would:

- identify the various conditions (e.g., silt behind the dam) and sensitivities (e.g., fish habitat which would be effected) that need to be addressed;
- evaluate appropriate methods, schedules, mitigation and reclamation strategies; and
- outline the general approaches/strategies that would be used.

For dam removal, important design considerations to mitigate environmental effects would include:

- Strategies to stabilize or remove sediment fill upstream of the dam;
- Strategies to address possible bank stability issues related to de-watering the reservoir;
- Strategies to re-vegetate the newly exposed river banks and flood plains;
- Timing and execution methodology for the actual dam removal;
- Staged removal; and
- The extent to which the removal follows engineering design criteria.

For complete dam removal, potential environmental effects could be mitigated by controlling the removal processes through staged dam removal to ensure that released water complies with water quality guidelines. The planning of the dam removal process could also include measures to promote the development of stable

channel geometry upstream of the dam and limit disturbance to the channel geometry downstream of the dam, including fish habitat.

A variety of strategies exist for mitigating the erosion of the sediment fill upstream of the dam. The methods may include:

- Removal of sediment behind the dam;
- Stabilizing the sediment by engineered measures or vegetation cover (either by allowing natural encroachment or a seeding program); and/or
- Partial removal and stabilization.

The selected option to control the sediment movement would need to meet regulatory requirements, be environmentally sound, and be economically feasible. Due to the size of the river, stabilizing the sediment fill in the main channel area of the reservoir could take extensive erosion protection works, as the discharge could create high shear stresses which will likely easily erode the fine sediments expected to deposit in the reservoir. In addition, de-watering of the reservoir would remove the hydrostatic pressure on the reservoir shoreline and most likely create slumping and mass movement of material into the lower elevations of the de-watered reservoir.

Careful control of the previously-flooded land restoration and sediment transport processes would also be important in the dam removal planning and design. These aspects would require detailed study in the evaluation of options for decommissioning the facilities.

In addition to these internal planning exercises, Nalcor would also participate in any environmental assessment process that exists at the time of decommissioning. This environmental assessment process would inform the public of the intention of dam decommissioning, the options to be assessed and record the public comments and issues. These concerns and comments would need to be evaluated and addressed in the decommissioning plan to reduce or eliminate environmental effects.

Planning and Mitigation for the Socio-economic Environment

Each of the decommissioning options would potentially have adverse and positive socio-economic effects on Economy, Employment and Business and Communities. It is not possible to quantitatively define these for each option or to develop appropriate mitigation measures because many factors can play into how the socio-economic effects may change over a 50 to 100 year period. Analyses of the socio-economic effects is more appropriately conducted at the time that decommissioning is being considered because it would provide meaningful information to select the preferred option and determine optimization/mitigation measures.

Socio-economic effects on Cultural Heritage Resources are not anticipated at this time as no new areas of disturbance would be likely.

The useful life of a dam can exceed the 50 to 100 year life of the hydroelectric power generating facilities. In the unlikely event that hydropower production has ceased, the dam might still have other beneficial applications such as flood control, recreation, water supply and low flow augmentation. As long as the dam remains useful to local residents, complete removal of it may not be the preferred option, and there may be opposition from different groups of people for various reasons. In addition, removing the dam could affect established land and resource use patterns within the naturalized habitats, particularly disruption or destruction of existing local fish and wildlife populations. Public concerns and issues, including potential effects to other infrastructure and employment and business, would be assessed through the applicable public process(es) (e.g., environmental assessment process), and appropriate mitigation measures developed at that time.

Public Health and Safety

From a public health and safety perspective, current regulations and industry practices for dams and hydropower facilities require owners of these facilities to protect the public from undue risk and harm. The Canadian Dam Association (CDA) has established guidelines for dam safety (CDA (2007)) that provides standards for designing, operating, and maintaining dams that achieve an acceptable level of public protection that exceed those for other industries.

In the unlikely event that decommissioning of the Project were undertaken, Nalcor would adhere to these dam safety guidelines and appropriate funding would be established to maintain the dams, as applicable and mitigation measures (i.e., sediment stabilization) to ensure that the decommissioned facilities, if left in place, do not deteriorate to the point where they become a hazard to the public or the environment.

Cost

Order of magnitude cost estimates were prepared for each of the three options described. As can be expected, there is quite a range depending on the degree of decommissioning planned.

Complete Removal	Partial Removal	Conversion to a Self-Regulating facility
Estimated Range $5.4 Billion to $8.1 Billion	Estimated Range $4.4 Billion to $6.6 Billion	Estimated Range $750 Million to $1.2 Billion

More detail on the development of these order of magnitude cost estimates is included in the Report included as part of this Response (Hatch 2010) (Appendix B).

References:

CDA (Canadian Dam Association). 2007. Dam Safety Guidelines 2007.

Hatch Ltd. 2010. Lower Churchill Project Decommissioning Overview.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.150**

Information Requested:

The Proponent is asked to provide the following:

b. The Proponent is asked to discuss how dam decommissioning would change environmental conditions, whether the pre-Project river system and associated habitats could be re-established and how long this might take.

Response:

How Dam Decommissioning Would Change Environmental Conditions

The changes in environmental conditions due to dam decommissioning will depend on the option selected, environmental planning and the mitigation applied. However, dam removal would represent a large and relatively fast (i.e., decades) change in river morphology at the dam location compared to natural rates (i.e., millenniums) and scales of normal river change. The reservoir, and the upstream channel and tributaries, would respond to the lowering of the water level through incision into the sediment fill in the upstream impoundment area forming new channels. This channel evolution would not necessarily return the impoundment area to its pre-Project condition. The channel changes could lead to a new equilibrium which would likely be different from the pre-damming channel form. This process of changing from a lake to a river environment would likely create changes in water quality (i.e., turbidity, acidity, and temperature) and fluvial geomorphologic changes such as braided channels, meanders, and cutbacks as the new equilibrium channel and floodplain are established, as described by Zhou and Donnelly (2002), Doyle (2002, 2003) and Heinz (2002).

Without proper control, the removal of a dam could have a profound influence on the subsequent geomorphic evolution of the impoundment area, as well as the extent and nature of the sediment effects downstream of the dam. Upstream from the removed dam, geomorphic processes could lead to bank failures as the channel forms if the channel depth increases above the critical value when the water level is lowered too quickly. With proper planning, mitigation measures can be put in place to minimize these effects.

A search was conducted for examples of dam removal projects and related effects. However, there is no history for decommissioning of large dams of comparable size to the Project. Some examples of much smaller dam removal projects were found and are cited in Table 1. Although the dams listed in Table 1 were much smaller than the Project dams, these examples are used to provide an illustration of some of the effects of dam removal on the environment.

Of these removals, the problems could mostly be attributed to poor planning of mitigation measures to deal with reservoir sediment mobilization.

Table 1 Summary of Some Sediment Transport Mitigation Techniques and Problems (Hatch 2010)

Dam	Date Removed	Height (ft)	Description
Willow Falls, Wisconsin	1992	18	• Significant post removal sediment transport degraded fishery for a short period. Additional dredging was planned. Trout fishery below the dam is now reported to be healthy.
Mounds, Wisconsin	1998	18	• Seeding, channel stabilization performed to mitigate potential sediment transport problems. However, post removal sediment transport degraded fishery for a short period. Additional dredging was planned. The river is now reported to be healthy.
Bluebird, Colorado	1990	17	• Sediment mitigation included seeding. Low flow channel allowed to develop naturally. Post removal studies unknown.
Woolen Mills, Wisconsin	1988	5.5	• Possible low level contaminated sediments in reservoir. Sediment mitigation measures included slow drawdown to allow low flow channel to form and seeding. • River habitat improved significantly 5 years after removal.
Jacoby Road, Ohio	1997	2.4	• Sediment mitigation measures included slow drawdown to allow low flow channel to form and seeding. • No post removal studies.
Fort Edward, New York	1973	9.4	• Removed in 1971 without proper assessments [1978 Federal Power Commission ruling]. 2600 m^3 (approx.) sediment dredged during dam removal. Removal released an estimated 23,000 m^3 of bedload materials from the former impoundment in 1974, with the amount increasing in subsequent years. From 1976 to 1977, over 470,000 m^3 of sediments had been dredged from the river simply to maintain navigation. In 1977 and 1978, approximately 138,000 m^3 of contaminated sediments were removed from the river by the state. And in 1983 the EPA declared a significant stretch of the river a federal Superfund site due to the PCB contamination (American Rivers et al., 1999).
Lewiston, Idaho	1973	13.7	• Reservoir completely filled with sediment. No mitigation precautions taken. • Post removal issues unknown.
Sweasey, California	1970	16.8	• Reservoir lowered slowly to allow low flow channel to develop. Sediment transport problems for 2 years after removal.
Nolichncky, Tennessee	1973	29	• Dam partially left in place to retain sediments. Significant sediment transport problems occurred over 2 year period.
Stronach, Wisconsin	2000	5.5	• Staged reservoir lowering (50 mm/month) was performed to permit low flow channel to develop. Post removal conditions not known.
Newaggo, Michigan	1969	20	• Removal produced a wave of sediment extending 5 miles downstream. Over 500, 000 m^3 of sediment expected to move down river for 50 to 80 years. However, sediment concentrations have remained within normal ranges.
Sandstone, Minnesota	1995	6.1	• No mitigation precautions taken. Sediments were allowed to wash downstream which caused problems.
Welch, Minnesota	1994	2.7	• Significant nontoxic sediment in reservoir allowed to wash downstream.
Waterworks, Wisconsin	1998	2.7	• Revegetation occurred naturally during construction. Sediment mitigation measures involved slow drawdown to allow low flow channel to develop.
Seven Pennsylvania	1996-99	1 – 4	• Revegetation occurred naturally during construction. Sediment mitigation measures involved slow drawdown to allow low flow channel to develop.

Dam	Date Removed	Height (ft)	Description
Mussels, Pennsylvania	1992	9.4	• 760, 000 m^3 of non-hazardous silt in the reservoir. Sediment mitigation measures involved staged drawdown to allow low flow channel to develop and downstream access road construction designed to serve as stilt trap. • 57, 000 m^3 (estimated) silt discharged after removal.
Fulton, Wisconsin	1993	NR	• Significant sediment in reservoir. Sediment mitigation measures involved construction of a sediment trap (37x 9x 2.4 m), dredging of stream channel, grading and stabilization of riverbanks. • Post-removal sediment problems affected fish habitat for 5 km downstream that are expected to abate in 5 years.
Hyman Falls, Wisconsin	1995	NR	• Significant sediment in head pond. Sediment mitigation measures involved construction of a sediment trap (60x15x1.2 m). • No post removal studies.
Prairie Dells, Wisconsin	1991	18.3	• Significant sediment in head pond. Sediment mitigation measures involved construction of a sediment trap (60x12x2.4 m) and controlled drawdown over 2 years to allow low flow channel to develop. Two years after removal, 30, 000 m^3 of sediment excavated from trap. Ongoing turbid events have had negative effect on fishery that was expected to continue for 5 years.
Elwha Giles Canyon, Washington	Planned	33 67	• Over 15 million m^3 of sediment in reservoirs. Expected severe effects for 2 to 5 years. Some effects expected for up to 10 years. Sediment mitigation studies are ongoing with preferred option being natural restoration.

Re-establishment of pre-Project River System and Associated Habitats

As stated above, channel evolution would not necessarily return the impoundment area to its pre-Project condition. The channel changes could lead to a new equilibrium which would likely be different from the pre-damming channel form. This process of changing from a lake to a river environment would likely create changes in water quality (i.e., turbidity, acidity, and temperature) and fluvial geomorphologic changes such as braided channels, meanders, and cutbacks as the new equilibrium channel and floodplain are established, as described by Zhou and Donnelly (2002), Doyle (2002, 2003) and Heinz (2002).

In the future, if removal of the dam is considered, it would be necessary to conduct a sediment assessment. The assessment would determine: the amount of sediment deposition inside the reservoir, the sediment properties, whether or not the sediment contains any contaminated materials, how fast the sediment will be eroded, the methods that will need to be employed to stabilize the sediment and channel banks, and if necessary, the methodology for removal and disposal of the sediment fill.

Primary succession vegetation will begin to establish naturally with shoreline stability and as the thickness of sediments form along shorelines (Section 6.3.13, Minaskuat Inc. 2008). American River and Trout Unlimited (2002) states, “Dam impoundments are often nutrient-rich and can be full of seeds that were deposited on the impoundment bottom. Commonly, plant life will grow quickly when the land is exposed and planting vegetation will not be necessary”. Eventually a riparian zone similar to that of existing riparian thicket ecotypes will be created.

Timing to re-Establish a River System and Associated Habitat

The question of how long it will take for the fluvial geometry to stabilize cannot be answered with any certainty because of the uncertainties associated with sediment deposition characteristics. Changes could be rapid over a short period of time in the river reaches immediate upstream and downstream of the dams. As the distance

from the dams increase, the duration for changes will increase, and it could take years for the river to reach dynamic equilibrium. Doyle et al. (2003) reported that the time to reach dynamic equilibrium depends on how easily the sediment deposition in the reservoir is eroded. For this reason, it is not possible to predict the time scale of the geomorphic change. For the smaller dams that have been removed it has been shown that it may only take a few years to reach equilibrium, whereas for a large dam where a large amount of sediment may be stored it will likely take significantly longer for a state of equilibrium to be reached.

The sequence and timing for the formation of habitat will vary (e.g., unvegetated, gravel bar, riparian, wetland or other) according to the conditions listed above. The rate and succession of riparian vegetation will also depend on whether the entire river returns to an unregulated state or whether the Project remains in place, as these scenarios will affect the frequency, timing and severity of flood and ice scour events (Minaskuat Inc. 2008). The associated wildlife species will in turn be influenced by the resultant vegetation composition and structure at each stage of vegetation succession.

References:

American River and Trout Unlimited. 2002. Exploring Dam Removal, A decision Making Guide.

American Rivers, Friends of the Earth, and Trout Unlimited. 1999. Dam Removal Success Stories: Restoring Rivers Through Selective Removal of Dams that Don't Make Sense. Washington, DC: American Rivers.

Doyle, M.W., Stanley, E. H. and Harbor, J. M. 2002. Geomorphic Analogies for Assessing Probable Channel Response to Dam Removal, Journal of The American Water Resources Association, Vol. 38, No. 6.

Doyle, M.W., Stanley, E.H. and Harbor, J.M. 2003. Channel Adjustment Following Two Dam Removals in Wisconsin, Water Resources Research, Vol. 39, No. 1, 2003.

Hatch Ltd. 2010. Lower Churchill Project Decommissioning Overview.

Heinz (The Heinz Center's Dam Removal Research Group). 2002. Dam Removal Research Status and Prospects, William L. Graf. Editor, The H. John Heinz Center for Science, Economics and the Environment.

Minaskaut Inc. 2008. Project Area Ecological Land Classification.

Zhou, R. D. and Donnelly, C. R. 2002. The Impact of Dam Removal on Instream Sediments, Proceedings of the 2002 Canadian Association Conference, Victoria, British Columbia.

IR# JRP.151

Aboriginal Consultation and Traditional Land and Resource Use

Requesting Organization – Joint Review Panel **Information Request No.: JRP.151**

Subject - Aboriginal Consultation and Traditional Land and Resource Use

References:

EIS Guidelines, Section 4.4.4.4 (Description of the Existing Environment – Land and Resource Use) and Section 4.8 (Consultation with Aboriginal Groups and Communities)

Related Comments / Information Requests:

CEAR # 282 (Labrador Metis Nation)
CEAR # 284 (Nunatsiavut Government)
CEAR # 286 (Uashaunnuat, the Innu Takuaikan Uashat mak Mani-Utenam Band Council and certain Innu families)
CEAR # 289 (Innu Nation)
CEAR # 290 (Innus of Ekuanitshit)

IR # JRP.1, 2, 1S/2S, 3

Rationale:

The EIS Guidelines require the following baseline information on traditional land and resource use:

> The Proponent shall describe relevant land and resource use within the study area of the VECs, including the following: (…)
>
> (b) Current use of land and resources (including aquatic resources) by Aboriginal persons for traditional purposes, including location of camps, harvested species and transportation routes; (…) (p. 28)

With respect to consultation with Aboriginal groups, the EIS Guidelines require the following from the Proponent:

> The EIS shall demonstrate the Proponent's understanding of the interests, values, concerns, contemporary and historic activities, Aboriginal traditional knowledge and important issues facing Aboriginal groups, and indicate how these will be considered in planning and carrying out the Project. (…)
>
> To assist in ensuring that the EIS provide the necessary information to address issues of potential concern to these groups, the Proponent shall consult with each group for the purpose of:
>
> (a) Familiarizing the group with the Project and its potential environmental effects;
>
> (b) Identifying any issues of concern regarding potential environmental effects of the Project; and
>
> (c) Identifying what actions the Proponent is proposing to take to address each issue identified, as appropriate (p. 40-41).

The Proponent has not provided adequate information on the current use of lands and resources for traditional purposes by Aboriginal persons and has not carried out adequate consultation with each identified Aboriginal group.

The Proponent indicated that it proposes to implement community consultation agreements with the Quebec Innu and the Labrador Metis Nation and that it continues to address concerns raised by various Aboriginal groups during the consultation process (Response to IR# JRP1S/2S(a)). In a letter to the Panel dated January 19, 2010 (CEAR # 206), the Proponent provided an update on progress made towards implementation of consultation agreements with the various Aboriginal groups.

The information that the Proponent is planning to gather through the implementation of these agreements is necessary to enable the Panel to assess environmental effects. This contradicts the Proponent's assertion that "(…) Follow-up Programs and Adaptive Management Process within the environmental assessment process are the mechanisms that will allow Nalcor to incorporate information received as a result of the implementation of the consultation agreements" (Response to IR# JRP.1S/2S(c) (ii)).

In response to IR# JRP.2(a), the Proponent mentions that Project-related information had been provided to the Naskapi Nation of Kawawachikamach in November 2008 and May 2009. Subsequent submissions by the Proponent do not mention the Naskapi Nation.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.151**

Information Requested:

The Proponent is asked to submit either full copies of the draft community consultation agreements, or, if Aboriginal groups do not give permission to release the document, a detailed outline of the agreement, together with the workplan the Proponent will follow to gather additional information and fulfill the EIS Guidelines requirements when the agreement is implemented. The Panel requests that the Proponent continue to provide a monthly update on the negotiation and implementation of the proposed community consultation agreements.

The Proponent is asked to continue consultation with Innu Nation, Labrador Metis Nation, the Nunatsiavut Government, and the Quebec Innu in order to (a) report on concerns and issues raised during the consultation process and indicate how the Proponent will address these and, (b) where possible, update information on current traditional land and resource use.

Where an Aboriginal group is unwilling to share this information with the Proponent, the Proponent is asked to indicate whether and how it will support Aboriginal groups to present current land and resource use information directly to the Panel before or at public hearings.

The Proponent is also asked to update the Panel with respect to any consultation activities that may have taken place with the Naskapi Nation since May 2009.

Response:

The rationale section of Information Request (IR) #JRP.151 states that Nalcor Energy (Nalcor) has not provided adequate information on the current use of lands and resources for traditional purposes by Aboriginal persons and has not carried out adequate consultation with each identified Aboriginal group. It goes on to state that the information Nalcor is planning to gather through the implementation of community consultation/capacity agreements is necessary to enable the Panel to assess environmental effects of the Lower Churchill Hydroelectric Generation Project (Project).

Nalcor is concerned that, although there is no legal requirement to enter into consultation/capacity agreements, the Panel has now indicated that the implementation of these agreements is necessary to enable the Panel to assess the potential environmental effects of the Project on the current traditional land and resource use of the various Aboriginal groups referenced in the Guidelines.

Nalcor respectfully disagrees with these statements and asserts that the past, current, and ongoing efforts to engage in consultation and collect baseline information have provided Nalcor a reasonable understanding of the interests, values, concerns, and contemporary and historic activities of the Aboriginal groups listed in the guidelines. Nalcor further asserts that the additional efforts to familiarize the groups with the Project and potential effects, identify issues and concerns, and identify actions to address issues are adequate to meet the requirements of the Panel and the Guidelines.

Nalcor has executed agreements with some of the Aboriginal groups listed in the Guidelines, as set out below. However, the absence of executed agreements with other Aboriginal groups listed in the Guidelines does not, in any way, prevent Nalcor from continuing to engage in meaningful consultation. There is not requirement in the Guidelines, or in law regarding Aboriginal Consultation, that an agreement between Nalcor and a potentially affected Aboriginal Group must be executed in order for Nalcor to fulfill its consultation obligations as required

under the Guidelines or otherwise. An Aboriginal group has the option of either availing themselves of the offer to consult or refusing. Consultation is a two way street and cannot be forced upon an Aboriginal group, nor can Nalcor be forced to consult under unreasonable terms. If an Aboriginal group refuses to avail itself of the opportunity to be consulted, Crown decision-makers are completely free to proceed with a consideration of the project before them and the Aboriginal group cannot later challenge that decision on the basis that it was not consulted.

As the Panel is aware, Nalcor's consultation efforts have been significantly frustrated by external factors including divergent political agendas between the groups, conflicting land claim initiatives, opposition to Innu Nation negotiations and pressures upon limited community capacity resulting from competing development consultation initiatives (e.g., La Romaine Hydroelectric development). Despite these challenges, Nalcor has continued to act in good faith to seek opportunities to come into the communities for the purposes of consultation and offer consultation/capacity agreements, as appropriate.

2010 Consultation Program

Nalcor cannot solely rely on the information planned to be acquired through the implementation of consultation/capacity agreements with the communities. Therefore, in addition to pursuing agreements with the communities, Nalcor has initiated a supplementary consultation program designed to collect additional information and provide additional consultation opportunities. This program will work in combination with any finalized consultation/capacity agreements concluded with the Aboriginal groups. Where no consultation/capacity agreement is reached, Nalcor will, subject to receiving permission from each community, proceed with the 2010 Consultation Program.

The key elements of the 2010 Consultation Program include:

- Familiarizing the communities with the Project;
- Conducting community interviews;
- Collecting current land and resource use information;
- Identifying community and individual concerns;
- Discussing possible effects of the project and potential mitigations; and
- Producing community specific reports.

2010 Consultation Assessment Report

To further demonstrate Nalcor's understanding of the interests, values, concerns, contemporary and historic activities, Aboriginal traditional knowledge and important issues facing Aboriginal groups, Nalcor has undertaken to complete a comprehensive Consultation Assessment Report which will be delivered to the Panel no later than September 30, 2010.

This report will include:

- Summary of consultation activities;
- Re-evaluation of existing data;
- Incorporation of new information obtained from the 2010 Consultation Program;
- An assessment of:
  - Interests, values and concerns
  - Contemporary Traditional land use

- Historic activities
- Traditional Knowledge
- Important issues; and

- Identification of actions Nalcor is proposing to take to address the issues as appropriate.

Although it is preferred to see consultation/capacity agreements finalized with various groups it is Nalcor's expectation that the submission of the 2010 Consultation Assessment Program Report together with whatever results are obtained through the community consultation/capacity agreements will augment the existing information and allow the Panel to proceed with hearings.

Consultation/Capacity Agreements

Nalcor is sensitive to the resource constraints facing communities when engaging in consultation. Although there is no legal requirement for the conclusion of consultation/capacity arrangements, Nalcor has developed an approach to consultation which includes provision of funding and other support to the community to facilitate consultation where appropriate.

Commencing in the spring of 2009 Nalcor offered draft consultation/capacity agreements to NunatuKavut, Pakua Ship, Unamen Shipu, Nutashkuan, Ekuanitshit, Uashat mak Mani-Utenam and Matimekush-Lac John for discussion (Attachment 1). On December 11, 2009, an agreement was concluded with NunatuKavut. This agreement expired on March 31, 2010. A renewal agreement with NunatuKavut is currently being pursued. In response to concerns expressed by other communities, a modified agreement, the Community Engagement Agreement was offered in late winter, 2010 to the other communities (Attachment 2). On April 29, 2010 an agreement was concluded with Pakua Shipi.

Nalcor continues to seek opportunities to engage in consultation with the Naskapi Nation of Kawawachikamach, however due to an absence of evidence of land use activities in the Project area, and the remote proximity, no formal consultation/capacity agreements have been offered.

As explained in IR# JRP.2a, the physical footprint of the Project does not extend into Labrador Inuit Lands or the Labrador Inuit Settlement Area. Therefore, no consultation/capacity agreements have been offered.

Update on Negotiation of Agreements and Consultation Activities

Nalcor's approach to the consultation required by the Guidelines has taken into account an assessment of the land and resource use of each group in the proposed Project Area and the potential impact of the Project upon those interests. Nalcor has reviewed available documentation and information looking for evidence of historical and contemporary use of lands or resources in the proposed Project Area, the proximity of the group to the proposed Project Area and the impact of potential environmental effects upon interests of each group.

This approach to consultation has resulted in differences in level of engagement with different groups. All groups listed in the Guidelines have been provided with notice and relevant information respecting the Project. Subsequent steps taken by Nalcor to ensure meaningful and adequate consultation have been tailored to the particular circumstances of each group.

<u>Innu Nation</u>

Nalcor has been engaged in consultation with Innu Nation since 2000 and consultative efforts are ongoing. Between 2000 and 2008 consultation was conducted pursuant to a series of confidential Process Agreements. These agreements were designed to provide the Innu with Project-related information, identify issues and

concerns, develop an understanding of Innu land use and social, cultural and economic activities (both contemporary and historic) and Innu traditional knowledge and determine appropriate actions and measures to be undertaken by Nalcor. The various Process Agreements established a framework and terms of reference for three distinct matters: the conduct of Lower Churchill Innu Impacts and Benefits Agreement (IBA) negotiations to accommodate and mitigate the potential adverse impacts of the Project upon the Innu of Labrador; a regularized community consultation process fully funded by Nalcor and its predecessors; and Innu participation on a Task Force which served as the vehicle for the sharing, exchange and evaluation of a comprehensive range of environmental, engineering and other technical information. The Task Force also supervised the collection and review of information concerning Innu traditional knowledge relating to Innu land and resource use within the proposed Project Area.

Since the conclusion of the Process Agreements, consultation has been conducted pursuant to a series of individualized understandings and agreements. The remaining work of the Task Force was completed under a short term MOU. Separate funding was continued for IBA negotiations and the community consultation process.

On September 26, 2008, Innu Nation and the Province signed the Tshash Petapen (New Dawn) Agreement (Attachment 3) which established the framework for conclusion of the IBA, Churchill Falls Hydro-electric Development Redress Agreement and a bilateral land claims agreement-in-principle.

On February 16, 2010, negotiations respecting accommodation for the potential adverse impacts of the Project were concluded and Innu Nation and Nalcor initialed the IBA and the Churchill Falls Hydro-electric Development Redress Agreement.

Since initialing, ongoing consultations with Innu Nation are being conducted pursuant to a MOU signed on February 16, 2010 which fully describes the obligations of Nalcor and Innu Nation until ratification of the IBA.

NunatuKavut (formerly Labrador Metis Nation)

Nalcor's consultative efforts with NunatuKavut commenced in April 2007 and have been ongoing since that time. On December 11, 2009 NunatuKavut and Nalcor, concluded a Consultation/Capacity Agreement. As a result of the agreement, NunatuKavut submitted a preliminary report to Nalcor, outlining its membership's issues and concerns with the proposed Project. This Agreement expired on March 31, 2010. Parties are now engaged in negotiating the terms of a renewal consultation agreement.

Regardless of the outcome of negotiations of consultation/capacity agreements, Nalcor will subject to the approval of the communities, continue to engage in consultation respecting the Project through the provision of information and through community meetings to determine particular issues and concerns. Nalcor has prepared a Plain Language Summary of the EIS. Nalcor has written to NunatKavut respecting the Plain Language Summary and indicated its intention to deliver one or more presentations on the Project, based on this summary, at a mutually convenient time and location in late spring/early summer, 2010.

It is also Nalcor's intention, subject to receiving the approval of NunatuKavut, to pursue data collection through the 2010 Consultation Program. The results of that program will be incorporated into the 2010 Consultation Assessment Report to be submitted to the Panel by September 30, 2010.

A detailed record of consultation with NunatuKavut is provided (Attachment 4).

Nunatsiavut Government

Information and documentation supplied by the Labrador Inuit in the course of land claims negotiations and as evidenced in the Labrador Inuit Land Claims Agreement does not illustrate any record of historical use and occupancy by the Labrador Inuit of the land and resources in the proposed Project Area.

Nalcor has collected over 30 years of data which has concluded that there will be no measurable Project-related impacts upon either lands or resources within the Labrador Inuit Settlement Area or upon Inuit rights under the treaty.

As a result of this information it is Nalcor's view that the project requirement for consultation can be fulfilled by an ongoing process of notice, information exchange and bilateral discussions without the necessity of a formal consultation agreement between Nalcor and the Nunatsiavut Government.

Nalcor has advised the Nunatsiavut Government of the results of its assessment of the lack of Project impacts upon the Labrador Inuit Settlement Area and Inuit rights under the Agreement and has offered to meet to discuss this assessment.

Nalcor remains prepared to continue to meet with the Nunatsiavut Government to exchange Project-related information and to that end has prepared a Plain Language Summary which will be available in both English and Inuktitut. Nalcor has advised the Nunatsiavut Government that it will make this summary available to the Nunatsiavut Government and will deliver an oral presentation on the Project in both English and Inuktitut at a mutually convenient time and location in late spring/early summer, 2010.

A detailed record of consultation with the Nunatsiavut Government is provided (Attachment 5).

Pakua Shipi

Although Pakua Shipi has been identified in the Guidelines, existing information available to Nalcor indicates no record of historic or current land and resources use and occupancy by the community in the Project Area.

Not withstanding this lack of evidence, Nalcor and Pakua Shipi concluded a Consultation/Capacity Agreement on April 29, 2010. The Parties have developed a jointly agreed upon workplan and work scope for the exchange of Project-related information, identification of community concerns, and the collection of current traditional land and resource use information. The results of the implementation of this agreement will be incorporated into the 2010 Consultation Assessment Report to be delivered to the Panel by Nalcor by September 30, 2010.

In addition to consultation conducted under the Consultation/Capacity Agreement, Nalcor has prepared a Plain Language Summary of the EIS. Nalcor has written to Pakua Shipi respecting the Plain Language Summary indicating its intention to deliver one or more presentations on the Project based on this summary at a mutually convenient time and location in late spring/early summer, 2010.

A detailed record of consultation with Pakua Shipi is provided (Attachment 6).

Unamen Shipu

Although Unamen Shipu has been identified in the Guildelines, existing information available to Nalcor indicates no record of historic or current land and resources use and occupancy by the community in the Project Area.

Notwithstanding this lack of evidence, during the past year Nalcor has been engaged in correspondence and discussions with Unamen Shipu respecting the terms and conditions of formal consultation/capacity arrangements. Negotiations with the community have been productive and are ongoing.

Regardless of the outcome of negotiations of consultation/capacity agreements, Nalcor will continue to engage in consultation respecting the Project through the provision of information and through community meetings to determine particular issues and concerns. Nalcor has prepared a Plain Language Summary of the EIS. Nalcor has written to Unamen Shipu respecting the Plain Language Summary and indicated its intention to deliver one or more presentations on the Project based on this summary at a mutually convenient time and location in late spring/early summer, 2010.

It is also Nalcor's intention, subject to receiving the approval of the community, to pursue data collection through the 2010 Consultation Program in Unamen Shipu. The results of that program will be incorporated into the 2010 Consultation Assessment Report to be submitted to the Panel by September 30, 2010.

A detailed record of consultation record with Unamen Shipu is provided (Attachment 7).

Nutashkuan

Although Nutashkuan has been identified in the Guildelines, existing information available to Nalcor indicates no record of historic or current land and resources use and occupancy by the community in the Project Area.

Notwithstanding this lack of evidence, during the past year Nalcor has been engaged in meetings, correspondence and discussions with Nutashkuan respecting the terms and conditions of formal consultation/capacity arrangements. The most recent iteration of such arrangements is currently under review by the Chief and Council but no formal agreement has been concluded.

Regardless of the outcome of negotiations of consultation/capacity agreements, Nalcor will continue to engage in consultation respecting the Project through the provision of information and through community meetings to determine particular issues and concerns. Nalcor has prepared a Plain Language Summary of the EIS. Nalcor has written to Natashkuan respecting the Plain Language Summary and indicated its intention to deliver one or more presentations on the Project based on this summary at a mutually convenient time and location in late spring/early summer, 2010.

It is also Nalcor's intention, subject to receiving the approval of the community, to pursue data collection through the 2010 Consultation Program in Natashkuan. The results of that program will be incorporated into the 2010 Consultation Assessment Report to be submitted to the Panel by September 30, 2010.

A detailed record of consultation with Natashkuan is provided (Attachment 8).

Ekuanitshit

Although Ekuanitshit has been identified in the Guildelines, existing information available to Nalcor indicates no record of historic or current land and resources use and occupancy by the community in the Project Area.

Not withstanding this lack of evidence, during the past year Nalcor has been engaged in meetings, correspondence and discussions with Ekuanitshit respecting the terms and conditions of formal community consultation arrangements. Initial discussions were very productive, resulting in the exchange of draft agreements. While it appeared that parties were close to reaching agreement in the early part of 2010, negotiations have stalled and no formal agreement has been concluded.

Regardless of the outcome of negotiations of consultation/capacity agreements, Nalcor will continue to engage in consultation respecting the Project through the provision of information and through community meetings to determine particular issues and concerns. Nalcor has prepared a Plain Language Summary of the EIS. Nalcor has written to Ekuanitshit respecting the Plain Language Summary and indicated its intention to deliver one or more

presentations on the Project based on this summary at a mutually convenient time and location in late spring/early summer, 2010.

It is also Nalcor's intention, subject to receiving the approval of the community, to pursue data collection through the 2010 Consultation Program in Ekuanitshit. The results of that program will be incorporated into the 2010 Consultation Assessment Report to be submitted to the Panel by September 30, 2010.

A detailed record of consultation with Ekuanitshit is provided (Attachment 9).

Uashat mak Mani-Utenam

Although Uashat mak Mani-Utenam has been identified in the Guildelines, existing information available to Nalcor indicates no record of historic or current land and resources use and occupancy by the community in the Project Area.

Not withstanding this lack of evidence, Nalcor has made repeated efforts to engage the Innu of Uashat mak Mani-Utenam in a formal consultative process, and to that end has provided the community with draft agreements for its review and consideration. However, no response has been received from Uashat mak Mani-Utenam.

Regardless of the outcome of negotiations of consultation/capacity agreements, Nalcor will continue to engage in consultation respecting the Project through the provision of information and through community meetings to determine particular issues and concerns. Nalcor has prepared a Plain Language Summary of the EIS. Nalcor has written to Uashat mak Mani-Utenam respecting the Plain Language Summary and indicated its intention to deliver one or more presentations on the Project based on this summary at a mutually convenient time and location in late spring/early summer, 2010.

It is also Nalcor's intention, subject to receiving the approval of the community, to pursue data collection through the 2010 Consultation Program in Uashat mak Mani-Utenam. The results of that program will be incorporated into the 2010 Consultation Assessment Report to be submitted to the Panel by September 30, 2010.

A detailed record of consultation with Uashat mak Mani-Utenam is provided (Attachment 10).

Matimekush-Lac John

Although Matimekush-Lac John has been identified in the Guildelines, existing information available to Nalcor indicates no record of historic or current land and resources use and occupancy by the community in the Project Area.

Not withstanding this lack of evidence, Nalcor has made repeated efforts to engage the Innu of Matimekush-Lac John in a formal consultative process, and to that end has provided the community with draft agreements for its review and consideration. Nalcor has been advised by the Chief of Matimekush-Lac John that the most recent draft provided to the community on April 9, 2010 is under review by the community's legal counsel. However, efforts to arrange a meeting to discuss the terms and conditions of the proposed agreement have to-date been unsuccessful.

Regardless of the outcome of negotiations of consultation/capacity agreements, Nalcor will continue to engage in consultation respecting the Project through the provision of information and through community meetings to determine particular issues and concerns. Nalcor has prepared a Plain Language Summary of the EIS. Nalcor has written to Matimekush-Lac John respecting the Plain Language Summary and indicated its intention to deliver

one or more presentations on the Project based on this summary at a mutually convenient time and location in late spring/early summer, 2010.

It is also Nalcor's intention, subject to receiving the approval of the community, to pursue data collection through the 2010 Consultation Program in Matimekush-Lac John. The results of that program will be incorporated into the 2010 Consultation Assessment Report to be submitted to the Panel by September 30, 2010.

A detailed record of consultation with Matimekush-Lac John is provided (Attachment 11).

Naskapi Nation of Kawawachikamach

Kawawachikamach was not identified in the Guildelines and existing information available to Nalcor indicates no record of historical land and resources use and occupancy by the community in the Project Area.

Not withstanding these factors, Nalcor has and will continue to provide Kawawachikamach with notice and ongoing Project-related information, and opportunities for the community to identify its issues and concerns. Nalcor has concluded that a formalized consultation agreement is not necessary. Nalcor advised Kawawachikamach that a Plain Language Summary of the EIS has been prepared, which will be offered to the community in English and in Naskapi, and that Nalcor will deliver an oral presentation on the Project based on this summary at a mutually convenient time and location in late spring/early summer, 2010.

A detailed record of consultation with the Naskapi Nation of Kawawachikamach, including an updated table, is provided (Attachment 12).

Groups Unwilling to Share Information on Present and Current Land and Resource Use

Nalcor will continue to work openly and in good faith to provide Aboriginal groups with information and opportunities to assist in the provision of current land and resource use information to the Panel. Should a group be unwilling to share this information with Nalcor, the Panel process provides the opportunity for those groups to put information before the Panel if it chooses to.

ATTACHMENT 1

INFORMATION RESPONSES
LOWER CHURCHILL PROJECT

JOINT REVIEW PANEL

Aboriginal Consultation and Traditional Land and Resource Use

IR# JRP.151

COMMUNITY CONSULTATION AGREEMENT TEMPLATE

May 2010

nalcor energy
LOWER CHURCHILL PROJECT

COMMUNITY CONSULTATION AGREEMENT –`_____, 2009.

BETWEEN: **Nalcor Energy**, a body corporate existing pursuant to the *Energy Corporation Act*, SNL 2007, c. E-11.01, having its head office in the City of St. John's, in the Province of Newfoundland and Labrador;

("Nalcor")

AND: _____ [Aboriginal group or community]

(Collectively, the "Parties".)

WHEREAS:

1. The *Environmental Impact Statement Guidelines* for the environmental assessment of the generation components of the Lower Churchill Project (the "Project") require that the Proponent consult with named Aboriginal groups and communities to familiarize the group or community with the Project and its potential environmental effects, to identify any issues of concerns regarding potential environmental effects of the Project and to identify what actions the Proponent proposes to take to address issues of concerns.

2. Nalcor has registered the proposed transmission line project for environmental assessment by the Governments of Newfoundland and Labrador and Canada and wishes to provide information respecting the proposed transmission line project to _____.

3. Nalcor wishes to provide information respecting the both the generation and transmission components of the Project and to consult with the _____ in respect of the Project impacts in order to fulfill certain of the requirements of the *Environmental Impact Statement Guidelines* and to obtain information with respect to the potential environmental effects of the Project upon the interests and rights of _____.

NOW THEREFORE the Parties agree to conduct consultation in respect of the Project in accordance with the following terms and conditions of this Community Consultation Agreement (the "Consultation Agreement"):

1. <u>Community Consultation</u>

1.1 _____and Nalcor shall jointly implement a community consultation process that shall have the following objectives:

- to enable and facilitate effective communication and consultation between the Parties with respect to the Project and to fund the participation of _____ in achieving the objectives of this Consultation Agreement in accordance with its terms;
- to respond to questions, issues and concerns raised by the _____ about the Project;
- to determine what _____ think about the project and how it may affect the _____;

- to communicate the findings of the community consultation process to _____ and Nalcor;
- to identify traditional knowledge and current use of resources.

1.2 The Parties agree to cooperate with each other to ensure the objectives of the community consultation process set out in section 1.1 are achieved. In the event of a dispute, the Parties agree to meet within 5 days of written notice of the dispute and to attempt to resolve the dispute through reasonable efforts taken in good faith. If the dispute cannot be resolved by the parties, it shall be referred to the Senior Representatives of Nalcor and _____, identified in section 7.2.

1.3 _____shall employ one full-time community consultation officer for _____ funded by Nalcor in accordance with Appendix "B" of this Consultation Agreement and who will perform the community consultation officer's duties in that community. The selection and employment of the community consultation officer shall be subject to Nalcor's prior approval. The community consultation officer will gather and disseminate information on the Project from and to _____ using one or more of the following methods:

- community resource centres;
- workshops;
- informant interviews;
- community newsletters;
- internet communications;
- radio open-line programs; and
- community information sessions.

1.4 Within twenty 20 days of the execution of this Consultation Agreement, _____ shall provide to Nalcor, for its approval, a Work plan and schedule of community consultation activities for the period commencing on the date of execution of this Consultation Agreement up to and including the preparation of the final report pursuant to section 4.2 twelve (12) months after the execution of this Consultation Agreement. The Work plan shall be attached as Appendix "A" to this Consultation Agreement.

2. Term and Amendment

2.1 This Consultation Agreement shall come into effect upon its execution by the Parties.

2.2 The Parties agree that the term of this Consultation Agreement shall be for the period commencing upon the execution of this Consultation Agreement (the "Effective Date") and terminating the earlier of twelve (12) months from the date of execution or sixty days (60) from the date of written notice under section 2.3(b).

2.3 Notwithstanding section 2.2,

(a) the Parties may, by agreement in writing, extend the term of this Consultation Agreement; and

(b) either Party may terminate this Consultation Agreement at any time by giving the other Party sixty (60) days written notice of intent to terminate.

2.4 Upon termination, all elements of this Consultation Agreement terminate, including all financial contribution commitments, and any unexpended advances of funds will be returned by _____ _____ to Nalcor. For greater certainty, Nalcor shall not be responsible for any new expenditure made, incurred or committed to by _____ after the date of termination referred to in section 2.2.

2.5 This Agreement may only be amended with the written consent of both Parties and any such amendment will become effective upon its execution by the Parties, unless another date is agreed to.

3. <u>Funding</u>

3.1 Nalcor shall provide honoraria and funding in accordance with Appendix "B" of this Consultation Agreement.

4. <u>Reporting Requirements</u>

4.1 On a monthly basis, the _____ shall provide to Nalcor:

- a written activity report describing the consultation activities undertaken, including any relevant issues emerging as a result of such consultation; and
- an unaudited monthly financial report in the format presented in Appendix "C" prepared in accordance with generally accepted accounting principles, reporting total revenues and eligible expenditures incurred and accrued and funded pursuant to this Consultation Agreement.

4.2 No later than twelve (12) months after the effective date of this Consultation Agreement, _____ _____shall provide to Nalcor a report in writing summarizing the consultation activities which have been undertaken and describing the findings of the consultation process, including any traditional knowledge or information on the current use of resources for traditional purposes within the Project area.

4.3 _____ shall, no later than ninety (90) days following the close of its fiscal year, provide Nalcor with an audited financial statement prepared in accordance with generally accepted auditing principals showing total revenue and eligible expenditures under this Consultation Agreement and detailing that the funds received under this Consultation Agreement were accounted for and spent properly and in accordance with this Consultation Agreement.

4.4 Nalcor may request from _____ such information and documentation that it may reasonably require to confirm that advances or payments made pursuant to this Consultation Agreement were disbursed for eligible expenditures and made by_ _____ in accordance with this Consultation Agreement and may, at its own expense, appoint an independent auditor to verify eligible expenditures made by _____ _____ pursuant to this Consultation Agreement.

5. Information, Confidentiality and Disclosure

5.1 The Parties agree that it will be necessary to share, evaluate and discuss certain information to fulfill the objectives of this Consultation Agreement and therefore agree to provide such information as is relevant and necessary to fulfill the objectives of this Consultation Agreement. The Parties acknowledge that certain information may be restricted, commercially sensitive or otherwise subject to confidentiality requirements. Nalcor agrees to provide access to such restricted, confidential or commercially sensitive information, where necessary and relevant to the objectives of this Consultation Agreement, provided that appropriate confidentiality agreements have been executed by the Parties to protect such confidential and commercially sensitive information.

5.2 Notwithstanding anything else in this Consultation Agreement, _____ acknowledges that Nalcor shall not be obliged to disclose or share with _____ environmental, engineering, financial or other information pertaining to the evaluation of particular development options by Nalcor.

5.3 The Parties agree to execute appropriate confidentiality agreements to protect restricted, confidential or commercially sensitive information and to release information respecting the Project only in accordance with the terms of such confidentiality agreements or as otherwise required by law.

5.4 The Parties agree that all discussions leading to the formation of this Consultation Agreement, this Consultation Agreement and discussions, negotiations, information acquired and reports prepared pursuant to this Consultation Agreement will be confidential and will not be disclosed to any other person except:

(a) as the Parties agree in writing;

(b) as may be required by law or by the terms of any confidentiality agreement executed between the Parties;

(c) as may be permitted pursuant to the exercise of a statutory or regulatory discretion; or

(d) pursuant to section 6.2 or in litigation dealing with a breach or an alleged breach of this Consultation Agreement.

6. Without Prejudice

6.1 This Agreement and all negotiations surrounding it shall not be, and nothing contained in this Consultation Agreement shall be, construed as conferring on, recognizing, limiting, modifying,

replacing, denying or derogating from any Aboriginal, treaty or constitutional rights or obligations of either the Parties or the _____ people which may be claimed by the Parties, or the _____ people and their representatives thereof and is without prejudice to the positions which may be taken by the Parties with respect thereto in any other forum, court of law or otherwise.

6.2 Notwithstanding section 6.1, this Consultation Agreement and all negotiations surrounding it and the consultation activities conducted pursuant to this Consultation Agreement are not subject to settlement privilege and either Party may reference the existence or the content of this Consultation Agreement and any discussions, negotiations, activities or reports conducted or prepared pursuant to this Consultation Agreement and may tender evidence of such discussions, negotiations, activities or reports in any action, petition or proceeding in any forum relating to the issue of consultation.

6.3 This Agreement is not, and shall not be interpreted to be, a treaty or land claims agreement within the meaning of s.25 or s.35 of the *Constitution Act, 1982*.

6.2 This Consultation Agreement and the negotiations leading to its formation, execution and implementation are without prejudice to any Party in any future negotiations.

6.3 Except as otherwise specifically provided herein, nothing in this Consultation Agreement shall limit in any manner the rights, jurisdiction, authority, obligations or responsibilities of either Party or their representatives.

6.4 Nothing in this Consultation Agreement obliges Nalcor to act in a manner inconsistent with or contrary to law and nothing in this Consultation Agreement fetters or is to be interpreted as fettering the discretion of Nalcor

6.5 Nothing in this Consultation Agreement is intended to limit the participation by _____ _____ or by Nalcor in any public processes established by Newfoundland and Labrador or Canada respecting the environmental assessment of the Project.

7. <u>Communications</u>

7.1 Any notice or other communication required to permitted to be given under this Consultation Agreement shall be given in writing and will be deemed to have been well and sufficiently given if sent by registered mail, courier or facsimile to:

In the case of Nalcor Energy, to:

Gilbert Bennett
Vice President
Lower Churchill Project
P.O. Box 12800, 500 Columbus Drive
St. John's, NL A1B 0C9
Ph: (709) 737-1782

In the case of _____ to:

_____

Any notice sent by registered mail shall be deemed to have been duly given and received by a Party on the fifth business day following the day of mailing and on the following day if sent by facsimile transmission.

7.2 A person shall be designated by each of the Parties to act as the Senior Representative of that Party for the purposes of this Consultation Agreement. Until the Parties to this Consultation Agreement are otherwise advised, the designated persons who represent each of the Parties are:

In the case of Nalcor Energy,

In the case of _____

7.3 In the event that it becomes necessary to substitute individuals for those referred to in section 7.2, the Party doing so shall notify the other Party in accordance with section 7.1 and provide the appropriate documentation to effect the change.

8. General

8.1 There will be no presumption that any ambiguity in any of the terms of this Consultation Agreement shall be interpreted or resolved in favour of either Party.

8.2 This Consultation Agreement, including the Appendices, and any valid amendment to it constitute the entire agreement between the Parties with respect to the subject matter of this Consultation Agreement, unless otherwise agreed by the Parties.

8.3 _____ represents that this Consultation Agreement is binding upon it and its membership and that all necessary actions have been taken to authorize the execution of this Consultation Agreement.

8.4 Nalcor represents that this Consultation Agreement is binding upon it and that all necessary actions have been taken to authorize the execution of this Consultation Agreement.

8.5 _____ represents and warrants that there are no actions or proceedings pending by or against _____ or any of its members that would materially impair its ability to fulfill its obligations under this Consultation Agreement and that it has not entered into any other agreement that would prevent it from fulfilling its obligations under this Consultation Agreement.

8.6 This Consultation Agreement is a legally binding contract which shall be considered to have been made in Newfoundland and Labrador and is subject to laws of general application and shall be interpreted in accordance with the laws of Newfoundland and Labrador and the federal laws of Canada applicable therein without regard to conflicts of laws principles that would impose the laws of any other jurisdiction and each Party hereby irrevocably and unconditionally

submits to the exclusive jurisdiction of the courts of Newfoundland and all courts competent to hear appeals therefrom.

8.7 No Party shall challenge or support a challenge to the validity of this Consultation Agreement or any provision thereof.

8.8 The Parties agree that compliance by Nalcor with the provisions of this Consultation Agreement completely fulfills the requirements of the *Environmental Impact Statement Guidelines* and discharges the obligations of Nalcor with respect to consultation with _____ _____ in respect of the *Environmental Impact Statement Guidelines*. Provided that this Consultation Agreement remains in effect for its full term, the Parties agree that compliance by Nalcor with the provisions of this Consultation Agreement shall completely fulfill the requirements of the *Environmental Impact Statement Guidelines* and discharges the obligations of Nalcor with respect to consultation with _____ in respect of the *Environmental Impact Statement Guidelines.*

8.9 All communications, notices, reports and other documentation required or permitted by this Consultation Agreement shall be made only in French or English, provided that such communications, notices, reports and other documentation shall be provided to the receiving Party in the official language of that Party.

IN WITNESS WHEREOF each of the Parties have caused this Consultation Agreement to be executed by the duly authorized signing officers of the Parties:

		Nalcor Energy
Per		Per
Witness		
		Date

		_____
Per		Per
Witness		
		Date

APPENDIX "A"

Workplan

APPENDIX "B"

Eligible Expenditures

Eligible expenditures to be funded under the terms and conditions of this Consultation Agreement must be legitimate and reasonable and are defined as follows:

- salary for 1 community consultation officer: **[$_____**]
- pre-approved travel, honoraria and disbursements incurred **[$_____ per elder to a maximum of $_____]**.

APPENDIX "C"

Monthly Financial Report Format

STATEMENTS OF REVENUES AND EXPENDITURES		REPORT PERIOD	
Month of:	**Month Current**	**Project to Date**	
		Opening	**Closing**
Revenue:			
Expenditures			
Total			
Community Consultation			
Salaries and Benefits			
Travel and Disbursements			
Community Consultation			
Office and Overhead Costs			
Total			
Total Expenditures			
Transfers			
Community Consultation			
Payments as per Agreement			
Transferred – in			
Transferred – out			
Balance Funded			

APPENDIX "D"

Monthly Financial Report Format

STATEMENTS OF REVENUES AND EXPENITURES		**REPORT PERIOD**	
Month of:	**Month Current**	**Project to Date**	
		Opening	**Closing**
Revenue:			
Expenditures			
Community Engagement			
Salaries and Benefits			
Professional Fees			
Travel and Disbursements			
Translation			
Workshop and Consultation Expenses			
Equipment and Supplies			
Office and Overhead Costs			
Total			

ATTACHMENT 2

INFORMATION RESPONSES
LOWER CHURCHILL PROJECT

JOINT REVIEW PANEL

Aboriginal Consultation and Traditional Land and Resource Use

IR# JRP.151

COMMUNITY ENGAGEMENT AGREEMENT TEMPLATE

May 2010

nalcor energy
LOWER CHURCHILL PROJECT

Confidential & Without Prejudice

COMMUNITY ENGAGEMENT AGREEMENT

BETWEEN: **Nalcor Energy**, a body corporate existing pursuant to the *Energy Corporation Act*, SNL 2007, c. E-11.01, having its head office in the City of St. John's, in the Province of Newfoundland and Labrador, represented herein by Gilbert Bennett, Vice-President Lower Churchill Project, Nalcor Energy, duly authorized to sign this Community Engagement Agreement;

("Nalcor")

AND: _____

(each of Nalcor and _____ being a "Party" and collectively, the "Parties")

WHEREAS:

1. Section 4.8 of the *Environmental Impact Statement Guidelines* for the Lower Churchill Hydroelectric Generation Project provides for consultation between Nalcor, as the Proponent and the Innu of _____ in order to:

   i. familiarize _____ with the Lower Churchill Hydroelectric Generation Project and its potential environmental effects;

   ii. identify any issues or concerns of _____ regarding potential environmental effects of the Lower Churchill Hydroelectric Generation Project; and

   iii. identify what actions the Proponent proposes to take to address any issues or concerns of _____ regarding the potential environmental effects of the Lower Churchill Hydroelectric Generation Project.

2. Nalcor wishes to provide information respecting both the proposed hydroelectric generation components and the Labrador-Island transmission link of the Lower Churchill Hydro-electric Project (the proposed hydroelectric generation components and the Labrador-Island transmission link being collectively the "Project") and to consult with the Innu of _____ _____ to obtain information with respect to the potential environmental effects of the Project upon the interests of the Innu of _____ and to determine what actions may be necessary to address the issues and concerns of the Innu of _____ _____ if any, including mitigation measures and accommodation measures;

3. Nalcor and _____ wish to enter into this Community Engagement Agreement (the "Agreement") which is intended to provide _____ with capacity funding to work with Nalcor to develop and implement a framework and process

that will assist the Parties to work collaboratively and cooperatively in the exchange of Project-related information and associated activities.

NOW THEREFORE, in consideration of the terms and other considerations set out below, the Parties agree to develop and implement a process for the exchange of Project-related information in accordance with the requirements of the *Environmental Impact Statement Guidelines* and this Agreement.

6. IDENTIFICATION OF CONTACTS

6.1 Subject to section 1.2, within five (5) days of the execution of this Agreement and in any event no later than May 5, 2010, _____ shall hire one full-time Project Coordinator who shall, in cooperation with the Nalcor Contact, be responsible for the development and implementation of the Workplan approved under section 2.4 and who shall perform the duties set out in the Workplan.

6.2 The selection of, and the terms of reference for, the Project Coordinator shall be subject to Nalcor's prior consent, which consent shall not be unreasonably withheld. The Project Coordinator shall be accountable to both _____ and Nalcor for the performance of his or her duties under the Workplan.

6.3 Within five (5) days of the execution of this Agreement and in any event no later than May 5, 2010, Nalcor shall designate an individual to serve as the Nalcor Contact.

6.4 On or before May 7, 2010, the Nalcor Contact will make contact with the Project Coordinator to identify him/herself, to exchange contact information, to discuss any information that may be required in order to implement the terms of this Agreement and to set a target date for completion of the draft workplan described in section 2.2.

7. DEVELOPMENT AND APPROVAL OF WORKPLAN

7.1 The Project Coordinator and the Nalcor Contact shall jointly develop and implement a community engagement process which will facilitate the achievement of the following objectives:

- To identify one or more points of contact in the community to enable effective communication, information exchange and consultation between the Parties with respect to the Project;
- To provide funding for the participation of the community in the community consultation process;
- To enable Nalcor to respond to any questions, issues and concerns raised by the Innu of _____ about the Project;
- To enable Nalcor to determine what Innu of _____ think about the Project and its impacts upon their values, interests and concerns;
- To communicate the findings of the community consultation process to both Parties;
- To identify _____ traditional knowledge and current use of land and resources in the Project area;

- To enable Nalcor to comply with the *Environmental Impact Statement Guidelines* for the environmental assessment of the Lower Churchill Hydroelectric Generation Project with respect to the Innu of _____;
- To identify what actions Nalcor proposes to take to address any issues and concerns identified by the Innu of _____ with respect to the Project;
- To identify issues in relation to accommodation and mitigation, if any, for future discussion by the Parties.

2.2 In order to develop an effective community engagement process which will achieve the objectives referred to in section 2.1, the Parties agree that their first priority will be to work cooperatively to finalize a detailed schedule of consultation activities and tasks. The Parties have established a preliminary schedule attached as Appendix "A" to this Agreement and agree that the Project Coordinator and the Nalcor Contact will meet within five (5) days after making contact under section 1.4 and in any event no later than May 12, 2010, to review and revise this preliminary schedule and develop a draft workplan which will include a detailed schedule of proposed community consultation activities and tasks to be completed during the term of this Agreement. The draft workplan developed by the Project Coordinator and the Nalcor Contact shall include the following components, as appropriate:

- Provision of information to _____ by Nalcor: what information and when it will be provided;
- Collection of required information from _____: what information will be collected, when and how it will be collected and when it will be provided to Nalcor and in what form;
- Meetings: the meetings required by this Agreement or as agreed to by the Parties and the location, participants, purposes and timing of such meetings;
- Work to be accomplished between each meeting (including collection and provision of information, analysis and input);
- Internal community consultation: what is required and when this will be accomplished;
- Identification of tasks associated with major activities and required resources;
- Deliverables: schedule for submission of monthly reports referred to in section 5.1 and the final Project Coordinator's Report referred to in section 5.5.

2.3 The draft workplan shall be completed within five (5) days of the first meeting of the Project Coordinator and the Nalcor Contact under section 2.2 and in any event no later than May 17, 2010 and upon its completion the draft workplan shall be immediately forwarded to _____ _____ and Nalcor for review and for Nalcor's approval.

2.4 Nalcor shall review the draft workplan and shall either approve the draft workplan or, if in Nalcor's opinion, elements of the draft workplan are not reasonable, it shall provide _____ _____ with notice of its proposed changes together with supporting reasons. The Parties agree to negotiate any revisions to the draft workplan in good faith so that they may arrive at a mutually agreeable workplan. If the draft workplan is approved by Nalcor, it shall become the Workplan. The Workplan shall replace the preliminary schedule attached as Appendix "A". The Workplan shall be attached as Appendix "A" and form part of this Agreement. The Parties agree that the Workplan shall be approved no later than May 20, 2010.

2.5 The Parties agree to cooperate with one another to ensure the objectives of the community engagement process set out in section 2.1 are achieved. In the event of a dispute, the Project Coordinator and the Nalcor Contact agree to meet within five (5) days of written notice of the dispute and to attempt to resolve the dispute through reasonable efforts taken in good faith. If the dispute cannot be resolved, it shall be referred to the Senior Representatives of Nalcor and _____ identified in section 8.2.

3. TERM AND AMENDMENT

3.1 This Agreement shall come into effect upon its execution by the Parties.

3.2 The Parties agree that the term of this Agreement shall be for the period commencing upon its execution (the "Effective Date") and expiring one hundred and twenty (120) days from the Effective Date.

3.3 Notwithstanding section 3.2, this Agreement may be terminated at any time upon either Party giving thirty (30) days written notice of intent to terminate to the other Party.

3.4 In the event of termination under section 3.3, Nalcor (without prejudice to any other rights or remedies available to it), shall pay to _____ an amount to cover eligible expenditures incurred or accrued up to the date of termination plus any other costs properly attributable to termination that _____ reasonably incurs and which are documented to the satisfaction of Nalcor acting reasonably, which other costs shall not exceed ten per cent (10%) of the total of payments made under section 4.2 immediately prior to the date of termination and _____ shall provide Nalcor with all outstanding reports (whether in final or draft form) referred to in section 5.1 as well as any information, data, material and analysis collected or produced by the Project Coordinator up to the date of termination.

3.5 For greater certainty, upon termination under section 3.3, _____ shall not be entitled to make any claim against Nalcor for any consequential costs, losses, including loss of profit or damages associated with or arising upon notice of termination or termination and Nalcor shall not be responsible for any new expenditures made or committed to by _____ _____ after the notice of intent to terminate is given by Nalcor under section 3.3.

3.6 Upon the expiration of this Agreement under section 3.2 or termination under 3.3, _____ _____ will repay to Nalcor any funding advanced in excess of eligible expenditures incurred pursuant to this Agreement.

3.7 Where enters into a contract for the supply of a work, good or service required by or permitted under this Agreement and for which the funding provided by Nalcor under section 4.1 is to be applied, _____ shall ensure that such contract provides for termination on the following terms:

a) termination may be arranged on short notice and at minimum expense; and
b) no allowance shall be made for any consequential costs or losses, including loss of profits;

and no compensation shall be payable to _____ for obligations under any such contract which, in Nalcor's reasonable opinion, were incurred by _____ ..... _____ as a result of its failure to obtain or include such termination provisions.

3.8 This Agreement may only be amended with the written consent of both Parties and any such amendment will become effective upon its execution by the Parties, unless another date is agreed to.

4 FUNDING

4.1 Nalcor shall provide funding in accordance with the budget attached as Appendix "B" to this Agreement.

4.2 Subject to section 4.6, the total estimated amount of funding, including a 10% administration fee, for eligible expenditures under this Agreement, as set out in Appendix "C" and incurred by or on behalf of _____ in the implementation of the Workplan shall be _____dollars ($_____) Canadian, plus taxes as applicable under the *Excise Tax Act* (Canada)[1] which shall be advanced to _____ in four installments to be paid as follows:

(a) the first payment of _____dollars ($_____) shall be made on the Effective Date;
(b) the second payment of _____dollars ($_____) shall be made on the later of sixty (60) days after the Effective Date or July 1, 2010;
(c) the third payment of _____dollars ($_____)be made on the later of ninety (90) days after the Effective Date or August 1, 2010; and
(d) the fourth and final payment of _____dollars ($_____) shall be made on the later of 120 days after the Effective Date or on the date that both the Project Coordinator's Report referred to in section 5.5 and the final Progress Report required under section 5.1 have been received by Nalcor.

4.3 Notwithstanding section 4.2, Nalcor reserves the right to withhold payments referred to in section 4.2 in whole or in part as follows:
(a) either or both of the second or third payments referred to in section 4.2 may be withheld if the reporting requirements set out in section 5.1 have not been fulfilled by __ _____ or the Project Coordinator, as the case may be;
(b) the full amount of the fourth and final payment referred to in section 4.2 may be withheld until Nalcor has received both the Project Coordinator's Report referred to in section 5.5 and the final Progress Report referred to in section 5.1,

and Nalcor shall not be liable to pay any amounts so withheld under this section unless and until _____ is in compliance with the requirements of section

[1] Tax issues under review by Nalcor.

5.1 or 5.5 or both, as applicable.

4.4 The Parties agree that, subject to approval in writing by Nalcor, funds allotted for one line item set out in the budget attached as Appendix "B" may be reallocated or transferred in whole or in part to one or more other line items in that budget, provided that _____ _____ continues to comply with this Agreement and with the Workplan. If _____ _____ proposes to transfer or reallocate funding between or among the budgetary line items set out in Appendix B, it shall, prior to such proposed reallocation or transfer, first submit a request in writing in a timely manner to Nalcor for its approval. Nalcor will not unreasonably deny such a request and will respond to _____ in a timely manner. In no case shall a transfer or reallocation of funds under this section result in any increase in the funding obligations, commitments or liabilities of Nalcor beyond that which has been agreed to by the Parties pursuant to this Agreement.

4.5 _____ will use the funding provided under section 4.2 for the sole purpose of carrying out this Agreement and will expend those funds only in accordance with the list of eligible expenditures set out in Appendix "C" to this Agreement.

4.6 _____ will apply for all rebates to which it is entitled under provincial or federal legislation, including but not limited to the goods and services tax under the *Excise Tax Act* (Canada) where applicable.[2]

5 REPORTING REQUIREMENTS

5.1 On the fifteenth (15th) day of each month, commencing on June 15, 2010 and continuing thereafter until August 15, 2010 or for each subsequent calendar month while this Agreement is in effect, the Project Coordinator shall provide to the Nalcor Contact and to _____ _____ a Progress Report consisting of the following:

(e) a written activity report for the preceding calendar month describing the progress in the implementation of the Workplan, including activities undertaken and any relevant issues which have been identified; and

(f) an unaudited financial report in the format presented in Appendix "D" prepared in accordance with generally accepted accounting principles, reporting total revenues and eligible expenditures incurred and accrued and funded pursuant to this Agreement in the preceding calendar month, together with all supporting documentation, including, where appropriate, a detailed description of the hours worked, honoraria, expenses and costs billed

[2] Necessity for clause and final wording under review by Nalcor.

in accordance with the following schedule:

Date of Submission of Progress Report	Period Covered by Progress Report
June 15, 2010	May 1, 2010 – May 31, 2010
July 15, 2010	June 1, 2010 – June 30, 2010
August 15, 2010	July 1, 2010 – July 31, 2010

The final Progress Report for the month of August, 2010 shall be submitted to Nalcor by the Project Coordinator no later than August 31, 2010.

5.2 _____ shall, no later than ninety (90) days following the expiration of this Agreement under section 3.2 or termination under section 3.3, provide Nalcor with an audited financial statement prepared in accordance with generally accepted auditing principles showing total revenue and eligible expenditures under this Agreement and detailing that the funds received under this Agreement were fully accounted for and spent properly and in accordance with the terms of this Agreement.

5.3 Nalcor may request from _____ such information and documentation that it may reasonably require to confirm that advances or payments made pursuant to this Agreement were disbursed for eligible expenditures and made by the Project Coordinator in accordance with this Agreement and may, at its own expense, appoint an independent auditor to verify eligible expenditures made by the Project Coordinator pursuant to this Agreement.

5.4 The Parties shall meet at least once every month while this Agreement is in effect or more often as agreed, to exchange information respecting the Project and the progress of community engagement pursuant to this Agreement, to discuss the issues, questions and concerns generated during the consultation process, and to report on the environmental assessment process and to review ongoing implementation of the Workplan.

5.5 Within five (5) days prior to the expiration of this Agreement, the Project Coordinator shall provide to Nalcor and _____ a final report in writing, entitled the "Project Coordinator's Report" which shall contain the following:

- A description of the community, including population;
- A detailed description of the consultation activities undertaken during the term of this Agreement, including the type, date and frequency of such activities;
- A transcript of any and all community information sessions, participant interviews and any other data generated, whether in written, recorded or digital format, during the consultation process, including any notices of meetings; and
- A detailed description of _____ and community issues and concerns respecting the Project and any information respecting current land and resource usage for traditional purposes and traditional knowledge which has been produced by or disclosed during the consultation process.

5.6 Within ten (10) days after the expiration of this Agreement, Nalcor and _____ _____ shall review the Project Coordinator's Report and to discuss next steps.

6 INFORMATION, CONFIDENTIALITY AND DISCLOSURE

6.1 The Parties agree that it will be necessary to share, evaluate and discuss certain information to fulfill the objectives of this Agreement and therefore agree to provide such information as is relevant and necessary to fulfill the objectives of this Agreement in a timely manner. The Parties acknowledge that certain information may be restricted, commercially sensitive or otherwise subject to confidentiality requirements. Nalcor agrees to provide access to such restricted, confidential or commercially sensitive information that Nalcor deems necessary and relevant to the objectives of this Agreement, provided that appropriate confidentiality agreements have been executed by the Parties to protect such confidential and commercially sensitive information and is satisfied that third parties to whom such information may be disclosed are subject to the same confidentiality requirements.

6.2 Notwithstanding anything else in this Agreement, _____ acknowledges that Nalcor shall not be obliged to disclose or share with _____ environmental, engineering, financial or other information pertaining to the evaluation of particular development options with respect to or associated with the Project by Nalcor.

6.3 The Parties agree to execute appropriate confidentiality agreements to protect restricted, confidential or commercially sensitive information and subject to section 6.4, to release information respecting the Project and traditional knowledge, including in relation to land, water and resource usage, only in accordance with the terms of such confidentiality agreements or as otherwise required by law.

6.4 The Parties agree that the property in the Project Coordinator's Report referred to in section 5.5 and the Progress Reports submitted under section 5.1 shall be vested in Nalcor and may be submitted to the Joint Review Panel during the environmental assessment of the Project or used in any other proceedings related to the subject matter of this Agreement. The Parties agree that _____ may use the Project Coordinator's Report or the monthly Progress Reports, provided that _____ first obtains the written consent of Nalcor to such use, which consent shall not be unreasonably withheld.

7 WITHOUT PREJUDICE

7.1 This Agreement and all negotiations surrounding it shall not be, and nothing contained in this Agreement shall be, construed as conferring on, recognizing, limiting, modifying, replacing, denying or derogating from any Aboriginal, treaty or constitutional rights or obligations of either the Parties or of the Innu of _____ and their representatives thereof and is without prejudice to the positions which may be taken by the Parties with respect thereto in any other forum, court of law or otherwise.

7.2 Nalcor acknowledges that it is the position of _____ that neither this Agreement, any negotiations surrounding it nor the consultation activities conducted pursuant to it shall be construed as meeting the constitutional obligations of the Crown in right of Newfoundland and Labrador, nor those of the Crown in right of Canada.

7.3 Notwithstanding section 6.1, this Agreement and all negotiations surrounding it and the consultation activities conducted pursuant to this Agreement are not subject to settlement privilege and either Party may refer to the existence or the content of this Agreement and any discussions, negotiations, activities or reports conducted or prepared pursuant to this Agreement and may tender evidence of such discussions, negotiations, activities or reports in any action, petition or proceeding in any forum relating to the issue of consultation.

7.4 This Agreement is a legally binding agreement which is intended to clarify and improve the working relationship of and communication between the Parties. It is not, and shall not be interpreted to be, a treaty or land claims agreement within the meaning of s.25 or s.35 of the *Constitution Act, 1982*.

7.5 This Agreement and the negotiations leading to its formation, execution and implementation are without prejudice to any Party in any future negotiations.

7.6 Except as otherwise specifically provided herein, nothing in this Agreement shall limit in any manner the rights, jurisdiction, authority, obligations or responsibilities of either Party or their representatives.

7.7 Nothing in this Agreement obliges _____ or Nalcor to act in a manner inconsistent with or contrary to law and nothing in this Agreement fetters or is to be interpreted as fettering the discretion or decision making authority of _____ _____ or Nalcor.

7.8 Nothing in this Agreement is intended to limit the participation by _____ or by Nalcor in any public processes established by Newfoundland and Labrador or Canada respecting the environmental assessment of the Project.

8 NOTICE

8.1 Any notice or other communication required or permitted to be given under this Agreement shall be given in writing and will be deemed to have been well and sufficiently given if sent by registered mail, courier or facsimile to:

In the case of Nalcor Energy, to:

Todd Burlingame
Environment and Aboriginal Affairs Manager
Nalcor Energy -- Lower Churchill Project
P.O. Box 12800, 500 Columbus Drive
St. John's, NL A1B 0C9
Ph: (709) 737-4251
Fax: (709) 737-1985

In the case of, _____ to:

Any notice sent by registered mail shall be deemed to have been duly given and received by a Party on the fifth business day following the day of mailing and on the following day if sent by facsimile transmission.

8.2 A person shall be designated by each of the Parties to act as the Senior Representative of that Party for the purposes of this Agreement. Until the Parties to this Agreement are otherwise advised, the designated persons who represent each of the Parties are:

In the case of Nalcor Energy,

Gilbert Bennett
Vice President
Lower Churchill Project
Nalcor Energy
P.O. Box 12800, 500 Columbus Drive
St. John's, NL A1B 0C9
Ph: (709) 737-1836
Fax: (709) 737-1782

In the case of _____,

8.3 In the event that it becomes necessary to substitute individuals for those referred to in section 8.2, the Party doing so shall notify the other Party in accordance with section 8.1 and provide the appropriate documentation to effect the change.

9 GENERAL

9.1 There will be no presumption that any ambiguity in any of the terms of this Agreement shall be interpreted or resolved in favour of either Party.

9.2 This Agreement and any valid amendment to it constitute the entire agreement between the Parties with respect to the subject matter of this Agreement, unless otherwise agreed by the Parties and supersedes all prior oral or written representations and agreements. There are no other agreements, understandings, representations, warranties, collateral agreements or conditions affecting this Agreement except as expressed or anticipated in it.

9.3 _____ represents that this Agreement is binding upon itself and the Innu of _____ and that all necessary actions have been taken to authorize the execution of this Agreement.

9.4 Nalcor represents that this Agreement is binding upon it and that all necessary actions have been taken to authorize the execution of this Agreement.

9.5 _____ represents and warrants that there are no actions or proceedings pending by or against _____ or any of its members that would materially impair its ability to fulfill its obligations under this Agreement and that it has not

entered into any other agreement that would prevent it from fulfilling its obligations under this Agreement.

9.6 This Agreement is a legally binding contract which shall be considered to have been made in Newfoundland and Labrador and is subject to laws of general application and shall be interpreted in accordance with the laws of Newfoundland and Labrador and the federal laws of Canada applicable therein without regard to conflicts of laws principles that would impose the laws of any other jurisdiction and each Party hereby irrevocably and unconditionally submits to the exclusive jurisdiction of the courts of Newfoundland and Labrador and all courts competent to hear appeals therefrom.

9.7 No Party shall challenge or support a challenge to the validity of this Agreement or any provision thereof.

9.8 The Parties agree to do or cause to be done all acts or things necessary to implement and carry into effect this Agreement to its full extent.

9.9 The provisions of Article 6 (Information, Confidentiality and Disclosure), section 4.7 (repayment of funding), sections 5.1 and 5.5 (reporting requirements), section 5.6 (meeting of the Parties), section 7.3 (no settlement privilege) and this section 9.9 shall survive the expiration of this Agreement under section 3.2 or termination under section 3.3.

10 LANGUAGE

10.1 The Parties agree that, for the purpose of convenience, all written communications, including any notices, reports and other documentation ("written communications") required or permitted by this Agreement between _____ and Nalcor shall be in French. Notwithstanding the preceding, the Parties agree that where the original language of a written communication is French, Nalcor reserves the right, at its sole cost, to translate such written communication into English, using an agreed-upon certified translator listed in Appendix "E". Where a written communication prepared in French is translated in accordance with this section, the Parties agree to be bound by and shall not challenge the validity of such translation. The Parties further agree that the English version (whether original or in translation) of any written communication shall be authoritative and in the case of inconsistency between the French version and the English version of a written communication, the English version (whether original or translated) shall prevail. Nalcor shall be entitled to use only the English version of a written communication in any proceeding or forum, including in any submission to the Joint Review Panel.

IN WITNESS WHEREOF each of the Parties have caused this Agreement to be executed by the duly authorized signing officers of the Parties:

Nalcor Energy

Per

Per

Witness

Date

Per

Per

Witness

Date

ATTACHMENT 3

INFORMATION RESPONSES
LOWER CHURCHILL PROJECT

JOINT REVIEW PANEL

Aboriginal Consultation and Traditional Land and Resource Use

IR# JRP.151

NEW DAWN AGREEMENT

May 2010

nalcor energy
LOWER CHURCHILL PROJECT

THE TSHASH PETAPEN AGREEMENT (jash pey-taah-ben)

NEW DAWN AGREEMENT

BETWEEN:

Her Majesty the Queen in right of Newfoundland and Labrador (the "**Province**")

- and -

Energy Corporation of Newfoundland and Labrador, a body corporate existing pursuant to the *Energy Corporation Act* being Chapter E-11.01 of the Statutes of Newfoundland and Labrador, 2007 ("**ECNL**")

- and -

Innu Nation, a body corporate under the laws of Canada

WHEREAS:

A. Negotiations have taken place concerning the major outstanding issues in on-going negotiations for a land claims Agreement in Principle ("**AIP**"), the upper Churchill River hydro-electric development, and an Impacts and Benefits Agreement ("**IBA**") for the lower Churchill River hydro-electric project (the "**Project**").

B. The parties now wish to conclude these negotiations and provide a framework for the conclusion of definitive agreements.

NOW THEREFORE the parties hereto agree as follows:

1. Land Claim Agreement In Principle

(a) Land selection and rights shall be in accordance with the following principles:

(i) Labrador Innu Lands (LIL – C1) of 5,000 square miles, as set out on the map attached at Appendix 1.

(ii) Labrador Innu Settlement Area outside LIL (Category 2 – C2) lands of 9,000 square miles, as shown on the map attached at Appendix 1.

(iii) Category 3 (C3) lands of 13,000 square miles, as shown on the map attached at Appendix 1. The rights applicable to the C3 land area are limited to the right to harvest migratory species of Wildlife without the applicable provincial licence and payment of the associated fee and the right to harvest Migratory Birds subject to the concurrence of the federal government.

(iv) The area of the proposed Mealy Mountains National Park will be included as part of the AIP.

(v) The inclusion of any area shown on the map attached at Appendix 1 that overlaps the Labrador Inuit Settlement Area is subject to Innu Nation making appropriate arrangements with the Nunatsiavut Government. Revenue sharing in the Economic Development chapter of the AIP will not apply anywhere in which the Labrador Innu Settlement Area overlaps with the Labrador Inuit Settlement Area. It is understood, however, that the Innu may receive Revenue from the Nunatsiavut Government in those areas as agreed to by the Innu and the Nunatsiavut Government pursuant to their overlap agreement.

(vi) Economic Development Areas ("**EDA**") will be as shown on the map attached at Appendix 1.

(vii) The right applicable in the EDAs in section 1.a.vi will be limited to an IBA for any Major Development. IBAs shall not be required for power transmission lines and associated facilities and infrastructure in these EDAs. For greater certainty, Churchill Falls (Labrador) Corporation Ltd. ("**CF(L)Co.**") shall not be subject to the requirement of an IBA. An IBA shall also not be required for forestry in the EDA (shown on the map attached at Appendix 1) south of the Churchill River and west of the Trans Labrador Highway, Phase 3. The process for concluding an EDA IBA will be the same as that for Category 2 lands.

(viii) The following areas of potential hydro-electric developments will be designated as hydro EDAs: Fig; Dominion; Minipi; and Kenamu, as described in "Southern Labrador Power Study," SNC Inc. 1977 (reference plate 6, extent of mapping). The right applicable in these hydro EDAs will be limited to an IBA for hydro-electric Major Developments. The process for concluding a hydro EDA IBA will be the same as that for Category 2 lands. Within any such IBA, commercial participation shall be a 3% net revenue royalty calculated on the same basis as the lower Churchill IBA royalty.

(ix) It is understood that the selection of LIL may require further refinement so as not to impede, impair, or adversely affect:

(1) the Project and associated infrastructure and facilities; and

(2) any hydro development or transmission corridors and associated facilities and infrastructure in the four named hydro EDAs.

(x) The Project IBA currently under negotiation will be the only IBA pursuant to which the Innu of Labrador are entitled to receive benefits for any development directly or indirectly required in relation to or associated with the Project. For greater certainty, if there is a subsequent

development in the Lower Churchill Project Area, an IBA will be required for that subsequent development.

(xi) It is understood that the access corridors as shown on the map attached at Appendix 1 in areas west of Natuashish are to provide general corridor access between central Labrador and northern Labrador. Further refinement by the Province and Innu Nation of this corridor may be required. Any refinement of these corridors shall be for the purpose of facilitating general access as described above.

(xii) The categories, if any, of the encircled areas on the map attached at Appendix 1 are yet to be determined. These areas will be subject to further negotiation by the parties.

(xiii) Any area noted in section 1.a.xii that the Province and Innu Nation agree to include in the AIP as C-1, C-2, C-3 lands will not be in addition to the relevant quantum set out in section 1(a)(i), 1(a)(ii), and 1(a)(iii).

(xiv) All of the boundaries of the proposed AIP selections shown on the map attached at Appendix 1 shall be adjusted to create final boundaries for those selections that are based upon topographic features to the greatest reasonable extent, while maintaining to the greatest reasonable extent the integrity of those selections.

(xv) The other provisions of this section are contingent upon the timely resolution of the following key issues:

(1) Certainty, indemnity and finality.

(2) Whether and how to define consultation.

(3) Certainty on consultation obligations.

(4) Composition of the Dispute Resolution Board and Arbitration Panels.

(5) The definition of "Major Development".

(6) Military flying.

(7) Specific roles and responsibilities for the Resource Management Board.

(8) The Access, Expropriation, Economic Development, Water Management and Lower Churchill chapters of the AIP.

(9) Non-assertion of aboriginal rights in the Lower Churchill Project Area against any Person.

(b) Issues that have been resolved and text that has been agreed in the draft AIP shall not be subject to re-negotiation or revision except as agreed to by the Province and Innu Nation. For purposes of this section, text which is not subject to a footnote or annotation or contained in square brackets shall be considered to be agreed to by the Province and Innu Nation.

2. Upper Churchill Project

(a) The Province shall pay to Innu Nation or, if established, the Innu Government (collectively hereafter "**Innu Nation**") an annual payment of two million dollars Canadian ($2,000,000.00) commencing upon ratification and execution of the IBA and terminating on August 31, 2041. The payments will be indexed annually using a rate of two and one-half percent (2.5%) commencing on the date of IBA ratification and execution.

(b) The Province shall pay to Innu Nation an annual amount equal to three percent (3%) of dividends on common shares received by the Province either directly or via a corporation owned by the Province and earned from the plant configuration of CF(L)Co. existing at the date of this Agreement. These payments shall commence effective September 1, 2041.

(c) In the event that the parent company of CF(L)Co. sells any of its common shares, the Innu Nation shall be entitled to receive three percent (3%) of the proceeds received from the sale of common shares. If a sale takes place prior to September 1, 2041, the total proceeds shall be reduced by the present value of the expected free cash flow from the common dividends from the date of sale up to and including August 31, 2041.

(d) If CF(L)Co. issues a new class of shares with the purpose of diluting the value of the dividends on common shares referred to in section 2(b), above, the Innu Nation's share of common dividends is to be calculated as if the new class of shares had not been issued.

(e) Innu Nation will receive the financial compensation as set out in clauses a. and b., above, to be paid conditional upon Innu Nation, on behalf of the Innu of Labrador, providing a comprehensive release for any and all past, present, and future claims by the Innu of Labrador concerning the interference with the enjoyment of aboriginal rights due to the upper Churchill River hydro-electric development.

3. Impacts and Benefits Agreement for the Lower Churchill Project

(a) The payments specified in sections 3(b) and 3(c) represent the full and final settlement to Innu Nation, its successors and assigns for all past, present and future claims, activities and compensation relating to the Project.

(b) Implementation Payments prior to First Commercial Power:

(i) ECNL shall pay to Innu Nation an annual amount of five million dollars Canadian ($5,000,000.00) ("**Implementation Payment**") to assist Innu Nation with expenditures associated with fulfilling Innu Nation's IBA responsibilities prior to and during the construction period. These amounts will be the full and final consideration provided to Innu Nation prior to the date power is first commercially produced from the Project ("**First Commercial Power**") for all IBA responsibilities and activities.

(ii) Implementation Payments will commence on the date of Project sanction (and following the signing of the IBA) and, if applicable, a pro rated portion of the last quarterly instalment before First Commercial Power shall be offset against the first annual payment set out in section 3(c)(ii).

(iii) Implementation Payments will be indexed to Canadian CPI to a maximum of 2.5% annually from project sanction to First Commercial Power.

(iv) Implementation Payments shall be due and payable in quarterly instalments and shall continue for a period not to exceed ten (10) years from the date that the initial Implementation Payment was made unless the Project is stopped or suspended for any reason at which time the Implementation Payments would be suspended.

(c) Annual Payment and Minimum Payment

(i) If the number of years between Project sanction and First Commercial Power is less than ten (10) years, Innu Nation is eligible to receive an annual Minimum Payment in accordance with section 3(c)(ii) equal to five million dollars ($5,000,000.00) for a period not to exceed ten (10) years less the number of years of receipt of the Implementation Payments, as set out in section 3(b)(i), above. For greater certainty, such payment shall be indexed to Canadian CPI to a maximum of 2.5% annually starting from the year of Project sanction.

(ii) ECNL shall, for each year or portion of a year during which the IBA is in full force and effect, pay annually to Innu Nation for such year or portion of a year following First Commercial Power, an Annual Payment in Canadian dollars determined as the greater of the Minimum Payment and five percent (5%) of annual After Debt Net Cashflow. For greater certainty, when the ten (10) year time period commencing at Project sanction has expired, the Minimum Payment is deemed to be equal to zero.

(iii) The parties shall agree on a mechanism to ensure that the cumulative Annual Payments to Innu Nation from First Commercial Power to decommissioning are equal to five percent (5%) of the cumulative After Debt Net Cashflow, while recognizing the intent of the Minimum Payments made post First Commercial Power referenced in section 3(c)(i).

(iv) The Annual Payment is subject to audit and verification.

(v) After Debt Net Cashflow is to be determined as follows, with all elements of the calculation related to the generation component of the Project and determined using Canadian Generally Accepted Accounting Principles ("**GAAP**"):

(1) Gross revenues, less transmission costs for market access including any applicable open access transmission tariffs and related upgrades; minus

(2) all operational and maintenance expenses and related charges, excluding depreciation and amortization on capital assets; minus

(3) all debt service costs related to the Project with respect to financing in place at First Commercial Power, both Project and equity related, including but not limited to principal repayments, interest, guarantee fees, issuance fees and other financing fees that may be charged from time to time; minus

(4) All debt service costs related to borrowings subsequent to that in place at First Commercial Power, both Project and equity related, including but not limited to principal repayments, interest, guarantee fees, issuance fees and other financing fees that may be charged from time to time; minus

(5) refinancing fees and related costs; minus

(6) preferred dividends (related to financing) incurred during the year; minus

(7) income and other taxes paid and payable during the year; minus

(8) capital expenditures incurred during the year; minus

(9) an allowance for decommissioning costs.

(d) Innu Business Participation Target will be four hundred million dollars Canadian ($400,000,000.00). If this target is not achieved, ECNL will pay an amount to Innu Nation equal to 5% of the difference between the target and the total value of the contracts awarded to Innu Businesses. The list of contracts last proposed by ECNL will be the contracts for which Innu Businesses will be offered the first opportunity to bid.

(e) After First Commercial Power, IBA payments will be suspended during an event of *force majeure*.

(f) Innu Nation shall provide a comprehensive release to ECNL related to any adverse effects of the Project upon the rights and interests of the Innu of Labrador, including aboriginal rights. Innu Nation also agrees to provide an indemnity to ECNL in respect of claims related to the adverse effects of the

Project. The scope of such indemnity shall be the subject of negotiations between ECNL and Innu Nation.

(g) Innu Nation agrees that the Project shall be defined as including all of the proposed hydro-electric generation and transmission facilities and associated infrastructure, and all activities carried on, at or in, or related to such generation and transmission facilities and associated infrastructure in the project area that are necessary to produce and transmit hydro-electric power from Gull Island and Muskrat Falls. For greater certainty, Innu Nation also agrees to the Project Description (Schedule 1-A), and Map of the Project Area (Schedule 1-B) contained in the draft IBA. The parties acknowledge that the definition of Project, the Project Description and Map of the Project Area may be subject to:

(i) refinements to more accurately reflect progress in the final design for the construction and operation of the Project; and

(ii) other technical revisions which may be made by agreement of Innu Nation and ECNL.

(h) This Agreement is contingent upon timely finalization by ECNL and Innu Nation of a draft IBA that resolves all outstanding issues between Innu Nation and ECNL in all chapters, including the commercial chapter, which shall include provisions determining the payment of the net royalty revenue referred to above. In this regard, ECNL and Innu Nation agree as follows:

(i) that the list of outstanding issues agreed to by the parties on September 26, 2008 is an accurate representation of the issues that are outstanding;

(ii) that ENCL shall, by September 30, 2008, prepare a consolidated IBA draft to date for review and verification by Innu Nation. The consolidated draft shall comprise the most recent version of the various draft chapters of the IBA and shall set out the matters that have been agreed to and those that remain outstanding. The parties agree that issues that have been resolved and text that has been agreed within the consolidated draft shall not be subject to re-negotiation or revision except as agreed to by ECNL and Innu Nation. For purposes of this section, text in the consolidated draft that is not subject to a footnote or annotation or contained in square brackets shall be considered to be agreed to by ECNL and Innu Nation; and

(iii) that once the draft IBA has been initialled by representatives of ECNL and of Innu Nation, it will not be revised without the consent of ECNL and Innu Nation.

4. General

(a) The parties agree to use every reasonable effort to complete the AIP, the IBA, and an agreement on financial compensation in respect of the upper Churchill River

hydro-electric development in a timely manner and to proceed to concurrent ratification and execution of these agreements on or before January 31, 2009.

(b) The parties agree that a failure to ratify and execute any one of:

(i) the AIP;

(ii) the IBA; or

(iii) the agreement on financial compensation in respect of the upper Churchill River hydro-electric development

shall be considered to be a failure to ratify and execute all. For greater certainty, until ratification and execution of all, neither the AIP nor the IBA, nor the agreement on financial compensation for the upper Churchill River hydro-electric development shall be of any force or effect.

(c) The parties agree that, once ratified and executed:

(i) the agreements referred to in section 4(b) shall not be altered or amended, except in accordance with their terms; and

(ii) each agreement referred to in section 4(b) shall come into effect in accordance with its terms. The fact that the Project does not proceed, or that its commencement is delayed or deferred, does not affect the continuing validity and legal effect of any of the agreements referred to in section 4.b unless the parties to the particular agreement have otherwise stipulated. For greater certainty, the failure to proceed with the Project, or to delay or defer the Project does not affect the continuing validity and legal effect of the IBA.

(d) The parties agree that ratification and execution of the IBA by Innu Nation and the First Nations constitutes full and final consent of the Innu of Labrador to the Project proceeding.

(e) Grand Chief Mark Nui, Deputy Grand Chief Peter Penashue, Sheshatshiu Innu First Nation Chief Anastasia Qupee, and Mushuau Innu First Nation Chief Prote Poker by their signatures agree to recommend this Tshash Petapen Agreement to the Innu Nation Board for approval.

IN WITNESSETH WHEREOF the parties hereto have set their hands on the 26th day of September, 2008.

Grand Chief Mark Nui
Innu Nation

Deputy Grand Chief Peter Penashue
Innu Nation

Chief Prote Poker
Innu Nation Executive

Chief Anastasia Qupee
Innu Nation Executive

E.J.Martin
President and CEO
Energy Corporation of Newfoundland and Labrador

Donald H. Burrage, Q.C.
Deputy Minister of Justice
Deputy Attorney General

ATTACHMENT 4

INFORMATION RESPONSES
LOWER CHURCHILL PROJECT

JOINT REVIEW PANEL

Aboriginal Consultation and Traditional Land and Resource Use

IR# JRP.151

RECORD OF CONSULTATION – NUNATUKAVUT

May 2010

nalcor energy
LOWER CHURCHILL PROJECT

Record of Consultation: Nunatukavut (formerly the Labrador Metis Nation)

Who	Date	Action Taken
President Montague	Jan 15, 2007	Letter to Minister Clyde Jackman urging the Crown to consult with the Labrador Metis Nation.
David Kiell	April 09, 2007	Letter to President Montague inviting him to Lower Churchill Project Open Houses to be held in Churchill Falls, Happy Valley-Goose Bay and North West River/Sheshatshiu on April 15th, 16th and 17th 2007 respectively.
David Kiell	April 17, 2007	Meeting in Happy Valley-Goose Bay attended by Gilbert Bennett, Leona Barrington, Steve Bonnell, Bert Pomeroy and Tammy Lambourne.
Gilbert Bennett	Feb 12, 2008	Letter to President Montague proposing Feb 25th meeting.
Gilbert Bennett	Feb 26, 2008	Meeting in Happy Valley-Goose Bay attended by Gilbert Bennett, Leona Barrington, Steve Bonnell, Chris Montague, Jamie Snook, Tammy Lambourne, Rick Bennett, John Glew.
Gilbert Bennett	Feb 26, 2008	Letter to President Montague requesting meeting and providing Project information package including: Seven Lower Churchill Project Environmental Registration documents; Two copies of the Project's reservoir map book; Two copies of the proposed site layouts at Gull Island and Muskrat Falls; and Aquatic Studies, Environmental Assessment Process, Historic Resource Studies, Mercury, Socioeconomic Assessment, Reservoir Formation, Terrestrial Studies.
Steve Bonnell	Feb 27, 2008	Email to Tammy Lambourne as follow up to Feb 26th meeting and requesting meeting Mar 11th.
Larry LeDrew	Mar 03, 2008	Letter to President Montague inviting him to Lower Churchill Project Open Houses to be held in Labrador City, Happy Valley-Goose Bay, North West on Mar 10th, 11th and 13th 2008 respectively.
Steve Bonnell	Mar 06, 2008	Email to Tammy Lambourne to confirm receipt of Feb 27th email.
Tammy Lambourne	Mar 06, 2008	Email to Steve Bonnell confirming receipt of Feb 27th email and proposing Mar 11th meeting focus on negotiating an environmental agreement between Newfoundland and Labrador Hydro and the Labrador Metis Nation.
Steve Bonnell	Mar 07, 2008	Email to Tammy Lambourne confirming Tuesday, Mar 11th meeting also advising that the nature of the meeting will have to be of a general nature.
Tammy Lambourne	Mar 10, 2008	Email to Steve Bonnell declining Mar 11th meeting.
Steve Bonnell	Mar 12, 2008	Letter to Tammy Lambourne sending Project information package including: Two copies of the Lower Churchill Project Environmental Assessment Registration document; Two copies of the reservoir map book; Two copies of the proposed site layouts at Gull Island and Muskrat Falls; and Aquatic Studies, Historic Resources, Reservoir Formation, Mercury in Reservoirs, Green House Gas Emissions, and Construction Workforce Fact Sheets.
Steve Bonnell	Mar 14, 2008	Email to Tammy Lambourne indicating that Newfoundland and Labrador Hydro was not ready at that point to enter into discussions regarding an environmental agreement. Also, welcoming meetings at any time.
President Montague	Mar 18, 2008	Letter to Steve Bonnell regarding Project information package they received from Nalcor Energy.

Record of Consultation: Nunatukavut (formerly the Labrador Metis Nation)

Who	Date	Action Taken
Gilbert Bennett	Apr 09, 2008	Letter to President Montague requesting meeting to move forward with discussions.
Todd Burlingame	May 09, 2008	Letter to Tammy Lambourne inviting her to the Lower Churchill Project Methylmercury Technical Workshop in Happy Valley-Goose Bay.
President Montague	May 30, 2008	Letter to Todd Burlingame requesting postponement of the Energy Alternatives Technical Workshop.
President Montague	July 15, 2008	Letter to Gilbert Bennett welcoming consultation.
Maria Moran	Aug 05, 2008	Email to Jamie Snook providing notes and proposed consultation plan.
Todd Burlingame	Aug 25, 2008	Letter to President Montague inviting him to a Lower Churchill Project Open House in Rigolet on Sept 15th, 2008.
Todd Burlingame	Aug 26, 2008	Letter to President Montague including Historic Resources Overview and Impact Assessment of Muskrat Falls Generating Facility and Reservoir, and Muskrat Falls to Gull Island Transmission Line Corridor.
President Montague	Sep 29, 2008	Labrador Metis Nation submitted a draft Consultation and Accommodation Discussion Paper to Newfoundland and Labrador Hydro.
Leslie Grattan	Nov 06, 2008	Telephone call to Jamie Snook; left message regarding Lower Churchill Project training and employment meeting Nov 13th, 2008.
Leslie Grattan	Nov 06, 2008	Email to Jamie Snook regarding telephone message and invitation to the Nov 13th Lower Churchill Project training and employment meeting in Happy Valley-Goose Bay.
Jamie Snook	Nov 06, 2008	Email to Leslie Grattan declining participation in Nov 13th Lower Churchill Project training and employment meeting.
Gilbert Bennett	Nov 10, 2008	Letter to President Montague regarding the draft consultation and accommodation discussion paper with an offer to meet.
Leslie Grattan	Nov 12, 2008	Telephone call to Jamie Snook regarding progress on a way forward and the Labrador Metis Nation's participation in the Nov 13th Lower Churchill Project training and employment meeting in Happy Valley-Goose Bay.
Leslie Grattan	Nov 12, 2008	Email to Jamie Snook regarding progress on a way forward and their participation in the Nov 13th Lower Churchill Project training and employment meeting in Happy Valley-Goose Bay.
Jamie Snook	Nov 12, 2008	Email to Leslie Grattan inquiring if she had a copy of the letter in response to the Labrador Metis Nation's draft consultation and accommodation discussion paper.
Leslie Grattan	Nov 12, 2009	Email to Jamie Snook indicating she would fax the letter in response to the Labrador Metis Nation's draft consultation and accommodation discussion paper.
Jamie Snook	Nov 13, 2009	Email to Leslie Grattan confirming receipt of the letter also declining a meeting at this time.
Leslie Grattan	Nov 17, 2008	Email to Jamie Snook updating him to the turnout of the Nov 13th Lower Churchill Project training and employment meeting in Happy Valley-Goose Bay.
Leslie Grattan	Nov 25, 2008	Email to Jamie Snook inviting him to attend the Dec 09th Lower Churchill Project training and employment meeting in Happy Valley-Goose Bay. Also inviting him to meet separately regarding information provided at the Nov 13th meeting.
Todd Burlingame	Dec 30, 2008	Letter to President Montague with an offer to meet and providing information on Project related employment estimates and possible associated training strategies.

Record of Consultation: Nunatukavut (formerly the Labrador Metis Nation)

Who	Date	Action Taken
Jeanette Drover	Jan 29, 2009	Email to Jamie Snook inviting him to the Feb 13th Lower Churchill Project training and employment meeting in Happy Valley-Goose Bay.
Lisa Dempster	Feb 02, 2009	Email to Jeanette Drover inquiring into the details of the Feb 13th Lower Churchill Project training and employment meeting in Happy Valley-Goose Bay.
Gilbert Bennett	Feb. 02, 2009	Letter to President Chris Montague with copy of Transmission Registration enclosed for your interest and information. Appreciate the opportunity to discuss the Transmission Registration with you at your convenience.
Leslie Grattan	Feb 03, 2009	Email to Lisa Dempster regarding the Labrador Metis Nation's participation in the Feb 13th training and employment meeting in Happy Valley-Goose Bay.
Jeanette Drover	Feb 10, 2009	Email to Lisa Dempster sending the agenda to the Feb 13th Lower Churchill Project training and employment meeting in Happy Valley-Goose Bay.
Lisa Dempster	Feb 11, 2009	Email to Jeanette Drover welcoming participation in the Feb 13th Lower Churchill Project training and employment meeting in Happy Valley-Goose Bay. A representative from the Labrador Metis Nation was not able to attend.
Gilbert Bennett	Mar 18, 2009	Letter to President Montague offering congratulations on re-election and proposing meeting.
Jeanette Drover	Mar 31, 2009	Telephone call to Roland Kemuksigak inviting him to the Lower Churchill Project Fish Habitat Compensation Workshop in Happy Valley-Goose Bay on Apr 07th.
Jeanette Drover	Mar 31, 2009	Email to Roland Kemuksigak inviting him to the Lower Churchill Project Fish Habitat Compensation Workshop in Happy Valley-Goose Bay on Apr 07th.
Jeanette Drover	Apr 06, 2009	Email to Roland Kemuksigak sending the agenda for the Lower Churchill Project Fish Habitat Compensation Workshop in Happy Valley-Goose Bay on Apr 07th.
Jeanette Drover	Apr 07, 2009	Lower Churchill Project Fish Habitat Compensation Workshop in Happy Valley-Goose Bay attended by Ken Weagle, Jim McCarthy, Dave Brown, Bob White, Jeanette Drover and Roland Kemuksigak.
Jeanette Drover	Apr 07, 2009	Lower Churchill Project Fish Habitat Compensation Workshop in Happy Valley-Goose Bay attended by Ken Weagle, Jim McCarthy, Dave Brown, Bob White, Jeanette Drover and President Montague.
Gilbert Bennett	Apr 23, 2009	Letter to President Montague requesting meeting also including draft consultation agreement.
Mary Hatherly, Todd Burlingame	Apr 23, 2009	Meeting with President Montague to discuss the draft consultation agreement.
Mary Hatherly, Todd Burlingame	Jun 10, 2009	President Montague submitted a revised draft consultation agreement to Nalcor Energy.
Chris Montague	Jun 10, 2009	Meeting with Todd Burlingame and Mary Hatherly. LMN's proposed revisions to community consultation agreement submitted
Mary Hatherly/Chris Montague	Jun 17, 2009	Series of e-mails requesting clarification of certain points and responses
Mary Hatherly/Chris Montague/Dorothy Earle	Jul 2, 2009	Conference call to discuss LMN's proposed revisions to community consultation agreement
Mary Hatherly/ Bruce Clarke	Jul 2, 2009	Phone call to discuss proposed changes; follow-up email
Mary Hatherly/Chris Montague	Jul 3, 2009	E-mail with Nalcor Energy's' redraft of community consultation agreement attached

Record of Consultation: Nunatukavut (formerly the Labrador Metis Nation)

Who	Date	Action Taken
Mary Hatherly/ Bruce Clarke	Aug 10, 2009	E-mail with Nalcor Energy's' redraft of community consultation agreement attached
Mary Hatherly/ Bruce Clarke	Sep 1, 2009	Email correspondence seeking update from LMN
Todd Burlingame	Oct 5, 2009	Letter to President Chris Montague re: Labrador-Island Transmission Link: Amendment to the EA Registration and Project Description
Gilbert Bennett, Todd Burlingame, Mary Hatherly	Dec 11, 09	Community Consultation Agreement between Nalcor Energy and the Labrador Metis Nation signed
Gale Warren, Emma Sharkey, Elisabeth Poirier-Garneau	Jan 20, 2010	Nalcor Aboriginal Planning team met with the Chris Montague, George Russell, Tammy Lambourne to discuss the Community Consultation Agreement and actions going forward.
Marion Organ, Emma Sharkey	Jan 26, 2010	Marion presented an overview of the generation and transmission projects to Tammy Lambourne, Geroge Russell and Roland Kemuksigak
Emma Sharkey/Gale Warren/George Russell/Tammy Lambourne	Jan 27-Feb 04, 2010	Series of e-mails re: finalization of work plan
Emma Sharkey	Feb 1, 2010	E-mail to Tammy Lambourne and George Russell providing further requested information on the transmission link and LCP field work.
Emma Sharkey	Feb 2, 2010	E-mail to George Russell requesting to schedule weekly conference calls between Nalcor and LMN
Emma Sharkey	Feb 3, 2010	E-mail to George Russell sharing minutes from Nalcor-LMN meeting
Emma Sharkey	Feb 8, 2010	Phone call to George Russell to discuss the work plan, LMN AGA details for Nalcor presentation, LMN member concerns, and Nalcor-LMN community meetings.
Emma Sharkey/ George Russell/ Tammy Lambourne	Jan 1-Feb 11, 2010	Series of e-mails re: preparation for LMN 2010 AGA, LMN community meetings and request for issues and concerns raised by LMN members.
Emma Sharkey	Feb 15, 2010	Phone call to George Russell to discuss logistics for LMN-Nalcor community meetings.
Emma Sharkey	Feb 16, 2010	Phone call to George Russell seeking LMN community contacts to coordinate community meetings with.
Emma Sharkey	Feb 16, 2010	Phone call to Billie Dyson to discuss arrangements for LMN community meeting in Cartwright.
Emma Sharkey	Feb 16, 2010	Phone call to Lisa Dempster to discuss arrangements for LMN community meeting in Charlottetown.
Emma Sharkey	Feb 16, 2010	Phone call to Glynes Penney to discuss arrangements for LMN community meeting in Port Hope Simpson.
Emma Sharkey	Feb 19, 2010	Phone call to Diane Poole to discuss the potential for a Nalcor-LMN meeting in Mary's Harbour.
Emma Sharkey/Gale Warren/George Russell/Tammy Lambourne	Feb 16-Feb 23, 2010	Series of e-mails re: setting up meetings in LMN Communities
Emma Sharkey	Feb 17, 2010	E-mail to Dorothy Earle re set up of Happy Valley Goose Bay LMN-Nalcor community meeting
Emma Sharkey	Feb 24, 2010	E-mail to George Russell inviting LMN leadership to travel to LMN communities with Nalcor
Gale Warren	Feb 26, 2010	E-mail to George Russell requesting confirmation that LMN communities have been notified of Nalcor's scheduled meetings in their communities at the beginning of March

Record of Consultation: Nunatukavut (formerly the Labrador Metis Nation)

Who	Date	Action Taken
Emma Sharkey	Feb 26, 2010	Phone call to George Russell requesting confirmation that LMN communities have been notified of Nalcor's scheduled meetings in their communities at the beginning of March
Emma Sharkey	Feb 26, 2010	Phone call to Dorothy Earle requesting confirmation that LMN communities have been notified of Nalcor's scheduled meetings in their communities at the beginning of March
Emma Sharkey	Feb 26, 2010	Phone call to Glynes Penney inquiring into whether LMN head office had informed her of Nalcor's scheduled community meeting in Port Hope Simpson
Emma Sharkey	Feb 26, 2010	Phone call to Billie Dyson inquiring into whether LMN head office had informed her of Nalcor's scheduled community meeting in Cartwright.
Emma Sharkey	Feb 26, 2010	Phone call to Lisa Dempster arranging final details for meeting in Charlottetown including meeting with upper year high school students to talk about employment opportunities.
Emma Sharkey/ Glynes Penney	Feb 17-Feb 26, 2010	Series of e-mails re: Nalcor-LMN community meeting in Port Hope Simpson
Emma Sharkey/Billie Dyson	Feb 17-Feb 26, 2010	Series of e-mails re: LMN-Nalcor community meeting in Cartwright
Emma Sharkey/Lisa Dempster	Feb 17-Feb 26, 2010	Series of e-mails re: LMN-Nalcor community meeting in Charlottetown
Gilbert Bennett, Todd Burlingame, Emma Sharkey	Feb 28, 2010	Presentation and dialogue about Lower Churchill Project generation and transmission components with LMN membership at the LMN 2010 AGA in L'Anse au Claire
Emma Sharkey	Feb 28, 2010	Phone call to Lisa Dempster confirming Nalcor-LMN Charlottetown meeting
Emma Sharkey	Feb 28, 2010	Phone call to Glynes Penney confirming Nalcor-LMN Port Hope Simpson meeting
Todd Burlingame, Emma Sharkey	Mar 1, 2010	Presentation and dialogue about Lower Churchill Project generation and transmission components with LMN membership and the upper year high school students in Charlottetown
Todd Burlingame, Emma Sharkey	Mar 1, 2010	Presentation and dialogue about Lower Churchill Project generation and transmission components with LMN membership in Port Hope Simpson
Emma Sharkey	Mar 1, 2010	Phone call to George Russell confirming details of Mar. 2 Nalcor-LMN community meeting in Happy Valley Goose Bay.
Todd Burlingame, Emma Sharkey	Mar 2, 2010	Presentation and dialogue about Lower Churchill Project generation and transmission components with LMN membership and other community members in Happy Valley Goose Bay
Emma Sharkey	Mar 2, 2010	Phone call to Billie Dyson confirming Nalcor-LMN Cartwright meeting.
Todd Burlingame, Emma Sharkey	Mar 3, 2010	Presentation and dialogue about Lower Churchill Project generation and transmission components with LMN membership and other community members in Cartwright
Rosanne Williams Todd Burlingame	Mar 3, 2010	E-mail to Roland Kemuksigak with attached invitation to Nalcor's Fish Habitat Compensation Strategy Workshop in Happy Valley-Goose Bay
Rosanne Williams Todd Burlingame	Mar 3, 2010	E-mail to Roland Kemuksigak with attached invitation to Nalcor's Fish Habitat Compensation Strategy Workshop in Happy Valley-Goose Bay
Emma Sharkey/ George Russell/ Tammy Lambourne	Mar 4-Mar 8	Series of e-mails requesting phone meeting to discuss Nunatukavut (LMN) and Nalcor community meetings and membership concerns

Record of Consultation: Nunatukavut (formerly the Labrador Metis Nation)

Who	Date	Action Taken
Emma Sharkey	Mar 8 2010	Phone call to Andrea in St. Mary's responding to her request for advice on training for work with the LCP
Emma Sharkey	Mar 9, 2010	Phone call with Tammy Lambourne and George Russell to arrange an in-person meeting to discuss next steps; Tammy and George highlighted membership concerns arising from community meetings
Emma Sharkey	Mar 9, 2010	E-mail to George Russell and Tammy Lambourne requesting advice on replacing the use of LMN with Nunatukavut
Emma Sharkey/ Glynes Penney	Mar 16-Mar. 18, 2010	Series of e-mails following up on LMN community Port Hope Simpson meeting
Emma Sharkey	Mar 16, 2010	E-mail to Billie Dyson generally following up on Cartwright Nalcor-Nunatukavut meeting as well as responding with further information to a question raised by an LMN member at the Cartwright meeting.
Emma Sharkey	Mar 17, 2010	E-mail to Diane Poole following up on Nalcor-LMN community meetings re Mary's Harbour
Emma Sharkey	Mar 18, 2010	E-mail to Michelle Clarke re: maps and informational CD to Port Hope Simpson Town Hall
Emma Sharkey/ George Russell/ Tammy Lambourne	Mar 10-Mar 19, 2010	Series of e-mails re: setting up Mar. 25 in-person meeting between Nalcor and Nunatukavut (LMN)
Ken Brophy	Mar 19, 2010	E-mail to President Chris Montague following up on Mar 3, 2010 invitation to Nalcor's Fish Habitat Compensation Strategy Workshop to be held on Mar 23, 2010 in Happy Valley-Goose Bay.
Ken Brophy	Mar 19, 2010	E-mail to Roland Kemuksigak following up on Mar 3, 2010 invitation to Nalcor's Fish Habitat Compensation Strategy Workshop to be held on Mar 23, 2010 in Happy Valley-Goose Bay.
Emma Sharkey/ Tammy Lambourne	Mar 4-Mar 22	Series of e-mails requesting Nunatukavut (LMN) Monthly Financial Reports, as agreed to in the Community Consultation Agreement
Emma Sharkey	Mar 22, 2010	Letter, 4 large laminated maps detailing LCP generation and transmission components and an informational CD sent to Michelle Clarke in Port Hope Simpson.
Emma Sharkey	Mar 22, 2010	Letter, 4 large laminated maps detailing LCP generation and transmission components and an informational CD sent to Lisa Dempster in Charlottetown.
Emma Sharkey	Mar 22, 2010	Letter, 4 large laminated maps detailing LCP generation and transmission components and an informational CD sent to Billie Dyson in Cartwright.
Emma Sharkey	Mar 22, 2010	Letter, 4 large laminated maps detailing LCP generation and transmission components and an informational CD sent to George Russell in Happy Valley Goose Bay.
Emma Sharkey	Mar 23, 2010	E-mail to George Russell re: receipt and review of Nunatukavut report on initial scoping of membership concerns
Todd Burlingame, Mary Hatherly, Emma Sharkey, Steve Bonnell, Steve Pellerin	Mar 25, 2010	Meeting with President Chris Montague, Tammy Lambourne, and George Russell re: next steps in continuation of work together.
Emma Sharkey/ Billie Dyson	Mar 23-26, 2010	Series of e-mails following up on Cartwright LMN-Nalcor meeting and responding with further information to member question.
Emma Sharkey/ George Russell/ Tammy Lambourne	Mar 26-31, 2010	Series of e-mails in order to determine date and location for next in person meeting.
Emma Sharkey/ Lisa Dempster	Mar 16-Mar 26, 2010	Series of e-mails following up from LMN-Nalcor Charlottetown meeting

Record of Consultation: Nunatukavut (formerly the Labrador Metis Nation)

Who	Date	Action Taken
Emma Sharkey	Mar. 29, 2010	Phone call to George Russell re: access to "one-on-one interviews" with Nunatukavut Elders to obtain "culturally and historically relevant information on the Environmental Impact Statement" conducted during Nalcor-financed "ice-breaking/scoping" meetings with their membership in February.
Emma Sharkey	Apr 1, 2010	E-mail to George Russell and Tammy Lambourne providing Nalcor contact during her 2 week absence
Emma Sharkey	Apr 1, 2010	E-mail to George Russell and Tammy Lambourne confirming content of next in-person meeting (Apr 20, 2010).
Todd Burlingame, Mary Hatherly, Charles Cook, Emma Sharkey	Apr 20, 2010	Meeting with President Chris Montague, Tammy Lambourne, George Russell and to continue discussions on the conclusion of a Phase II Community Consultation Agreement. Pauline Elson and Charles Cook met to develop alignment between NunatuKavut financial reporting and Nalcor financial reporting requirements.
Emma Sharkey	Apr 22, 2010	E-mail to George Russell and Tammy Lambourne providing requested information on herbicide use along the transmission corridor, spur stability at Muskrat Falls, 2007-2009 drilling programs, proposed activities for 2010 field season, and minutes from Nalcor's session at LMN 2010 AGA.
Todd Burlingame	Apr 26, 2010	Letter of Understanding to President Chris Montague detailing discussions re: further reiterations of a Phase II Community Consultation Agreement.
Todd Burlingame	April 27, 2010	Letter to President Montague respecting Plain Language Summary and aboriginal consultation (CEAR Doc.# 346)
Emma Sharkey	Apr 21-30, 2010	Series of e-mails to George Russell and Tammy Lambourne inquiring about the status of a final report for Phase I of our Community Consultation Agreement.
Emma Sharkey	May 4-6, 2010	Series of phone calls to George Russell re: phase 2 of Community Consultation Agreement
Emma Sharkey	May 5, 2010	E-mail to George Russell re: NL Hydro student job postings
Todd Burlingame	May 10, 2010	Letter to President Chris Montague requesting to present the Plain Language Summary document in the communities of Cartwright on May 25, 2010, Port Hope Simpson on May 26, 2010, and Happy Valley-Goose Bay on May 28, 2010.
Emma Sharkey	May 11, 2010	Series of phone calls with George Russell to confirm receipt of letter to President Chris Montague requesting to present Plain Language Summary in Cartwright, Port Hope Simpson, and Happy Valley-Goose Bay and to discuss the provision of further information about the substance of the Plain Language Summary.
Emma Sharkey	May 11, 2010	E-mail to George Russell with further information about the substance of the Plain Language Summary document and the presentation Nalcor hopes to do in NunatuKavut communities.

ATTACHMENT 5

INFORMATION RESPONSES
LOWER CHURCHILL PROJECT

JOINT REVIEW PANEL

Aboriginal Consultation and Traditional Land and Resource Use

IR# JRP.151

RECORD OF CONSULTATION – NUNATSIAVUT GOVERNMENT

May 2010

nalcor energy
LOWER CHURCHILL PROJECT

Record of Consultation: Nunatsiavut Government

Who	Date	Action Taken
Gilbert Bennett	Mar 04, 2008	Letter to Tony Anderson with offer of meeting.
Gilbert Bennett	Apr 11, 2008	Meeting in Happy Valley-Goose Bay attended by Gilbert Bennett, Todd Burlingame, Ruby Carter, Doug Blake, Tim McNeil and Marina Biasutti-Brown.
Gilbert Bennett	May 09, 2008	Letter to Marina Biasutti-Brown inviting her to attend the May 20th Lower Churchill Project Methylmercury Technical Workshop in Happy Valley-Goose Bay.
Gilbert Bennett	May 14, 2008	Meeting in St. John's attended by Gilbert Bennett, Todd Burlingame, Ruby Carter, President of the Nunatsiavut Government (Acting) Tony Anderson, Nunatsiavut Government Ministers and Deputy Ministers.
Gilbert Bennett	May 14, 2008	Meeting in St. John's attended by Larry LeDrew, Steve Bonnell, Marion Organ, Ruby Carter, Todd Burlingame, Mary Hatherly and Marina Biasutti-Brown.
Gilbert Bennett	May 20, 2008	Lower Churchill Project Methylmercury Technical Workshop in Happy Valley-Goose Bay attended by Todd Burlingame, Larry LeDrew, Leslie Grattan, Leona Barrington, Susan Hollett and Marina Biasutti-Brown.
Todd Burlingame	May 27, 2008	Letter to Marina Biasutti-Brown inviting her to attend the Lower Churchill Project Energy Alternatives Technical Workshop in Happy Valley-Goose Bay.
Ruby Carter	Jun 11, 2008	Letter to Marina Biasutti-Brown sending a Project information package including: • Larry LeDrew's May 14th presentation containing an overview of the project, access across the dam, baseline data respecting mercury consumption and impact on ice; • Steve Bonnell's May 14th presentation on socio-economic studies; and • Reservoir mapping for Gull Island and Muskrat Falls.
Paul Harrington for Gilbert Bennett	Jun 16, 2008	Letter to President Lyall sending requested information and offer of meeting.
Leslie Grattan	Aug 13, 2008	Email to Marina Biasutti-Brown proposing meeting in Rigolet in September.
Todd Burlingame	Aug 25, 2008	Letter to Daniel Michelin inviting him to the Lower Churchill Project Open House in Rigolet Sept 15th.
Todd Burlingame	Aug 25, 2008	Letter to Darryl Shiwak inviting him to the Lower Churchill Project Open House in Rigolet Sept 15th.
Todd Burlingame	Sep 16, 2008	Meeting in Rigolet attended by Gilbert Bennett, Marion Organ, Leona Barrington, Sarah Sullivan, Leslie Grattan, Daniel Michelin, Darryl Shiwak, Doris Hopkins, Melva Williams and Max Pottle.
Marion Organ	Oct 06, 2008	Letter to Daniel Michelin sending Sept 16th meeting notes.
Marion Organ	Oct 06, 2008	Letter to Darryl Shiwak sending Sept 16th meeting notes.
Leslie Grattan	Nov 07, 2008	Email to Theresa Hollett and Marina Biasutti-Brown with offer of meeting in Happy Valley-Goose Bay on Nov 13th, 2008.
Leslie Grattan	Nov 13, 2008	Lower Churchill Project training and employment meeting in Happy Valley-Goose Bay attended by Maria Moran, Jeanette Drover and Tim McNeil.
Marion Organ	Jan 29, 2009	Letter to Daniel Michelin sending a copy of the report *Aquatic Environment in the Goose Bay Estuary* by AMEC and BAE Newplan 2001, the report I*ce Dynamics of the Lower Churchill River* by Hatch 2007 and the report *Seal Abundance and Distribution* by Sikumiut.
Steve Bonnell	Jan 29, 2009	Phone call to Nunatsiavut Government to advise them of Nalcor's intent to register the Labrador - Island Transmission Link under the provincial and federal EA processes on Thursday January 29, 2009. Detailed telephone message for: Marina Biasutti -Brown, Director of Environment.

Record of Consultation: Nunatsiavut Government

Who	Date	Action Taken
Gilbert Bennett	Feb 2, 2009	Letter to President Jim Lyall enclosing copy of Transmission Registration and expressing appreciation for the opportunity to discuss the project at his convenience.
Steve Bonnell, Kyle Tucker, Todd Burlingame, Jeanette Drover, Bob White	Feb 12, 2009	Meeting with Marina Biasutti-Brown, Director of Environment, Nunatsiavut Government, to provide an overview of the Labrador-Island Transmission Registration/Project Description document and an overview of the 2007-2008 field program.
Todd Burlingame	Oct 5, 2009	Letter to Grand Chief Mark Nui re: amendment to the EA Registration and project description for the Labrador-Island Transmission Link
Marion Organ, Steve Bonnell	Dec 16, 2009	Presented an overview of the Generation and Transmisson project.
Gale Warren, Emma Sharkey	Jan 12-Feb 10 2010	Series of e-mails to Tom Sheldon re: arranging Nalcor-Nunatsiavut workshop of the LCP.
Emma Sharkey	Feb 10-16	Series of e-mails to Sara Blake discussing the set-up of a potential Nalcor-Nunatsiavut workshop on the LCP
Emma Sharkey	Feb 10-11, 2010	Series of e-mails to Paula Sheppard discussing the set-up of a potential Nalcor-Nunatsiavut workshop on the LCP
Emma Sharkey	Feb 11, 2010	Phone call to Sarah Blake re: arranging Nalcor-Nunatsiavut workshop of the LCP. Sarah indicated she would call back to discuss.
Emma Sharkey	Feb. 17, 2010	Phone call to Sarah Blake re: arranging Nalcor-Nunatsiavut workshop of the LCP. Sarah requested Emma call back the following week to discuss.
Emma Sharkey	Feb 11-16, 2010	Series of e-mails to Tom Sheldon re correct contact for Paula Sheppard
Emma Sharkey	Feb. 24, 2010	Phone call to Sarah Blake re: Nalcor-Nunatsiavut workshop on the LCP.
Emma Sharkey	Mar. 4, 2010	Phone call to Sarah Blake re: whether Nalcor should use *Inuttitut* –versus *Inukttitut*- when translating into the Labradorian Inuit dialect.
Emma Sharkey	Mar. 4, 2010	Phone call to Paula Sheppard re: whether Nalcor should use *Inuttitut* – versus *Inukttitut*- when translating into the Labradorian Inuit dialect.
Emma Sharkey	Mar. 4, 2010	Phone call to Nunatsiavut Government re: whether Nalcor should use *Inuttitut* –versus *Inukttitut*- when translating into the Labradorian Inuit dialect.
Todd Burlingame	April 1, 2010	Letter to Nunatsiavut Government respecting Plain Language Summary and aboriginal consultation (CEAR Doc. #347)
Todd Burlingame	May 10, 2010	Letter to President Jim Lyall requesting to present the Plain Language Summary document in the communities of Nain on May 31, 2010 and Rigolet on June 2, 2010
Emma Sharkey	May 11, 2010	Phone call to Nunatsiavut Government to confirm receipt of letter to President Jim Lyall requesting to present Plain Language Summary in Nain and Rigolet. Left message with call-back information on general voicemail.
Emma Sharkey	May 13, 2010	Phone call to Nunatsiavut Government to confirm receipt of letter (CEAR Doc. #364) to President Jim Lyall and to inquire into who Nalcor should speak to in order to coordinate a plain language summary presentation in the communities of Nain and Rigolet.

ATTACHMENT 6

INFORMATION RESPONSES
LOWER CHURCHILL PROJECT

JOINT REVIEW PANEL

Aboriginal Consultation and Traditional Land and Resource Use

IR# JRP.151

RECORD OF CONSULTATION – PAKUA SHIPI

May 2010

nalcor energy
LOWER CHURCHILL PROJECT

Record of Consultation: Pakua Shipi

Who	Date	Action Taken
Gilbert Bennett	May 20, 2008	Letter to Chief Christiane Lalo sending Project information package including: • Two copies of the Lower Churchill Project Environmental Assessment Registration document; • Two copies of the reservoir map book; • Two copies of the proposed site layouts at Gull Island and Muskrat Falls; and • Aquatic Studies, Historic Resources, Reservoir Formation, Mercury in Reservoirs, Green House Gas Emissions, and Construction Workforce Fact Sheets.
Maria Giovaninni	June 05, 2008	Telephone call to Chief Lalo; left message.
Maria Giovaninni	June 11, 2008	Telephone call to Chief Lalo; left message.
Todd Burlingame	June 15, 2009	Letter to Chief Bellefleur providing a copy of the French version of the Environmental Assessment Registration and Project description for the Labrador-Island Transmission Link Project.
Maria Giovaninni	June 16, 2008	Telephone call to Chief Lalo; left message.
Chief Lalo	June 17, 2008	Telephone call to Maria Giovaninni. Chief Lalo will confirm proposed meeting date with Chief Bellefleur and return phone call.
Maria Giovaninni	June 27, 2008	Telephone call to Chief Lalo; left message to confirm July 24th meeting date.
Maria Giovaninni	June 30, 2008	Telephone call to Chief Lalo; left message.
Chief Lalo	July 02, 2008	Telephone call to Maria Giovaninni; left message.
Maria Giovaninni	July 04, 2008	Telephone call to Chief Lalo; left message.
Maria Giovaninni	July 08, 2008	Telephone call to Chief Lalo; left message.
Maria Giovaninni	July 09, 2008	Telephone call to Chief Lalo; left message.
Chief Lalo	July 10, 2008	Telephone call to Maria Giovaninni; left message.
Maria Giovaninni	July 11, 2008	Telephone call to Chief Lalo. Chief Lalo advised that the meeting has been arranged in Quebec City for July 24th.
Maria Giovaninni	July 15, 2008	Telephone call to Ken Rock to confirm time and location of July 24th meeting.
Maria Giovaninni	July 24, 2008	Meeting in Quebec City attended by Gilbert Bennett, Paul Harrington, Todd Burlingame, Maria Giovannini, Guy Bellefleur, Alain Sachel, Ken Rock, Christiane Lalo, Denis Mestenapeo, Emilien Bellefleur, Joseph Mullen
Chief Bellefleur/ Chief Lalo	Sep 04, 2008	Letter to Ed Martin requesting meeting.
Chief Bellefleur/ Chief Lalo	Sep 04, 2008	Letter to Premier Williams requesting his participation in a meeting with Chiefs and Newfoundland and Labrador Hydro.
Chief Bellefleur/ Chief Lalo	Jan 15, 2009	Meeting in St Augustin, Quebec as per exchange between Leslie Grattan and Ken Rock attended by Paul Harrington, Todd Burlingame, Leslie Grattan, Michael Wilkshire, Chief Christiane Lalo, Ken Rock, Denis Mestenapaeo, Alfred Tenegan and Maurice Bellefleur.
Gilbert Bennett	Feb 02, 2009	Letter to Chief Lalo with notification of the registration of the Labrador – Island Transmission Link Project and an English version of the Environmental Assessment Registration and Project description.
Todd Burlingame	Mar 03, 2009	Letter to Chief Lalo sending the Lower Churchill Project Environmental Impact Statement Executive Summary.
Gilbert Bennett	May 13, 2009	Letter to Chief Lalo requesting meeting also including draft consultation agreement.
Todd Burlingame	June 15, 2009	Letter to Chief Lalo providing a copy of the French version of the Environmental Assessment Registration and Project description for the Labrador-Island Transmission Link Project.
Michael Wilkshire	August 3, 2009	Telephone call to Chief Lalo – no response.

Record of Consultation: Pakua Shipi

Who	Date	Action Taken
Michael Wilkshire	August 4, 2009	Telephone call to Chief Lalo to discuss the agreement. Chief Lalo indicated that had not received agreement.
Michael Wilshire	August 5, 2009	Telephone call to Chief Lalo who confirmed that she had not received agreement.
Gilbert Bennett	August 18, 2009	Letter to Chief Lalo including copies of the agreement in both English and French and an invitation to meet to discuss the Project and the draft agreement at the convenience of the Chief and Band Council.
Todd Burlingame	Sept 17, 2009	Letter to Chief Lalo informing her of modifications in the Labrador – Island Transmission Link Project.
Todd Burlingame	Nov 19, 2009	Letter to Chief Lalo sending the French version of the Lower Churchill Project Environmental Impact Statement Executive Summary.
Todd Burlingame	Dec 16, 2009	Letter to Chief Lalo describing the objective of the consultation agreement and requesting a meeting to give a Project update and discuss the agreement.
Todd Burlingame	Jan 27, 2010	Meeting in Quebec City to discuss the agreement. Attended by Todd Burlingame, Mary Hatherly, Elisabeth Poirier-Garneau, Michael Wilkshire, Chef Christiane Lalo, Ken Rock, Alain Sachel.
Mary Hatherly	Feb 15, 2010	Email to Ken Rock with attached revised copy of the agreement for their consideration.
Ken Rock	Feb 15, 2010	Telephone call to Mary Hatherly, left message.
Ken Rock	Feb 16, 2010	Telephone call to Mary Hatherly, left message.
Mary Hatherly	Feb 19, 2010	Email to Ken Rock to schedule a time for a phone call to discuss proposed community consultation agreement.
Mary Hatherly	Feb 19, 2010	Email to Ken Rock to schedule a time for a telephone call to discuss the agreement.
Mary Hatherly	March 1, 2010	Telephone conversation with Ken Rock re: consultation arrangements .
Mary Hatherly	March 5, 2010	E-mail to Ken Rock with French translation of community consultation agreement attached.
Mary Hatherly	March 22, 2010	Telephone conversation with Ken Rock to discuss new approach to community consultation and funding issues.
Todd Burlingame	April 6, 2010	Letter to Chief Lalo respecting Plain Language Summary and consultation (CEAR Doc. # 339)
Mary Hatherly	April 13, 2010	Telephone conversation with Ken Rock to discuss the new agreement.
Mary Hatherly	April 13, 2010	Email to Ken Rock providing English and French copies of the Community Engagement Agreement and associated budget
Mary Hatherly	April 15, 2010	Email to Ken Rock informing him of her availabilities to discuss the agreement.
Ken Rock	April 15, 2010	Email to Mary Hatherly informing that after discussing with the Council members, Pakua Shipi agrees to sign the agreement.
Elisabeth Poirier-Garneau/Ken Rock	April 16-21	Series of telephone calls to arrange a meeting date and location for signature of the agreement.
Todd Burlingame/Mary Hatherly/Elisabeth Poirier-Garneau/Ken Rock	April 19, 2010	Conference call to discuss the role of the Project Coordinator in the context of the Community Engagement Agreement.
Elisabeth Poirier-Garneau	April 22, 2010	Telephone call to Rachelle Malec to finalize travel arrangements for Chef Lalo and councilor Gaston Mestenapéo.
Elisabeth Poirier-Garneau	April 23, 2010	Email to Ken Rock and Rachelle Malec providing travel details for the meeting.
Elisabeth Poirier-Garneau	April 26, 2010	Telephone call to Ken Rock to confirm the time and location of the meeting.
Elisabeth Poirier-Garneau	April 26, 2010	Email to Ken Rock to confirm the address of the meeting.
Elisabeth Poirier-Garneau	April 26, 2010	Telephone call to Rachelle Malec to confirm travel arrangements, meeting time and location.

Record of Consultation: Pakua Shipi

Who	Date	Action Taken
Elisabeth Poirier-Garneau	April 29, 2010	Meeting in St. John's to sign the Community Engagement Agreement. Attended by Todd Burlingame, Mary Hatherly, Elisabeth Poirier-Garneau, Michael Wilkshire, Chef Christiane Lalo, Ken Rock and Gaston Mestenapéo.
Elisabeth Poirier-Garneau	April 30, 2010	Email to Ken Rock to provide new contact information.
Ken Rock	April 30, 2010	Telephone call to Elisabeth Poirier-Garneau to obtain information about travel reimbursement and set up a meeting to develop the workplan.
Ken Rock	April 30, 2010	Telephone call to Elisabeth Poirier-Garneau to obtain information about travel reimbursement and suggesting a meeting in Montreal, on May 5, 2010, to develop the workplan.
Elisabeth Poirier-Garneau	April 30, 2010	Email to Ken Rock providing information about travel reimbursement.
Elisabeth Poirier-Garneau	April 30, 2010	Telephone call to Ken Rock confirming that Todd Burlingame and Elisabeth Poirier-Garneau will be available to meet in Montreal on Wednesday May 5.
Elisabeth Poirier-Garneau	May 3, 2010	Telephone call to Ken Rock to confirm the time and location of the meeting to be held on May 5, 2010.
Mary Hatherly	May 3, 2010	Email to Ken Rock to follow-up on the details of the agreement.
Mary Hatherly	May 5, 2010	Meeting in Montreal to discuss the workplan associated with the Community Engagement Agreement. Attended by Todd Burlingame, Elisabeth Poirier-Garneau, Alain Sachel and Ken Rock.
Ken Rock	May 6, 2010	Email to Elisabeth Poirier-Garneau providing her with an electronic copy of the draft workplan developed by Alain Sachel.
Elisabeth Poirier-Garneau	May 6, 2010	Email to Ken Rock thanking him for the document and for the meeting.
Alain Sachel	May 7, 2010	Telephone call to Elisabeth Poirier-Garneau to discuss some details of the agreement and the workplan and providing her with his contact information.
Todd Burlingame	May 7, 2010	Letter to Chief Lalo suggesting to provide an oral presentation of the Plain Language Summary in Pakua Shipi on June 1, 2010.
Elisabeth Poirier-Garneau	May 10, 2010	Email to Alain Sachel and Ken Rock providing them the English version of the workplan.
Alain Sachel	May 11, 2010	Email to Elisabeth Poirier-Garneau confirming that the workplan was in line with our discussions and making a few suggestions related to data collection and format of Project presentation.
Elisabeth Poirier-Garneau	May 11, 2010	Email to Alain Sachel and Ken Rock providing the French translation of the workplan.
Elisabeth Poirier-Garneau	May 12, 2010	Telephone call to Ken Rock to discuss the Plain Language Summary Presentation.
Alain Sachel	May 13, 2010	Telephone call to Elisabeth Poirier-Garneau to start the implementation of the workplan.
Elisabeth Poirier-Garneau	May 13, 2010	Email to Alain Sachel and Rachelle Malec to confirm the Plain Language Summary Presentation on June 3, 2010. Also provided French versions of the Plain Language Summary and the Executive Summary of the Environmental Impact Statement.

ATTACHMENT 7

INFORMATION RESPONSES
LOWER CHURCHILL PROJECT

JOINT REVIEW PANEL

Aboriginal Consultation and Traditional Land and Resource Use

IR# JRP.151

RECORD OF CONSULTATION – UNAMEN SHIPU

May 2010

nalcor energy
LOWER CHURCHILL PROJECT

Record of Consultation: Unamen Shipu

Who	Date	Action Taken
Gilbert Bennett	May 20, 2008	Letter to Chief Bellefleur sending Project information package including: • Two copies of the Lower Churchill Project Environmental Assessment Registration document; • Two copies of the reservoir map book; • Two copies of the proposed site layouts at Gull Island and Muskrat Falls; and • Aquatic Studies, Historic Resources, Reservoir Formation, Mercury in Reservoirs, Green House Gas Emissions, and Construction Workforce Fact Sheets.
Maria Giovaninni	June 11, 2008	Telephone call to Chief Bellefleur requesting meeting.
Maria Giovaninni	June 16, 2008	Telephone call to Chief Bellefleur. Chief Bellefleur proposed meeting dates of July 8th or 15th.
Maria Giovaninni	July 08, 2008	Telephone call to Chief Lalo and Chief Bellefleur; left message.
Maria Giovaninni	July 24, 2008	Meeting in Quebec City attended by Gilbert Bennett, Paul Harrington, Todd Burlingame, Maria Giovannini, Guy Bellefleur, Alain Sachel, Ken Rock, Christiane Lalo, Denis Mestenapeo, Emilien Bellefleur, Joseph Mullen
Chief Bellefleur/ Chief Lalo	Sep 04, 2008	Letter to Ed Martin requesting meeting.
Chief Bellefleur/ Chief Lalo	Sep 04, 2008	Letter to Premier Williams requesting his participation in a meeting with Chiefs and Newfoundland and Labrador Hydro.
Maria Giovaninni	Sep 15, 2008	Telephone call to Ken Rock. Ken Rock indicated a strong interest in meeting with Newfoundland and Labrador Hydro but neither group is available at the present.
Maria Giovaninni	Sep 18, 2008	Telephone call to Ken Rock proposing Oct 06th meeting.
Leslie Grattan	Oct 14, 2008	Email to Ken Rock proposing meeting in Natashquan on Oct 22nd.
Ken Rock	Oct 14, 2008	Email to Leslie Grattan proposing Newfoundland and Labrador Hydro hold meetings in Natashquan, Unamen Shipu and Pakua Shipi separately.
Leslie Grattan	Nov 04, 2008	Email to Ken Rock proposing presentation to Council representatives in Happy Valley-Goose Bay regarding Lower Churchill Project training and employment.
Leslie Grattan	Dec 10, 2008	Email to Ken Rock to reschedule (due to weather) Unamen Shipu and Pakua Shipi community meetings to January 2009.
Ken Rock	Dec 11, 2008	Email to Leslie Grattan with suitable meeting dates.
Michael Wilkshire	Dec 31, 2008	Telephone call to Lionel Alvue with offer of January meeting.
Michael Wilkshire	Jan 05, 2009	Email to Lionel Alvue with offer of January meeting.
Michael Wilkshire	Jan 16, 2009	Meeting in La Romaine, Quebec attended by Paul Harrington, Todd Burlingame, Michael Wilkshire, Leslie Grattan, Chief Guy Bellefleur, Joseph Mullen, Alain Bellefleur, Raymond Bellefleur and Emilien Bellefleur.
Gilbert Bennett	Feb 02, 2009	Letter to Chief Bellefleur with notification of the registration of the Labrador – Island Transmission Link Project and an English version of the Environmental Assessment Registration and Project description.
Todd Burlingame	Mar 03, 2009	Letter to Chief Bellefleur sending the Lower Churchill Project Environmental Impact Statement Executive Summary.
Gilbert Bennett	May 13, 2009	Letter to Chief Bellefleur requesting meeting also including draft consultation agreement.
Todd Burlingame	June 15, 2009	Letter to Chief Bellefleur providing a copy of the French version of the Environmental Assessment Registration and Project description for the Labrador-Island Transmission Link Project.

Record of Consultation: Unamen Shipu

Who	Date	Action Taken
Michael Wilkshire	August 3, 2009	Telephone call to Chief Bellefleur – Chief away from office
Michael Wilkshire	August 4, 2009	Telephone call to Chief Bellefleur – Chief away from office
Michael Wilkshire	August 5, 2009	Telephone call to Chief Bellefleur who confirmed that he had not received a French version of the agreement.
Gilbert Bennett	August 18, 2009	Letter to Chief Bellefleur including copies of the agreement in both English and French and an invitation to meet to discuss the Project and the draft agreement at the convenience of the Chief and Band Council.
Todd Burlingame	Sept 17, 2009	Letter to Chief Bellefleur informing him of modifications in the Labrador – Island Transmission Link Project.
Todd Burlingame	October 30, 2009	Letter to Chief Bacon to congratulate him on his election to the position of Chief.
Todd Burlingame	Nov 05, 2009	Letter to Chief Bacon requesting a meeting to discuss the Generation Project and the consultation agreement.
Todd Burlingame	Nov 19, 2009	Letter to Chief Bacon sending the French version of the Lower Churchill Project Environmental Impact Statement Executive Summary.
Todd Burlingame	Dec 16, 2009	Letter to Chief Bacon describing the objective of the consultation agreement and requesting a meeting to give a Project update and discuss the agreement.
Gale Warren	Jan 20 to 28, 2010	Series of emails between Gale Warren and Armand McKenzie to arrange the details of the meeting of January 29, 2010.
Gale Warren	Jan 29, 2010	Meeting in Quebec City to discuss the agreement. Attended by Todd Burlingame, Elisabeth Poirier-Garneau, Michael Wilkshire, Chef Georges Bacon, Armand McKenzie, François Lévesque, Gerry Mark, Adelard Bellefleur, Emilien Bellefleur, Bernard Mark, Alain Bellefleur, Denis Stubbert and Lionel Hervieux.
Todd Burlingame	Feb 09, 2010	Letter to Chief Bacon sending a French and English version of a Lower Churchill Project presentation in response to a request made during the January 29, 2010 meeting with the Chief and Band council.
François Lévesque	March 16, 2010	Email to Elisabeth Poirier-Garneau requesting a copy of the consultation agreement.
Mary Hatherly	March 17, 2010	Email to François Lévesque sending the original copy of the consultation agreement as well as an updated version for their consideration.
François Lévesque	March 18, 2010	Email to Mary Hatherly sending an edited version of the agreement that they are suggesting and requesting to meet to finalize the agreement.
Mary Hatherly	March 19, 2010	Telephone call to François Lévesque to discuss the details of the agreement.
Elisabeth Poirier-Garneau/ François Lévesque	March 19 to 23, 2010	Series of telephone calls to make arrangements for a meeting between Nalcor and Unamen Shipu on March 24, 2010.
Elisabeth Poirier-Garneau/ François Lévesque	March 24, 2010	Meeting in St. John's to discuss the agreement. Attended by Todd Burlingame, Mary Hatherly, Elisabeth Poirier-Garneau, Michael Wilkshire (interpreter), Chief Bacon, François Lévesque, Armand McKenzie, Adélard Bellefleur and Alain Lalo.
François Lévesque	March 30, 2010	Email to Mary Hatherly thanking for the meeting of March 24, 2010 and detailing the next steps to finalize the agreement.
Mary Hatherly	March 30, 2010	Email to François Lévesque agreeing on their proposed agenda and confirming that she will be sending out an edited version of the agreement by the end of the week.
Mary Hatherly	April 1, 2010	Email to Francois Levesque confirming preparation of revised Agreement

Record of Consultation: Unamen Shipu

Who	Date	Action Taken
Nalcor Energy	April 6, 2010	Letter to Chief Bacon respecting Plain Language Summary and aboriginal consultation (CEAR Doc. # 341)
Mary Hatherly	April 8, 2010	Email to Francois Levesque containing revised version of Agreement (English)
Mary Hatherly	April 9, 2010	Email to Francois Levesque containing revised version of Agreement with corrected date
Mary Hatherly	April 13, 2010	Email to Francois Levesque containing French translation of Agreement and appendices
Mary Hatherly	April 15, 2010	Email to Francois Levesque requesting information on status of review of terms of Agreement
Francois Levesque	April 16, 2010	Email to Mary Hatherly confirming ongoing review with anticipated conclusion date of April 23, 2010
Mary Hatherly	April 23, 2010	Email to Francois Levesque inquiring about status of review of Agreement
François Lévesque	May 7, 2010	Email to Mary Hatherly asking for a confirmation that his revisions of the agreement were received.
Mary Hatherly	May 7, 2010	Email to François Lévesque mentioning that she had not received the agreement and asking him to send it another time.
Elisabeth Poirier-Garneau	May 7, 2010	Telephone call to François Lévesque – no response.
Mary Hatherly	May 7, 2010	Email to François Lévesque suggesting that he send the revised agreement to both Mary Hatherly and Elisabeth Poirier-Garneau to ensure that a copy is received.
Todd Burlingame	May 7, 2010	Letter to Chief Bacon suggesting to provide an oral presentation of the Plain Language Summary in Unamen Shipu on June 2, 2010.
Mary Hatherly/Elisabeth Poirier-Garneau	May 11-12, 2010	Series of telephone calls to discuss the Community Engagement Agreement.
Elisabeth Poirier-Garneau	May 12, 2010	Telephone call to Band Council of Unamen Shipu to discuss the Plain Language Summary Presentation.
Chef Bacon	May 13, 2010	Telephone call to Elisabeth Poirier-Garneau to discuss the details of the Plain Language Summary Presentation.

ATTACHMENT 8

INFORMATION RESPONSES
LOWER CHURCHILL PROJECT

JOINT REVIEW PANEL

Aboriginal Consultation and Traditional Land and Resource Use

IR# JRP.151

RECORD OF CONSULTATION – NUTASHKUAN

May 2010

nalcor energy
LOWER CHURCHILL PROJECT

Record of Consultation: Nutashkuan

Who	Date	Action Taken
Gilbert Bennett	May 20, 2008	Letter to Chief Francois Bellefleur sending Project information package including: • Two copies of the Lower Churchill Project Environmental Assessment Registration document; • Two copies of the reservoir map book; • Two copies of the proposed site layouts at Gull Island and Muskrat Falls; and • Aquatic Studies, Historic Resources, Reservoir Formation, Mercury in Reservoirs, Green House Gas Emissions, and Construction Workforce Fact Sheets.
Todd Burlingame/ Maria Giovaninni	June 11, 2008	Telephone call to Clément Tremblay requesting meeting. Clément to confirm the possibility with Chief Bellefleur and return call to in a couple of days.
Maria Giovaninni	June 16, 2008	Telephone call to Clément Tremblay. Clément will return call in a few days to provide details.
Clément Tremblay	June 16, 2008	Telephone call to Maria Giovaninni advising of the difficulty of a meeting during the summer months.
Clément Tremblay	June 30, 2008	Telephone call to Maria Giovaninni; left message.
Clément Tremblay	July 24, 2008	Meeting in Quebec City attended by Paul Harrington, Todd Burlingame, Clément Tremblay and Jean Malec.
Maria Giovaninni	Aug 26, 2008	Telephone call to Clément Tremblay to arrange September meeting.
Maria Giovaninni	Aug 27, 2008	Telephone call to Clément Tremblay to arrange September meeting.
Maria Giovaninni	Aug 28, 2008	Telephone call to Clément Tremblay to arrange September meeting.
Clément Tremblay	Sep 09, 2008	Telephone call to Maria Giovaninni. Clément trying to arrange a meeting with representatives of Newfoundland and Labrador Hydro, Unamen Shipu, Pakua Shipi and Natashquan.
Maria Giovaninni	Sep 22, 2008	Telephone call to Clément Tremblay. Clément confirmed meeting date of Oct 22nd, 2008.
Maria Giovaninni	Oct 22, 2008	Meeting in Natashquan, Quebec attended by Gilbert Bennett, Todd Burlingame, Leslie Grattan, Michael Wilkshire, Clément Tremblay, Daniel Lalo, Roberto Wapistan, Nicolas Wapistan and eleven community members.
Todd Burlingame	Oct 27, 2008	Letter to Chief Francois Bellefleur sending the presentation from the Oct 22nd meeting.
Gilbert Bennett	Feb 02, 2009	Letter to Chief Bellefleur with notification of the registration of the Labrador – Island Transmission Link Project and an English version of the Environmental Assessment Registration and Project description.
Todd Burlingame	Mar 03, 2009	Letter to Chief Bellefleur sending the Lower Churchill Project Environmental Impact Statement Executive Summary.
Gilbert Bennett	May 13, 2009	Letter to Chief Bellefleur requesting meeting also including draft consultation agreement.
Todd Burlingame	June 15, 2009	Letter to Chief Bellefleur providing a copy of the French version of the Environmental Assessment Registration and Project description for the Labrador-Island Transmission Link Project.
Todd Burlingame/Gale Warren	June 22, 2009	Conference call with Clément Tremblay to discuss proposed community consultation agreement.
Gale Warren/ Clément Tremblay	July 7, 2009	Meeting in Quebec City to discuss the way forward and potential meeting dates.
Clément Tremblay	July 16, 2009	Telephone call to Gale Warren to discuss potential meeting dates.
Gale Warren	July 20, 2009	Email to Clément Tremblay to discuss potential meeting dates.
Clément Tremblay	July 21, 2009	Telephone call to Gale Warren to discuss potential meeting dates.
Gale Warren	July 24, 2009	Telephone call to Clément Tremblay to confirm meeting dates.

Record of Consultation: Nutashkuan

Who	Date	Action Taken
Gale Warren	Aug 6, 2009	Meeting in Quebec City to discuss agreement. Attended by Paul Harrington, Gale Warren, Mary Hatherly, Jeanette Drover, Michael Wilkshire, Chief Francois Bellefleur, Daniel Malec, Clément Tremblay.
Gale Warren	Aug 27, 2009	Email to Clément Tremblay with French version of the proposed community consultation agreement attached.
Clément Tremblay	Aug 28, 2009	Email to Gale Warren indicating that Nutashkuan will provide its response to community consultation agreement during the week of September 1, 2009.
Clément Tremblay	Sept 03, 2009	Telephone call to Gale Warren to provide update. Nutashkuan has advised they have new legal counsel, Michel Lussier. Counsel is engaged in reviewing the proposed agreement.
Clément Tremblay	Sept 09, 2009	Email to Gale Warren with review comments on agreement.
Todd Burlingame	Sept 17, 2009	Letter to Chief Bellefleur informing him of modifications in the Labrador – Island Transmission Link Project.
Todd Burlingame	Nov 19, 2009	Letter to Chief Bellefleur sending the French version of the Lower Churchill Project Environmental Impact Statement Executive Summary.
Todd Burlingame	Dec 16, 2009	Letter to Chief Bellefleur describing the objective of the consultation agreement and requesting a meeting to give a Project update and discuss the agreement.
Todd Burlingame	Jan 26, 2009	Meeting in Quebec City to discuss agreement. Attended by Todd Burlingame, Mary Hatherly, Elisabeth Poirier-Garneau, Michael Wilkshire, Chief Francois Bellefleur, Clément Tremblay, Francois Tremblay.
Mary Hatherly	Feb 19, 2010	Email to Francois Tremblay suggesting a meeting to discuss the agreement.
Natacha Leclerc	Feb 23, 2010	Email to Todd Burlingame, Mary Hatherly and Elisabeth Poirier-Garneau confirming that the agreement is under review by the legal counsel and that they will shortly communicate with Nalcor.
Todd Burlingame	April 6, 2010	Letter to Chief Bellefleur respecting Plain Language Summary and aboriginal consultation (CEAR Doc. # 340)
Mary Hatherly	Apr 14, 2010	Email to François Tremblay providing English and French copies of the Community Engagement Agreement and associated budget.
Elisabeth Poirier-Garneau	April 29, 2010	Telephone call to Clément Tremblay to get an update on the status of their revision of the proposed agreement. Was not available so M. Tremblay said he would call back the next day to provide update.
Clément Tremblay	April 30, 2010	Telephone call to Elisabeth Poirier-Garneau saying that he was not aware that the Band Council received a copy of the Community Engagement Agreement.
Elisabeth Poirier-Garneau	April 30, 2010	Email to Clément Tremblay providing a copy of the Community Engagement Agreement and suggesting a meeting with the Band Council to discuss the details of the Agreement.
Elisabeth Poirier-Garneau	May 4, 2010	Email to Clément Tremblay suggesting a meeting with the Band Council in Québec, on Thursday May 6 to discuss the Agreement.
Elisabeth Poirier-Garneau/Clément Tremblay	May 5, 2010	Series of telephone calls to attempt to schedule a meeting with the Band Council on May 6, in Québec. Clément mentioned that it was difficult to reach the Chief as he is in meetings.
Elisabeth Poirier-Garneau	May 5, 2010	Telephone call to Clément Tremblay. Left a message asking to confirm if he was able to contact the Chief and set up a meeting for May 6.
Elisabeth Poirier-Garneau	May 6, 2010	Email to Clément Tremblay informing him that since there have not been any news from the Chief at this point, we will not meet on that day, but will remain available to meet at a later date.
Clément Tremblay	May 6, 2010	Email to Elisabeth Poirier-Garneau informing her that canceling the meeting is a good decision as he was not able to find a convenient time.
Elisabeth Poirier-Garneau	May 6, 2010	Email to Clément Tremblay thanking him for his efforts to set up a meeting.

Record of Consultation: Nutashkuan

Who	Date	Action Taken
Todd Burlingame	May 7, 2010	Letter to Chief Bellefleur suggesting to provide an oral presentation of the Plain Language Summary in Nutashkuan on June 8, 2010.
Elisabeth Poirier-Garneau	May 12, 2010	Telephone call to Marianne Bellefleur to arrange the details of the Plain Language Summary Presentation.
Marianne Bellefleur	May 13, 2010	Telephone call to Elisabeth Poirier-Garneau to confirm that the Plain Language Summary Presentation can take place on Monday June 7, 2010. The logistics of the event were discussed.

ATTACHMENT 9

INFORMATION RESPONSES
LOWER CHURCHILL PROJECT

JOINT REVIEW PANEL

Aboriginal Consultation and Traditional Land and Resource Use

IR# JRP.151

RECORD OF CONSULTATION – EKUANITSHIT

May 2010

nalcor energy
LOWER CHURCHILL PROJECT

Record of Consultation: Ekuanitshit

Who	Date	Action Taken
Chief Piétacho	Jan 15, 2008	Letter to Minister Charlene Johnson regarding an extension to comment on the Lower Churchill Project Environmental Impact Statement draft guidelines and land negotiations.
Gilbert Bennett	May 20, 2008	Letter to Chief Piétacho sending Project information package including: • Two copies of the Lower Churchill Project Environmental Assessment Registration document; • Two copies of the reservoir map book; • Two copies of the proposed site layouts at Gull Island and Muskrat Falls; and • Aquatic Studies, Historic Resources, Reservoir Formation, Mercury in Reservoirs, Green House Gas Emissions, and Construction Workforce Fact Sheets.
Maria Giovaninni	June 05, 2008	Telephone call to Liette Boudreau regarding the possibility of a meeting.
Maria Giovaninni	June 11, 2008	Telephone call to Liette Boudreau regarding the possibility of a meeting. Chief Piétacho to return call to Maria Giovaninni June 13th.
Chief Piétacho	June 13, 2008	Letter to Gilbert Bennett indicating a strong interest to meet but delaying the meeting until after consultation is concluded for La Romaine.
Maria Giovaninni	June 16, 2008	Telephone call to Liette Boudreau to determine the prospects of a meeting. Liette Boudreau will call back within the next day or so with suitable dates.
Maria Giovaninni	June 30, 2008	Telephone call to Liette Boudreau regarding a proposed meeting. Liette Boudreau will get back to Maria Giovaninni in a few days regarding possible dates.
Maria Giovaninni	July 08, 2008	Telephone call to Liette Boudreau, Maria Giovaninni left message for Liette Boudreau or Chief Piétacho to return call.
Liette Boudreau	July 09, 2008	Telephone call to Maria Giovaninni; left message.
Maria Giovaninni	July 09, 2008	Telephone call to Liette Boudreau; left message.
Maria Giovaninni	July 11, 2008	Telephone call to Liette Boudreau regarding proposed July meeting. Liette Boudreau to confirm July meeting with Chief Piétacho and return call to Maria Giovaninni.
Maria Giovaninni	July 15, 2008	Telephone call to Liette Boudreau. Liette Boudreau advised that the proposed July meeting is not suitable. Liette Boudreau to inquire into suitability of Aug 05th meeting.
Liette Boudreau	July 22, 2008	Telephone call to Maria Giovaninni. Liette Boudreau will call Maria Giovaninni back July 30th to confirm the proposed Aug 05th meeting date.
Maria Giovaninni	Aug 13, 2008	Telephone call to Liette Boudreau. Liette Boudreau on holidays, left message.
Maria Giovaninni	Aug 27, 2008	Telephone call to Liette Boudreau; left message.
Liette Boudreau	Sept 02, 2008	Telephone call to Maria Giovaninni. Liette Boudreau will call back Sep 11th to confirm meeting.
Maria Giovaninni	Sept 15, 2008	Telephone call to Liette Boudreau; left message.
Mike Wilkshire	Dec 12, 2008	Telephone call to Liette Boudreau; left message regarding possible January meeting.
Mike Wilkshire	Dec 15, 2008	Telephone call to Liette Boudreau regarding possible January meeting.
Todd Burlingame	Dec 30, 2008	Letter to Chief Piétacho proposing meeting date of Jan 13th, 2009.
Gilbert Bennett	Feb 02, 2009	Letter to Chief Piétacho with notification of the registration of the Labrador – Island Transmission Link Project and an English version of the Environmental Assessment Registration and Project description.
Todd Burlingame	Mar 03, 2009	Letter to Chief Piétacho sending the Lower Churchill Project Environmental Impact Statement Executive Summary.

Record of Consultation: Ekuanitshit

Who	Date	Action Taken
Gilbert Bennett	May 13, 2009	Letter to Chief Piétacho requesting meeting also including draft consultation agreement.
David Schulze	May 25, 2009	Letter to Gilbert Bennett confirming receipt of draft consultation agreement and confirming meeting for June 01st in Mingan.
David Schulze	June 01, 2009	Meeting in Mingan, Quebec attended by Paul Harrington, Todd Burlingame, Mary Hatherly, Jeanette Drover, Mike Wilkshire, Chief Jean-Charles Piétacho, Vice Chief Vincent Napish and Councillors.
Todd Burlingame	June 15, 2009	Letter to Chief Piétacho providing a copy of the French version of the Environmental Assessment Registration and Project description for the Labrador-Island Transmission Link Project.
David Schulze	July 13, 2009	Correspondance to Mary Hatherly and Todd Burlingame including revisions to draft community consultation agreement proposed by Ekuanitshit.
David Schulze/Mary Hatherly	Aug 11, 17-18	Series of e-mails to set up a conference call to discuss the terms of proposed community consultation agreement and schedule a subsequent community meeting.
Michael Wilkshire/Liette Boudreau		Phone call to propose second meeting in Ekuanitshit in early September to finalize agreement.
Todd Burlingame	Aug 14, 2009	Letter to Chief Piétacho proposing a meeting in Ekuanitshit in early September, 2009.
David Schulze/Mary Hatherly	Aug 24, 2009	Phone call to discuss the terms of the community agreement. Planning of next meeting in the community after elections in mid-September.
Todd Burlingame	Sept 17, 2009	Letter to Chief Piétacho informing him of modifications in the Labrador – Island Transmission Link Project.
Gilbert Bennett	Oct 30, 2009	Letter to Chief Piétacho to congratulate for re-election to the position of Chief of the Innu community of Ekuanitshit.
Todd Burlingame	Nov 19, 2009	Letter to Chief Piétacho sending the French version of the Lower Churchill Project Environmental Impact Statement Executive Summary.
Mary Hatherly	Dec 18, 2009	Email to David Schulze with a revision of the community consultation agreement and confirm meeting to be held on Jan 19, 2010.
Mary Hatherly	Jan 11 to 12, 2010	Email exchange with David Schulze to reschedule the meeting of Jan 19 to the following week.
Mary Hatherly	Jan 25, 2010	Email to David Schulze to confirm meeting to discuss consultation agreement.
Mary Hatherly	Jan 27, 2010	Meeting in Quebec City to discuss the agreement. Attended by Todd Burlingame, Mary Hatherly, Elisabeth Poirier-Garneau, Michael Wilkshire, Chief Jean-Charles Piétacho, David Schulze, Bernard Lafontaine, Isabelle Napess.
Mary Hatherly	Jan 25, 2010	Email to David Schulze to confirm meeting to discuss consultation agreement.
David Schulze	Feb 03, 2010	Email to Mary Hatherly offering comments on the consultation agreement.
David Schulze	Mar 04, 2010	Email to Mary Hatherly proposing a different approach to the consultation agreement.
David Schulze	March 12, 2010	Letter to the Joint Review Panel copied to Todd Burlingame stating that the Innu of Ekuanitshit will continue working in collaboration with Nalcor on the environmental assessment of the Lower Churchill Project.
Mary Hatherly	Mar 19, 2010	Email to David Schulze confirming that the agreement is under internal review.
Mary Hatherly/David Schulze	Mar 19 to 30, 2010	Series of emails to discuss the details of the agreement and reimbursement for fees and expenses.
Todd Burlingame	April 6, 2010	Letter to Chief Pietacho respecting Plain Language Summary and aboriginal consultation (CEAR Doc. #343)

Record of Consultation: Ekuanitshit

Who	Date	Action Taken
Chief Pietacho	April 14, 2010	Letter to Todd Burlingame respecting status of community consultation negotiations
Mary Hatherly	April 15, 2010	Email to David Schulze containing French and English versions of proposed Community Engagement Agreement
Todd Burlingame	April 23, 2010	Letter to Chief Pietacho in response to Chief's letter of April 14.
Todd Burlingame	May 7, 2010	Letter to Chief Piétacho suggesting to provide an oral presentation of the Plain Language Summary in Ekuanitshit, on June 3, 2010.
Elisabeth Poirier-Garneau	May 12, 2010	Telephone call to Ekuanitshit Band Council the possibility to make a Plain Language Summary presentation in the community.
Elisabeth Poirier-Garneau	May 13, 2010	Telephone call to Liette Boudreau to discuss the logistics of the Plain Language Summary presentation.

ATTACHMENT 10
INFORMATION RESPONSES
LOWER CHURCHILL PROJECT

JOINT REVIEW PANEL

Aboriginal Consultation and Traditional Land and Resource Use

IR# JRP.151

RECORD OF CONSULTATION – UASHAT MAK MANI-UTENAM

May 2010

nalcor energy
LOWER CHURCHILL PROJECT

Record of Consultation: Uashat mak Mani-Utenam

Who	Date	Action Taken
Gilbert Bennett	May 20, 2008	Letter to Chief Grégoire sending Project information package including: • Two copies of the Lower Churchill Project Environmental Assessment Registration document; • Two copies of the reservoir map book; • Two copies of the proposed site layouts at Gull Island and Muskrat Falls; and • Aquatic Studies, Historic Resources, Reservoir Formation, Mercury in Reservoirs, Green House Gas Emissions, and Construction Workforce Fact Sheets.
Maria Giovaninni	June 05, 2008	Telephone call to Lyne Morissette to propose a meeting.
Maria Giovaninni	June 11, 2008	Telephone call to Lyne Morissette to propose a meeting.
Maria Giovaninni	June 16, 2008	Telephone call to Lyne Morissette. Lyne Morissette suggested July 9th or July 15th.
Maria Giovaninni	June 30, 2008	Telephone call to Lyne Morissette; left message.
Lyne Morissette	July 03, 2008	Telephone call to Madeline Holden; left message.
Lyne Morissette	July 07, 2008	Telephone call to Madeline Holden; left message to confirm dates.
Maria Giovaninni	July 07, 2008	Telephone call to Lyne Morissette; left message.
Maria Giovaninni	July 07, 2008	Telephone call to Lyne Morissette. Lyne Morissette advised that July 15th is not suitable and suggested July 22nd or 23rd.
Maria Giovaninni	July 08, 2008	Telephone call to Lyne Morissette; left message to confirm arrangements.
Maria Giovaninni	July 08, 2008	Telephone call to Lyne Morissette. Lyne Morissette advised that July 23rd is more suitable for a meeting.
Maria Giovaninni	July 09, 2008	Telephone call to Lyne Morissette. Lyne Morissette advised that July 23rd will not work but July 29th or 30th might. Meeting did not occur at the request of Conseil Innu Takuaikan Uashat mak Mani-Utenam.
Maria Giovaninni	Sept 15, 2008	Telephone call to Lyne Morissette; left message.
Mike Wilkshire	Dec 12, 2008	Telephone call to Lyne Morissette; left message.
Mike Wilkshire	Dec 15, 2008	Telephone call to Lyne Morissette; no answer.
Todd Burlingame	Dec 30, 2008	Letter to Chief Gregoire proposing meeting date of Jan 12th.
Lyne Morissette	Jan 06, 2009	Letter to Todd Burlingame welcoming Jan 12th meeting.
Todd Burlingame	Jan 08, 2009	Letter to Lyne Morissette regarding Jan 12th meeting.
Lyne Morissette	Jan 09, 2009	Letter to Todd Burlingame confirming the Jan 12th meeting.
Lyne Morissette	Jan 12, 2009	Meeting in Sept Iles, Quebec attended by Todd Burlingame, Mike Wilkshire, Leslie Grattan, Deputy Chief and Council Members for Uashat mak Mani-Utenam, Uashat Technical Committee, Families from Matimekosh-Lac Jean, James O'Reilly, and Patricia Ochman.
Todd Burlingame	Jan 29, 2009	Letter to Chief Grégoire thanking for the meeting and sending notification of the registration of the Labrador – Island Transmission Link Project and an English version of the Environmental Assessment Registration and Project description.
Todd Burlingame	Mar 03, 2009	Letter to Chief Grégoire sending the Lower Churchill Project Environmental Impact Statement Executive Summary.
Gilbert Bennett	May 13, 2009	Letter to Chief Grégoire requesting meeting also including draft consultation agreement.
Todd Burlingame	June 15, 2009	Letter to Chief Grégoire providing a copy of the French version of the Environmental Assessment Registration and Project description for the Labrador-Island Transmission Link Project.
Michael Wilkshire	Aug 03, 2009	Telephone call to Chief Grégoire – no response.
Michael Wilkshire	Aug 04, 2009	Telephone call to Chief Grégoire – no response.
Michael Wilkshire	Aug 11, 2009	Telephone call to Lyne Morissette – left message.

Record of Consultation: Uashat mak Mani-Utenam

Who	Date	Action Taken
Michael Wilkshire	Sept 03, 2009	Telephone call to Lyne Morissette who acknowledge receipt of Community Consultation proposal, which is currently under review by legal counsel. Undertook to respond with comments once review complete, revision of text may be required at that time.
Todd Burlingame	Sept 17, 2009	Letter to Chief Grégoire informing him of modifications in the Labrador – Island Transmission Link Project.
Chief Grégoire	Nov 10, 2009	Letter to Gilbert Bennett stating that would be prepared to meet to discuss procedures for consultation with the community regarding the Project.
Todd Burlingame	Nov 19, 2009	Letter to Chief Grégoire sending the French version of the Lower Churchill Project Environmental Impact Statement Executive Summary.
Gilbert Bennett	Jan 12, 2010	Letter to Chief Grégoire explaining the purpose of the community consultation agreement and suggesting a meeting to discuss the agreement.
Elisabeth Poirier-Garneau	Feb 10, 2010	Telephone call to Lyne Morissette, who was busy so she said she would call back in the afternoon.
Elisabeth Poirier-Garneau	Feb 12, 2010	Telephone call to Lyne Morissette who apologized for not being able to return call, she is still very busy and said she will call back later during the day.
Elisabeth Poirier-Garneau	Feb 18, 2010	Telephone call to Lyne Morissette – no response.
Todd Burlingame	April 6, 2010	Letter to Chief Gregoire respecting Plain Language Summary and aboriginal consultation (CEAR Doc. #342)
Todd Burlingame	April 15, 2010	Letter to Chief Gregoire respecting Community Engagement Agreement and with offer of a meeting to discuss the terms and conditions of the agreement
Todd Burlingame	May 7, 2010	Letter to Chief Grégoire suggesting to provide an oral presentation of the Plain Language Summary in the community of Uashat mak Mani-Utenam on June 4, 2010.
Elisabeth Poirier-Garneau	May 13, 2010	Telephone call to Mathilda Fontaine to discuss the details of the Plain Language Summary Presentation.

ATTACHMENT 11
INFORMATION RESPONSES
LOWER CHURCHILL PROJECT

JOINT REVIEW PANEL

Aboriginal Consultation and Traditional Land and Resource Use

IR# JRP.151

RECORD OF CONSULTATION – MATIMEKUSH-LAC JOHN

May 2010

nalcor energy
LOWER CHURCHILL PROJECT

Record of Consultation: Matimekush-Lac John

Who	Date	Action Taken
Gilbert Bennett	May 20, 2008	Letter to Chief Real McKenzie sending Project information package including: • Two copies of the Lower Churchill Project Environmental Assessment Registration document; • Two copies of the reservoir map book; • Two copies of the proposed site layouts at Gull Island and Muskrat Falls; and • Aquatic Studies, Historic Resources, Reservoir Formation, Mercury in Reservoirs, Green House Gas Emissions, and Construction Workforce Fact Sheets.
Maria Giovaninni	June 05, 2008	Telephone call to Chief McKenzie; left message.
Todd Burlingame	June 10, 2008	Telephone call to Chief McKenzie; left message.
Maria Giovaninni	June 11, 2008	Telephone call to Chief McKenzie; left message.
Maria Giovaninni	Jan 12, 2009	Meeting in Sept Iles, Quebec attended by Todd Burlingame, Michael Wilkshire, Leslie Grattan, Deputy Chief and Council Members for Uashat mak Mani-Utenam, Uashat Technical Committee, Families from Matimekosh-Lac Jean, James O'Reilly and Patricia Ochman. The participation of Nation Innu Matimekush-Lac John was invited and arranged by the Conseil Innu Takuaikan Uashat mak Mani-Utenam.
Todd Burlingame	Jan 29, 2009	Letter send to Chef Grégoire was copied Chief McKenzie with notification of the registration of the Labrador – Island Transmission Link Project and an English version of the Environmental Assessment Registration and Project description.
Todd Burlingame	Mar 03, 2009	Letter to Chief McKenzie sending the Lower Churchill Project Environmental Impact Statement Executive Summary.
Gilbert Bennett	May 13, 2009	Letter to Chief McKenzie requesting meeting also including draft consultation agreement.
Todd Burlingame	June 15, 2009	Letter to Chief McKenzie providing a copy of the French version of the Environmental Assessment Registration and Project description for the Labrador-Island Transmission Link Project.
Michael Wilkshire	Aug 03, 2009	Telephone call to Chief McKenzie – no response.
Michael Wilkshire	Aug 04, 2009	Three telephone calls to Chief McKenzie – no response.
Michael Wilkshire	Aug 05, 2009	Telephone call to Chief McKenzie – no response.
Michael Wilkshire	Aug 11, 2009	Telephone call to Chief McKenzie – left message.
Todd Burlingame	Sept 17, 2009	Letter to Chief McKenzie informing him of modifications in the Labrador – Island Transmission Link Project.
Todd Burlingame	Nov 19, 2009	Letter to Chief McKenzie sending the French version of the Lower Churchill Project Environmental Impact Statement Executive Summary.
Todd Burlingame	Dec 16, 2009	Letter to Chief McKenzie describing the objective of the consultation agreement and requesting a meeting to give a Project update and discuss the agreement.
Elisabeth Poirier-Garneau	Feb 10, 2010	Telephone call to Chief McKenzie – left message.
Chief McKenzie	Feb 10, 2010	Returned phone call to Elisabeth Poirier-Garneau. Discussed the possibility of a meeting to discuss the consultation agreement.
Todd Burlingame	Feb 12, 2010	Letter to Chief McKenzie suggesting to meet in March 2010.
Todd Burlingame	April 6, 2010	Letter to Chief McKenzie respecting Plain Language Summary and proposed consultation (CEAR Doc. #344)
Chief McKenzie	Apr 7, 2010	Telephone call to Elisabeth Poirier-Garneau to discuss the Consultation Agreement.
Elisabeth Poirier-Garneau	April 9, 2010	Email to Chief McKenzie providing the English version of the revised Community Engagement Agreement and associated budget.

Record of Consultation: Matimekush-Lac John

Who	Date	Action Taken
Elisabeth Poirier-Garneau	April 14, 2010	Email to Chief McKenzie providing the French version of the Community Engagement Agreement and associated budget.
Elisabeth Poirier-Garneau	April 19, 2010	Telephone call to Chief McKenzie to confirm the reception of the agreement and was informed that the Chief was out of town for the whole week.
Elisabeth Poirier-Garneau	April 20, 2010	Email to Chief McKenzie to confirm the reception of the agreement and inviting him to contact Nalcor to discuss the details of the agreement.
Chief McKenzie	April 26, 2010	Telephone call to Elisabeth Poirier-Garneau confirming the reception of the agreement and informing that their legal council was reviewing the agreement. Chief McKenzie mentioned that they would be on the land until mid-May so we would not hear from them until then.
Todd Burlingame	May 7, 2010	Letter to Chief McKenzie suggesting to provide an oral presentation of the Plain Language Summary in the community of Matimekush-Lac John on June 7, 2010.
Elisabeth Poirier-Garneau	May 13, 2010	Telephone call to Chief McKenzie to discuss the possibility of the Plain Language Summary Presentation. Chief McKenzie advised that there would be elections on July 7 and it would be better to do the presentation later in July, after the campaign.

ATTACHMENT 12
INFORMATION RESPONSES
LOWER CHURCHILL PROJECT

JOINT REVIEW PANEL

Aboriginal Consultation and Traditional Land and Resource Use

IR# JRP.151

RECORD OF CONSULTATION – NASKAPI NATION OF KAWAWACHIKAMACH

May 2010

nalcor energy
LOWER CHURCHILL PROJECT

Record of Consultation: Naskapi Nation of Kawawachikamach

Who	Date	Action Taken
Chief Einish	Oct 10, 2008	Letter to Maryse Pineau and Paul Carter wishing to be adequately consulted during the Environmental Assessment process.
Dominic Cliché CEEA	Oct 27, 2008	Letter to Chief Einish regarding his request for consultation with the proponent.
Todd Burlingame	Nov 19, 2008	Letter to Chief Einish sending information package including: • Two copies of the Lower Churchill Project EA Registration document; • Two copies of the reservoir map book; • Two copies of the proposed site layouts at Gull Island and Muskrat Falls; and • Five copies of the LCP "Your questions Answered" information brochure.
Maria Vincelli	May 11, 2009	Email to Todd Burlingame requesting he resend the Project information package.
Todd Burlingame	May 11, 2009	Email to Maria Vincelli indicating that information will be sent out as soon as possible.
Todd Burlingame	May 14, 2009	Letter to Maria Vincelli resending Project information package including: • Two copies of the Lower Churchill Project EA Registration document; • Two copies of the reservoir map book; • Two copies of the proposed site layouts at Gull Island and Muskrat Falls; and • Five copies of the LCP "Your questions Answered" information brochure.
Todd Burlingame	May 13, 2009	E-mail to Maria Vincelli following up on request to resend copy of - the Reservoir Mapping book that shows the anticipated flooding resulting from the Lower Churchill Hydrogeneration Project; • The map showing the location of the main proposed Project facilities, if it is different or more detailed than the one in the EIS; • Five information sheets about the Project, including its EA and associated issues.
Todd Burlingame	Sep 29, 2009	Letter to Chief Philip Einish with attachment of the translated version of the Environmental Registration and Project Description for the proposed Labrador-Island Transmission Link (French)
Todd Burlingame	Nov 5, 2009	Letter to Chief Einish with attached copy of the translated version of the *Environmental Registration* and *Project Description* document for the proposed Labrador-Island Transmission link (English)
Todd Burlingame	April 1, 2010	Letter to Chief Einish respecting the Plain Language Summary and aboriginal consultation (CEAR Doc. #337)
Todd Burlingame	May 10, 2010	Letter to Chief Philip Einish requesting to present the Plain Language Summary document in the community of Kawawachikamach June 8, 2010 (CEAR Doc. #357)
Emma Sharkey	May 11, 2010	Phone call to the Naskapi Nation of Kawawachikamach to confirm receipt of letter to Chief Philip Einish requesting to present Plain Language Summary in Kawawachikamach. Left message with call-back information on general voicemail.
Emma Sharkey	May 13, 2010	Phone call to Kawawachikamach to confirm receipt of letter (CEAR Doc. #357) to Chief Einish and to inquire into who Nalcor should speak to in order to coordinate a plain language summary presentation in Kawawachikamach.
Todd Burlingame	May 13, 2010	Re-sent letter to Chief Philip Einish (CEAR Doc. # 257)requesting to present the Plain Language Summary document in the community of Kawawachikamach June 8, 2010.

IR# JRP.152

Downstream Effects below Muskrat Falls

Requesting Organization – Joint Review Panel **Information Request No.: JRP.152**

Subject - Downstream Effects below Muskrat Falls

References:

EIS Guidelines, Section 4.4.2 (Study Area)

Related Comments / Information Requests:

CEAR # 277 (Fisheries and Oceans Canada)
CEAR # 282 (Labrador Metis Nation)
CEAR # 284 (Nunatsiavut Government)
CEAR # 285 (Hydro-Quebec)
CEAR # 289 (Innu Nation)
CEAR # 291 (Sierra Club Atlantic)

IR # JRP.43

Rationale:

In JRP.43, the Proponent was asked to provide a more thorough analysis of potential impacts of the Project on the main stem and tributaries below Muskrat Falls, the Goose Bay Estuary and Lake Melville. Comments submitted by Fisheries and Oceans Canada during the additional 30-day consultation period indicate that potential effects of the Project on secondary production, fish productivity and the impacts of possible foodweb shifts in the areas below Muskrat Falls were not addressed in the Proponent's response.

Other reviewers also expressed concerns that the potential for the Project to cause impacts below Muskrat Falls has been minimised, or has not been addressed adequately. In particular, the Nunatsiavut Government expressed concerns that changes to river dynamics could have environmental consequences as far reaching as Lake Melville, which in turn could affect availability, accessibility and quality of country foods for Inuit and affect harvesting and subsistence practices. The Nunatsiavut Government also notes that the inclusion of Inuit Traditional Knowledge may have helped addressed limitations and uncertainties with respect to predicting effects of the Project beyond the mouth of the Churchill River.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.152**

Information Requested:

The Proponent is asked to discuss the potential effects of the Project (including cumulative effects over time) on secondary production, fish productivity and the impacts of possible foodweb shifts in the areas below Muskrat Falls.

To help substantiate its predictions, the Proponent is asked to provide a literature review on the potential for dams to cause long-term and cumulative effects on the productivity of downstream ecosystems, including marine ecosystems. The Proponent should also discuss effects noted in the literature in relation to changes observed by Inuit in the Lake Melville area following the Churchill Falls project (as reported by the Nunatsiavut Government in their submission to the Panel of June 19, 2009, CEAR # 217, Appendix A).

Response:

Nalcor Energy (Nalcor) has reviewed the potential effects of the Lower Churchill Hydroelectric Generation Project (the Project) downstream of Muskrat Falls. Key conclusions of this review are as follows:

- The Churchill River is regulated by the Churchill Falls facility and the flows downstream of Muskrat Falls will remain at current levels. Considering this, and the limited nature and extent of effects downstream of Muskrat Falls (i.e., no adverse effects predicted below Muskrat Falls) the potential effects of the Project (including cumulative effects over time) on secondary production, fish productivity and the impacts of possible food web shifts in the areas below Muskrat Falls, particularly beyond the mouth of the river in to Goose Bay and Lake Melville, are predicted to be negligible and not significant.
- A literature review on the potential long-term and cumulative effects of other dams on the productivity of downstream ecosystems was conducted. However, the majority of the literature relates to downstream effects due to changes in flow regime, and this will not be the situation with the lower Churchill River where no change in flow regime is predicted due to the Project.
- Likewise, the Traditional knowledge provided by the Nunatsiavut Government is related to the effects associated with the existing Churchill Falls development and hence are not directly applicable to the predictions for the proposed Project.

The following sections expand on these conclusions.

Potential Effects

The aquatic effects assessment of the proposed Project included those predicted downstream of Muskrat Falls. The extent of the predicted effects related to the proposed Project were described in the Environmental Impact Statement (EIS) and clarified in IR response IR# JRP.43. The Aquatic Assessment Area as described is appropriate for predicting the Project effects and their likely significance. While secondary production, fish production and food-web shifts were not measurable parameters, the parameters used to assess the Aquatic Ecosystem provide indications of the overall Valued Ecosystem Component, including these aspects. The downstream extent of each measurable parameter utilized in the Aquatic Environmental assessment was either modeled or measured downstream of Muskrat Falls. These parameters included nutrient and water quality parameters such as flow, total suspended solids (TSS), total phosphorous (TP), salinity, temperature, and ice dynamics. Significant effects to these parameters could cause a significant change in secondary production, fish production or food-web

shifts. Considering the limited nature and extent of effects downstream of Muskrat Falls (i.e., no adverse effects predicted below Muskrat Falls) the potential effects of the Project (including cumulative effects over time) on secondary production, fish productivity and the impacts of possible food web shifts in the areas below Muskrat Falls, particularly beyond the mouth of the river in to Goose Bay and Lake Melville, is considered to be negligible and not significant.

Secondary Production

Secondary production within the aquatic environment is the use/conversion of energy captured from primary production (i.e., photosynthesis) for production of organisms such as phytoplankton and zooplankton. Therefore, the rate of primary production is one of the key factors in limiting the rate of secondary production as it is typically the principal source of organic energy supporting aquatic food webs in large lakes with relatively limited littoral zones. Areal primary production (production per square metre of lake surface) is a function of the depth of the euphotic zone (the region with sufficient light to support photosynthesis) and the maximum rate of photosynthesis (P_{max}) achievable by the phytoplankton community, which is affected by the nutrient supply and by phytoplankton biomass. Primary production can be altered due to changes in water transparency and nutrients, and both primary and secondary production can also be affected by water retention times (see Fish Habitat Compensation Strategy appended to IR# JRP.153).

The predicted changes in primary and secondary production within Gull Island and Muskrat Falls reservoirs has been described in Section 3.1.4 of the Fish Habitat Compensation Strategy (see IR# JRP.153). A summary of the predicted changes in the reservoirs upstream of Muskrat Falls is provided here as it plays a role in the potential for changes downstream. Pre-impoundment primary production in the lower Churchill River is currently estimated at 3 to 3.5 times P_{max}. Considering light transmission effects only, primary production within the reservoirs could decrease by 50 to 75 percent in open water areas under the conservative worst-case scenario during impoundment, recovering to 60 to 85 percent of initial conditions during the early years at full supply level (FSL), and ultimately returning to at least baseline conditions in the long term as shown by TSS modeling (Minaskuat 2008). Depending on the location within the reservoirs, baseline conditions could be reached between five (Gull Island reservoir) and twenty (Muskrat Falls reservoir) years (see Figure 6 in IR# JRP.149).

Any near-shore areas of heavy, local active erosion could see a reduction to 10 to 15 percent of pre-impoundment production levels during impoundment and early stabilization as well as during periods of strong, localized sediment re-suspension. Impoundment will also result in two reservoirs with water retention times much longer than the present continuous flow conditions in Winokapau and Gull lakes. This will allow the crustacean zooplankton community to develop indigenous populations as opposed to the current transient 'populations' which are remnants of upstream lake communities that are simply 'passing through'. The crustacean zooplankton currently consists of cladocerans and copepods with generation times at summer water temperatures on the order of 1 to 2 weeks for cladocerans and approximately 4 weeks for copepods. Gull Island reservoir is expected to have an average retention time of approximately 28 days. Muskrat Falls reservoir is estimated to have a retention time of approximately 10 days. The increased retention time in Gull Island reservoir is predicted to move its plankton composition character towards that observed in the upstream lakes in the Churchill watershed (lakes Michikamau through Lobstick). This would be less pronounced in the Muskrat Falls reservoir due to its still relatively rapid, 10-day flushing with respect to zooplankton population losses.

The secondary production below Muskrat Falls would potentially be affected by two aspects; similar physical factors to that within the proposed reservoirs (i.e., TSS and nutrients) which would affect ongoing production below Muskrat Falls and additional phytoplankton/zooplankton export from the reservoirs.

The Churchill River below Muskrat Falls will be subject to similar transient declines in water transparency as that predicted for the open water areas of the proposed reservoirs. As presented in the water quality modeling study (Minaskuat 2008) and in IR# JRP.43, TSS and TP will increase below Muskrat Falls following reservoir creation as a result of reservoir shoreline erosion. This is predicted to cause an initial decline in water transparency and consequently, primary and secondary productivity similar to that described for the proposed reservoirs. Also similar to within the proposed reservoirs, approximately 10 percent of the predicted TP concentration increase would be in a dissolved form and hence biologically available; the remainder will likely be bound to clay particles within TSS (either naturally occurring TSS or that associated with reservoir stabilization). Due to the concentrations of TP in the water predicted below Muskrat Falls and the relatively rapid uptake of biologically available phosphorus by primary producers within the reservoirs and main stem, any subsequent increase in secondary production via phytoplankton and zooplankton in the main stem below Muskrat Falls, is predicted to be minimal. It should be also be noted that below Muskrat Falls, retention time of water will not change and therefore any phytoplankton/zooplankton within this section of river would remain transient and flushed into saline conditions where they cannot survive and would be removed quite rapidly from the water column (Filardo and Dunstan 1985; Jeppesen 1994).

While there may be limited increases in phytoplankton and zooplankton export from Muskrat Falls to the lower reaches of the Churchill River (i.e., to the mouth of Goose Bay), the short time that they are available before being flushed into saline conditions creates only minimal opportunity for changes to the energy flow through the benthic food web and benthos-feeding fish to occur.

Fish Productivity and Possible Food Web Shifts

Although potential short-term increases in fish productivity could be anticipated while secondary production is increased, the estimated increases in secondary production described above are not predicted to cause measurable long-term changes in terms of overall fish productivity, nor alter or cause large-scale trophic food web shifts in species below Muskrat Falls. However, it should be noted that while the kill and injury rate through the Kaplan turbines proposed for Muskrat Falls is low, whitefish and sucker species at other facilities have been shown to shift feeding from lower trophic (i.e., planktonic) to higher trophic levels by feeding on damaged or killed fish that are passed through turbines (Schetagne et al. 2003). This phenomenon appears to have occurred in the lower Churchill River below the existing Churchill Falls tailrace. Fish that enter the penstock and turbines may become damaged, disorientated or killed as they pass through the turbines (see IR# JRP.51) and therefore, whitefish and suckers may be capable of feeding at this non-typical higher trophic level.

As shown in the modeled TP concentration results below Muskrat Falls (Minaskuat 2008), increases are predicted to occur in the first few years of development and then return to baseline. During this time, an increase in fish growth due to increased food supply could occur (Platt et al 2003). With any increase in availability of a trophic-level food source, for example an increase in zooplankton, fish species and benthic macroinvertebrates adapted to its capture and consumption will typically be the first to directly benefit. Secondary beneficiaries typically include species that would be adapted to capture and consume those fish feeding on an increase in its food source. For example, northern pike would likely be a secondary beneficiary from an increase in lake whitefish abundance or growth due to increases in plankton availability. A possible food web shift (i.e., a change in species feeding from one trophic level to another), would be unlikely and would typically require longer term changes to the trophic dynamics. However, it is quite possible for species which currently feed at various trophic levels (e.g., brook trout and Atlantic salmon) to alter their ratio of feeding based on availability. Table 1 presents a summary of trophic feeding levels for each species captured below Muskrat Falls. In this respect, opportunistic species such as brook trout and Atlantic salmon may shift their feeding to more zooplankton in areas where these increases are identified (Brown and Rasmussen 2009). They

can also easily shift back once concentrations return to baseline. While this is an example from within a reservoir and not downstream, sampling by Nalcor within the Cat Arm reservoir after inundation indicated enhanced growth of both zooplankton-feeding Arctic char and benthos-feeding brook trout following impoundment (Knoechel and Copeman 1989).

Table 1 Generalized Feeding Habits and Food Sources Below Muskrat Falls

Species	Trophic Classification[1]	Food Sources Below Muskrat Falls[2]	General Food Types[3]
Longnose Sucker	Insectivore Herbivore	Detritus Aquatic Invertebrates	Primarily feed upon detritus and benthic invertebrates. They have been noted to feed upon fish eggs as well
White Sucker	Insectivore Herbivore	Detritus	Primarily feed upon detritus and benthic invertebrates. They have been noted to feed upon fish eggs as well
Lake Whitefish/Dwarf lake Whitefish	Herbivore Planktivore Insectivore Piscivore	Aquatic Invertebrates Plankton Detritus Fish	A wide range of aquatic and terrestrial invertebrates and planktonic creatures. Fish make up a small portion of the normal form diet.
Lake Chub	Herbivore Planktivore Insectivore	Detritus	Primarily feed upon aquatic insect larvae, with zooplankton and algal matter making up a small portion of diet
Northern Pike	Piscivore Carnivore	Fish	Primarily feed upon fish, but have been noted to eat small mammals, frogs, and small water fowl.
Rock Cod	Insectivore Piscivore (including squid)	Fish Detritus	A wide range of marine invertebrates (including squid) and fish
Burbot	Piscivore	Fish	Primarily feed upon fish as adults, juveniles feed upon aquatic invertebrates and small fish
Tomcod	Herbivore Planktivore Insectivore Piscivore	Aquatic Invertebrates Fish Detritus Plankton	Diet consists almost exclusively of fish, with a wide range of marine invertebrates making up a small portion of diet
Atlantic Rainbow Smelt	Insectivore Piscivore	Fish	A wide range of marine and freshwater invertebrates and small fish
Round Whitefish	Planktivore Insectivore Piscivore	Detritus Aquatic Invertebrates	A wide range of aquatic and terrestrial invertebrates and planktonic creatures with fish make up a small portion diet.
Longnose Dace	Herbivore Insectivore	Aquatic Invertebrates Detritus	Primarily feed upon detritus and benthic invertebrates. They have been noted to feed upon fish eggs as well
Ouananiche (Atlantic Salmon)	Planktivore Insectivore Piscivore Carnivore	Aquatic Invertebrates Fish	A wide range of aquatic and terrestrial invertebrates, fish, and small terrestrial mammals
Brook Trout	Herbivore Planktivore Insectivore Piscivore Carnivore	Fish	A wide range of aquatic and terrestrial invertebrates, fish, and small terrestrial mammals. Plant matter makes up a small portion of their diet.

Note:
[1] Trophic classification is based on literature as well as data from stomach content analysis conducted below Muskrat Falls
[2] Stomach content analysis conducted by AGRA (1999); AMEC (2000); and AMEC (2001)
[3] General feeding habits derived from Scott and Crossman (1988)

The estimated time to return to near baseline TP concentrations below Muskrat Falls is 10 to 15 years (Minaskuat 2008) with a sequential decrease each year after inundation. Given the life-cycle of many fish species below Muskrat Falls, this could be enough time to have increased growth of mature individuals translate into an increase in reproductive output (i.e., more eggs because of better feeding). As a result, it is possible that species which feed upon plankton could have an increase in abundance during increased secondary production. This would most likely include whitefish, lake chub, and possibly some opportunistic feeders such as brook trout and salmon. However, as with any ecosystem, an increase in prey items may be somewhat offset by increased predation by species such as northern pike and burbot. Any increases, however, are predicted to be limited and return to baseline levels once nutrient input returns to near baseline.

Potential Effects Summary

In summary, the minimal effect predicted to secondary and fish productivity from the proposed Project would most likely occur in the freshwater portion of the lower Churchill River below Muskrat Falls. This minimal effect could result in a predicted initial increase in growth of planktivorous species such as whitefish and lake chub. Opportunistic species such as brook trout and salmon would also most likely take advantage and respond to an increase in zooplankton, although any increase is expected to be limited. Therefore, while potential short-term increases in fish productivity could be anticipated while secondary production is increased, the estimated increases in secondary production described above are not predicted to cause measurable long-term changes in terms of overall fish productivity, nor to alter or cause large-scale trophic food web shifts in species below Muskrat Falls.

Literature Review Summary

A literature review on the potential long-term and cumulative effects of other dams on the productivity of downstream ecosystems was conducted. However, the majority of the literature relates to downstream effects due to changes in flow regime which will not be the situation with the lower Churchill River where no change in flow regime is predicted due to the Project (see IR# JRP.149).

The majority of downstream effects related to reservoir developments have typically been due to altered flow and associated changes in water quality (e.g., nutrients, temperature regime, salinity) or variations in sedimentation and erosion within the watercourse. Changes in aquatic communities downstream of dams are generally related to one, or a combination, of these mechanisms. While the proposed Project is not predicted to alter the existing flow regime or associated parameters below Muskrat Falls, the existing Churchill Falls development has altered the flow regime and increased overall discharge due to diversions. Therefore, the literature review on the potential long-term and cumulative effects is only of assistance in substantiating changes in flow regime.

One condition that typically becomes prevalent following the construction and operation of a reservoir is that of a more moderate (i.e., less variable) flow regime downriver. Williams and Wolman (1984) studied the effects of 29 dams in the United States, and determined that the average peak flood flow was reduced by 3 to 92 percent (average reduction was 39 percent). Peak flooding events are typically associated with spring freshet (i.e., the melting of snow and ice forming large volumes of run-off) which can be a cue to spawning rituals and migrations among some species of fish (Petts 1984). While fish species that generally experience greater natural variability in habitat parameters, such as those that reside in streams or rivers, are thought to be more resilient than species which reside in less variable environments such as lakes or ponds (Paller 1997), those that routinely experience, and are adapted to, periods of flooding and drought can be affected by their alteration.

The effect of flow alteration on the biological community within a downstream estuary can be strongly related to the region in which the dam is built. Generally, impacts are more severe in tropical estuaries than in temperate, high latitude estuaries (Baxter 1977). For example, the construction of the Volta Dam in Ghana produced severe impacts on bivalves located downstream, making former spawning habitats unsuitable due to saltwater intrusion (Baxter 1977). In contrast to this, the marine zooplankton in the James Bay area showed little impact as a result of development which could be partially explained by the more resilient nature of the species present, as they are adapted to a more dynamic environment (Baxter 1977).

Neu (1975) states that the regulation of rivers flowing into the Gulf of St. Lawrence has had a severe impact on the fish assemblages present. The majority of the effects noted by Neu (1975) stem from a variation in the flow regime, which in turn reduced the amount of upwelling which was naturally present within the estuary. Estuaries are generally productive areas as a result of nutrient upwelling caused by the mixing of fresh water from rivers and sea water. Neu (1975) cited the following effects as a direct result of flow regulation:

- alteration of the seasonal strength of haline circulation;
- changes in the salinity of the surface layer;
- changes in the seasonal thermal regime in the near shore zone;
- reduction in the nutrient supply from deep ocean water; and,
- reduction in the productivity of fish and biomass.

None of these effects are anticipated from the Project.

Other observations from the literature and discussion relative to parameters used to assess the Aquatic Environment are as follows:

Flow

Figure 1 below presents the difference in pre- and post-Upper Churchill mean daily flow regime below Muskrat Falls. Additional information regarding the potential cumulative effects of this parameter is provided in IR# JRP.163. As shown, the winter low flows experienced during pre-development are lower than those currently recorded in the river. Likewise, the spring flood events associated with ice and snow melt in the Smallwood Reservoir (approximately 75 percent of the Churchill River watershed area) are now contained in the existing reservoir and do not interact with downstream environments as they did pre-development. The mean daily variation in the discharge from Muskrat Falls was much greater prior to the development of Churchill Falls, ranging from <500m^3/s in April to >4,600m^3/s in June. The post-development range of mean daily flow (i.e., existing conditions) is now near 1,700m^3/s for winter low flows and 3,200m^3/s during spring high flows. In addition to capturing the high spring run off, the Churchill River was also increased in drainage area by approximately 12 percent with the diversion of the Naskaupi and Kanariktok Rivers. In this respect, the operation of the existing Churchill Falls facility has changed the flow regime from the Churchill River into Goose Bay and Lake Melville. These changes have been in effect on the Churchill River for over 35 years and hence, are now considered baseline conditions, with species adapted to the altered flow regime and associated conditions.

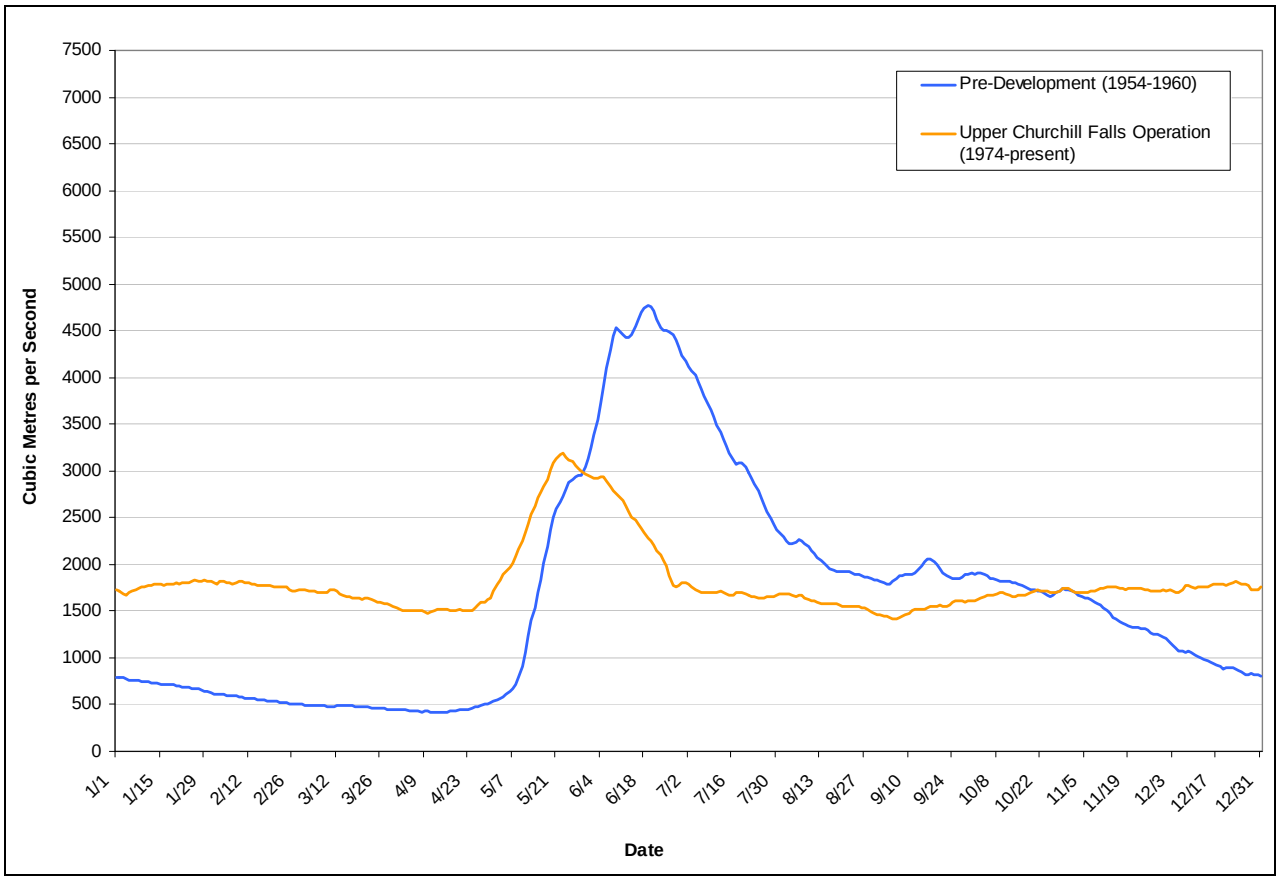

Figure 1 **Mean Daily Flows Recorded at Muskrat Falls before and after the Development of the Churchill Falls Facility (based on EC Water Station 03OE001)**

Water Quality

In the Lake Melville area, some baseline conditions prior to existing developments were recorded; however, collection programs were not development-specific. The first Blue Dolphin Expedition into Lake Melville took place is 1949, lead by David C. Nutt (Nutt 1951). The purpose of this expedition was to collect physical and ecological data, with future development in mind (Nutt 1951). The Expedition noted the importance of the freshwater input from the Churchill River (formerly the Hamilton River as referenced) to the ecology and productivity of the estuarine environment (Nutt 1951).

Historic oceanographic data from Hamilton Inlet was collected and compared to recent data by Cardosa and de Young (2002), to determine the variations that were created as a result of existing development on the Churchill River. While data were consolidated for a variety of parameters (water temperature, salinity, oxygen levels, phosphorus, nitrate, silicate and chlorophyll), many were measured in different seasons or did not cover similar areas, hence the only pre- and post-development comparison was salinity, which showed the same trends for the pre- and post-1970 data (Cardosa and de Young 2002). Surface salinity values were lowest in Goose Bay (0 to 10 ppt) and gradually increased through Groswater Bay and the Labrador Sea (Cardosa and de Young 2002). The salinity below 50 m water depth gradually increased from Goose Bay to offshore from approximately 21 to 22 ppt to 33 to 34 ppt. Surface water temperature within the Hamilton Inlet area was highest in Goose Bay and gradually reduced as measurement points were moved offshore to Groswater Bay and the Labrador Sea (Cardosa and de Young 2002).

Bobbitt and Akenhead (1982) also investigated the influence of the controlled discharge as a result of the Churchill Falls development from the Churchill River on the oceanography and changes in water properties of

Groswater Bay, Labrador. The report notes the change in flow regime as outlined in Figure 1 and indicates that salinity profiles in Lake Melville and Groswater Bay show that the water structure in summer remains practically unchanged (Bobbitt and Akenhead 1982). The residual time of freshwater in Lake Melville was found to be in the order of several months, indicating that Lake Melville acts as an effective filter between variations in river flow and changes in Groswater Bay. This was not consistent with local knowledge collected from the Goose Bay and Lake Melville area which indicates that salinity levels appeared to have increased since the development of the Churchill Falls facility (Sikumiut 2009). The inconsistency may be a result of localized changes in salinity as a result of either altered flow regime (i.e., the reduction of the spring high flow) or the diversion of the Naskaupi and Kanariktok Rivers to the Smallwood Reservoir (i.e., a reduction in freshwater outflow from Grand Lake and hence, potential salt water intrusion in that local area) that were not detected by the sampling regimes employed, or season of sampling by researchers, although this has not been confirmed. With limited salinity effects apparent as a result of the flow regime shift and diversions from the existing Churchill Falls development, the proposed Project's limited change in flow regime and no change in water volumes are not predicted to cause additional, or cumulative, effects on salinity.

Ice

Water temperature, flow regulation and salinity changes can have an affect on ice formation and maintenance. As with other parameters, ice dynamics (i.e., freeze-up, thickness and break-up) were not measured prior to the Churchill Falls development and hence, comparisons to current conditions are limited. The primary source of data for the modifications in freeze-up, break-up and ice strength has been Labrador Inuit Knowledge of Lake Melville and Goose Bay (Sikumiut 2009) and many residents of Northwest River and Rigolet commented on the quality of ice within their areas. For example, since the time of the development of the Churchill Falls facility it was noted that ice has been weaker and there are differences in ice formation due to an apparent increase in salt content in the water. They also commented that there has been faster and earlier ice break-up in the spring. As shown in the ice dynamic modeling and IR# JRP.43, the effects of the proposed Project on ice dynamics in the main stem below Muskrat Falls are expected to be localized and small (Hatch 2007); therefore, measurable changes in ice dynamics from current conditions within Goose Bay and Lake Melville are not predicted. The predicted changes in ice dynamics in the main stem below Muskrat Falls due to the proposed Project are also not predicted to be of sufficient magnitude to measurably affect fish productivity.

Sedimentation and Erosion

The creation of a reservoir alters the natural sedimentation cycle which occurs within a river system. The magnitude of these effects is highly variable and unique to each impoundment based on differing substrate composition, stream geometry, size of impoundment, and operating regime (Petts 1984; Williams and Wolman 1985; Graf 2006). Sedimentation will typically vary across a temporal scale for the same project, as channel adjustment changes the substrate composition and stream geometry within the project's lifespan.

As sediment is deposited behind a dam, sediment "reduced" water is discharged from the tailrace. This water will initially attempt to replenish its sediment load which will typically lead to increased bed degradation and/or shoreline erosion (Williams and Wolman 1984). The downstream extent of degradation or erosion differs among river systems depending on the river bed and shoreline substrate composition. Increased erosion will likely continue until one, or a combination, of the following occurs to establish a new equilibrium (Williams and Wolman 1984):

1. Sediment equilibrium is reached by the erosion of the river bed or shoreline. Once the sediment load has been replenished, erosion rates will return to baseline;

2. Reduction of water velocity as a result of channel deepening or widening. Loss of water velocity will force sediment in suspension to settle out of the water column;
3. Downstream hydraulic controls of the system are encountered, such as the ocean, a large lake or river, or other manmade structures;
4. Emergence of bedrock, or the armoring of the bed or shoreline caused by the removal of fines from the area; or
5. Vegetation growth is encountered creating a more stable and resilient shoreline.

Similar to the riverine sedimentation process, there is also an equilibrium balance of sediment input and erosion maintained within an estuarine environment and flow regulation can have similar effects here as in the riverine system. Following the construction of the Aswan Dam on the Nile River, there was a severe restriction to sediment input to the estuarine environment, which subjected the coastal shoreline areas to severe erosion and created instability (Sharaf El Din 1977). No sediment transport or TSS concentrations were recorded prior to the Churchill Falls development; however, Traditional Knowledge indicates that local residents noted a decreasing shoreline in Lake Melville and that trees and rocks have been washed away (Sikumiut 2009). It is unclear from the data available if major changes in sediment transport have occurred since the development of the Churchill Falls facility, even though the peak flood flow has been reduced.

The sediment transport study (NHC 2008) and previous IR# JRP.43b and IR# JRP.90a describe the predicted effects of sediment transport changes as a result of the proposed Project. The results show no change in sediment transport beyond the mouth of lower Churchill River and hence, predicted effects in Goose Bay and Lake Melville are not predicted to be different than existing conditions.

Observations of the Nunatsiavut Government

Observations recorded and submitted by the Nunatsiavut Government (NG) as described in the letter dated June 19, 2009 relative to effects in the Lake Melville area can be summarized as follows:

- Weaker tides and higher salt content in Lake Melville;
- Lower water levels in Lake Melville (some respondents reported higher levels as well);
- Weaker ice formation;
- Faster and earlier break-up of ice in Lake Melville;
- Increased shoreline erosion and the loss of banks and trees; and
- Differences in animal presence, abundance, and timing.

Each of these observations is likely the result of changes in flow regime related to the Churchill Falls development. Relevant observations have been incorporated in the sections above. The nature of the proposed Project is considerably different than that of the Churchill Falls development. Consequently, the EIS has predicted that the Project will not cause alterations to the flow regime similar to those that were experienced by the development of the Churchill Falls facility. The majority of the effects that have been observed within the Lake Melville region can be explained as a result of the diversion of the Naskaupi and Kanariktok Rivers to fill the Smallwood Reservoir (refer to IR# JRP.163). This diversion significantly reduced the freshwater input into Grand Lake and its outflow to Lake Melville at the community of Northwest River. There are no diversions associated with the development of the Project facilities.

Therefore, traditional knowledge provided by the NG is related to the effects associated with the Churchill Falls development and hence, are not directly applicable to the predictions for the proposed Project.

Summary Conclusion

The Churchill Falls development altered the flow regime of the lower Churchill River as well as the freshwater inflows to the estuary environment of Goose Bay and Lake Melville over 35 years ago. This altered inflow has most likely caused changes, and adaptation, within the fish assemblage/abundance in the estuary environment of Goose Bay and Lake Melville. The proposed Project is not predicted to affect the current flow regime below Muskrat Falls and therefore, the existing processes within the estuary will remain essentially unchanged from existing baseline conditions. Considering the prediction of no adverse effects below Muskrat Falls, the potential effects of the Project (including cumulative effects) on secondary production, fish productivity and the impacts of possible food web shifts in the areas below Muskrat Falls, particularly beyond the mouth of the river in to Goose Bay and Lake Melville, is predicted to be negligible and not significant.

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IR# JRP.153

Fish Habitat Compensation Strategy

Requesting Organization – Joint Review Panel **Information Request No.: JRP.153**

Subject - Fish Habitat Compensation Strategy

References:

EIS Guidelines, Section 4.6.1 (Environment Protection – Mitigation)

Related Comments / Information Requests:

CEAR # 289 (Innu Nation)

IR # JRP.107

Rationale:

Section 4.6.1 of the EIS Guidelines requires the Proponent to describe fish habitat compensation strategies.

In its response to JRP.107, the Proponent provides an annotated table of contents of its Fish Habitat Compensation Strategy Framework and indicates that discussion and consultations on a mutually agreeable approach to compensation have been ongoing with Fisheries and Oceans Canada (DFO) and the public since the submission of the EIS. The Proponent further indicates that it anticipated that a final Fish Habitat Compensation Strategy will be completed prior to Panel hearings.

The Panel notes that reviewers who submitted comments during the additional 30-day consultation period indicated that it was difficult to provide comments on the Proponent's responses related to fish and fish habitat since negotiations are still ongoing with DFO with respect to the Strategy.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.153**

Information Requested:

The Proponent is asked to provide a final Fish Habitat Compensation Strategy prior to scheduling of the public hearings, or in the event that a final strategy is not agreed upon, provide an update on the key components of the Strategy and on the areas of outstanding discussion(s).

Response:

The Lower Churchill Hydroelectric Generation Project Fish Habitat Compensation Strategy (AMEC 2010) hereafter referred to as the Strategy Report (Appendix C).

This submission contains Nalcor's Fish Habitat Compensation Strategy for the Project, as developed in accordance with the submitted framework (see IR response IR# JRP.107). Since the submission of the last round of IRs (October 2009), discussions with Fisheries and Oceans Canada (DFO) and other stakeholders have been ongoing to gather and discuss additional information on compensation options. A series of Technical Workshops in both St. John's and Goose Bay were also completed on March 12 and 23, 2010 to facilitate stakeholders input and comment on the Strategy Report as it progressed. These Workshops are not required by the typical *Fisheries Act* Authorization consultation process but were initiated by Nalcor to obtain input and comment as early as possible in the planning process. Additionally, workshops and meetings have been completed with DFO representatives to review the Strategy components (January 6 and February 18, 2010) and potential monitoring requirements (March 16, 2010).

Options assessment and discussions with DFO and stakeholders have determined that the more applicable compensation would be those that remain within, or as close to, the ecological habitats being affected. This is consistent with the Practitioner's Guide to Habitat Compensation (DFO 2007). On that basis, the lacustrine and riverine options as outlined in the strategy have been pursued.

The Strategy provides habitat requirements for fish species present and demonstrates how these will be met through habitat creation and enhancement. The intent of this approach is to sustain, to the extent possible, the existing and natural patterns of fish habitat utilization.

Values attributed to fish and fish habitat by the public, aboriginal peoples and other stakeholders have been identified as part of the development of this strategy and will continue to be incorporated in the further work on the Compensation Plan.

References:

AMEC. 2010. Lower Churchill Hydroelectric Development Fish Habitat Compensation Strategy. Prepared for Nalcor Energy, St. John's, NL.

Fisheries and Oceans Canada. 2007. Practitioner's Guide to Habitat Compensation for DFO Habitat Management Staff. Version 1.1 (http://www.dfo-mpo.gc.ca/oceans-habitat/habitat/policies-politique/operating-operation/compensation/pdf/Compensation_Guide_e.pdf). Fisheries and Oceans Canada, 20p.

IR# JRP.154

Ashkui

Requesting Organization – Joint Review Panel **Information Request No.: JRP.154**

Subject - Ashkui

References:

EIS Guidelines, Section 4.4.4.2 (Description of the Existing Environment – Aquatic Environment)

Related Comments / Information Requests:

CEAR # 287 (Grand Riverkeeper Labrador Inc.)
CEAR # 289 (Innu Nation)
CEAR # 291 (Sierra Club Atlantic)
CEAR # 292 (Environment Canada)

IR # JRP.48, 65, 105

Rationale:

The EIS Guidelines (Section 4.4.4.2) require that the EIS describe "[h]ydrological features such as lakes and streams/rivers, watershed boundaries, river hydrology and hydraulics, bathymetry, surface water flow, flood zones, lake and river ice formation, dynamics and melt patterns, salinity, tides, freshwater mixing zones and delta formation" (p.26), which would include ashkuis. In addition, the Proponent is instructed in Section 4.4.4.4 of the EIS Guidelines to describe "[c]urrent use of land and resources (including aquatic resources) by Aboriginal persons for traditional purposes and "[c]urrent use of land and resources (including aquatic resources) by other land users." (p.28)

In their submission during the additional 30-day consultation period, the Innu Nation states that "Ashkui are recognized by Innu as important locations for carrying out traditional activities" (CEAR # 289, p. 65) and provided a list of four additional references concerning ashkui that the Proponent did not cite in its response to JRP.48 (see CEAR #289, p.65).

Environment Canada's submission notes that "the ecological function of the new ashkui may not be the same as those that are lost. Hence, new ashkui may not replace habitat lost when natural ashkui are flooded." (CEAR # 292, p. 5) The Proponent is referred to this submission for further rationale.

In its response to JRP.65, the Proponent states that "If the results of the follow-up program confirmed the ashkui formation did occur and waterfowl use of the area reached expectations no further action would be taken. If expectations were not met adaptive management measures could be developed based on the data collected to address changes in the mitigation". However, no specific information on feasible mitigation measures or adaptive management is provided.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.154**

Information Requested:

The Proponent is asked to:

a. **Examine the additional information concerning ashkui as listed by Innu Nation in their submission and incorporate this information into the description and analysis of ashkui where appropriate;**

Response:

Nalcor Energy (Nalcor) was involved in investigations and discussions regarding ashkui in Labrador during the late 1990s and 2000. During this time, several agencies and organizations worked with Innu Nation and/or involved Innu participation regarding the importance of ashkui on the landscape. The references listed by Innu Nation (i.e., Baille et al. 2004; Fletcher and Breeze 2000; Fletcher et al. 2000; Gorsebrook Research Institute 2001) describe this experience. The information listed by Innu Nation has been examined, and details of this experience (in addition to that presented in the Environmental Impact Statement (EIS) (Volume IIA, Section 2.4.10.2 and Volume IIB, Section 5.11.2.2) are presented below. This information supports the information provided in the EIS regarding the cultural importance of ashkui and how they are used by fish and wildlife, and does not change the prediction of the environmental effects presented in the EIS.

Baille et al. (2004) recorded observations of staging waterfowl during military low-level flight training in southern Labrador. This behavioral study was funded by the Institute for Environmental Monitoring and Research (IEMR) and was completed at an ashkui on Lac Fourmont (south of the lower Churchill River watershed) during the spring of 2002. Fourteen species of waterfowl (including Common Goldeneye, Black Duck, Canada Goose, Greater Scaup and Ring-necked Duck), and other species (e.g., beaver, river otter, muskrat, Osprey, Bald Eagle, and Rough-legged Hawk) were observed over the course of this environmental effects monitoring program. Two occurrences of predation on waterfowl occupying ashkui were observed. In each case, a Common Goldeneye was captured by a larger animal (river otter or Bald Eagle) that normally forages on fish but may feed opportunistically on other species. The article suggests that spatial and temporal distribution of ashkui may also influence predator-prey interactions.

Fletcher and Breeze (2000) collected Innu traditional knowledge in relation to military low-level flight training and ashkui. This work was contracted by the IEMR to the Gorsebrook Research Institute in Nova Scotia. Interviews were completed with the aid of an Innu aimun interpreter, and maps were used to identify ashkui locations. Based on the input from the participating Innu, these authors define ashkui as sites that never freeze over and are open all winter, as well as the first openings in the ice that appear when weather warms in spring. Mammals such as beavers, otters, and muskrats; and avifauna species such as Canada Goose, Harlequin Duck, Black Duck, Barrow's Goldeneye, Green-winged Teal, Black Scoter are all associated with ashkui. Ashkui are known as good fishing areas and species such as Lake Trout, Brook Trout, Whitefish, suckers, pike and Burbot usually occur. Innu campsites are often located near ashkui due to the abundance of wildlife and fish resources. The location and timing of ashkui formation was discussed. Ashkui within the Churchill River watershed included Minipi River and Lake, Beaver Lake, and locations along the lower Churchill River such as Maikan-nipi (means Wolf Lake, one site at Metchin River outflow and one where a brook enters) and Maikan-nipiss (means Little Wolf Lake, site where river goes through). Other ashkui mentioned in the region included: Grand Lake at the mouth of the Cape Caribou River; at the head of Grand Lake, where the Beaver, Susan and Naskaupi Rivers flow into the Lake; and adjacent to Northwest Point in Lake Melville. The participants indicated that an ashkui often occurs where a river or stream enters or leaves a lake, where there are fast-flowing currents, or where

several currents coincide. Wind was mentioned as an important factor in accelerating the process of ice breakup and melt.

Gorsebrook Research Institute (2000) presents a compilation of comments retained through dialogue and tape recordings held during 10-12 May 2000. The meeting occurred adjacent to an ashkui at Seal Lake, Labrador and included Innu Elders, members of Innu Nation, consultants, government agencies and organizations (Public Works, Environment Canada, Newfoundland and Labrador Hydro, Canadian Centre for Remote Sensing), and universities. Ashkui are described as being valued culturally by the Innu and are considered a critical part of the landscape. These areas are not to be viewed as separate units of the environment but rather need to be thought of from several perspectives. The discussion over the two days included: a comparison of sustenance versus commercial values; traditional knowledge and ownership/use of this knowledge; the safety and quality of water at various sampled sites/manmade factors that influence it; and reference to limited availability of such knowledge in a geographic information system.

Fletcher et al. (2000) compiled information from various discussions and interviews between Innu representatives, including during the meeting held at Seal Lake in 2000 described by Gorsebrook Research Institute (2000). Additional information is presented in this reference. Ashkui appear mid-April to mid-May, however, they could appear as early as late March and as late as early June, based on annual variation. Twenty-nine lakes and rivers on the Quebec/Labrador Peninsula were identified as having one or more ashkui. However, more ashkui exist throughout Labrador. Innu knowledge of ashkui is indicated as multigenerational, and integrated into other information on wildlife and culture. Specific information related to activity around ashkui included the connection of dangers of unsafe ice and how to determine if it was safe to approach, the abundance of wildlife and other resources, characteristics of ice breakup, location of camps (near the site but not as to disturb wildlife, proximity to wood or water supply), and beliefs regarding respect to wildlife.

Fletcher et al. (2000) also noted that Innu reported observations related to climate change such as earlier open water and earlier formation of ashkui or melting of ice. Various developments were believed to be the cause of the disappearance of wildlife at certain ashkui. The bridge at North West River (where Grand Lake flowed into Lake Melville) was believed to have destroyed a productive ashkui. This bridge or other changes on the landscape, were believed to be the reason why seals no longer come to ashkui near Sheshatshiu. It was indicated that prior to the construction of the dam at the Upper Churchill, there were more Harlequin Duck, goldeneye and fish in the area. It was explained that the dam changed the timing and number of ashkui. Beaver, which were plentiful at Amisku-nipi (Beaver Lake), are no longer present.

These documents indicate a consistent understanding of an ashkui (i.e., when, where and why such features occur; the wildlife and fish resources that are often associated with ashkui; and the importance of such areas for the Innu). The authors consider ashkui as not only an important feature of the landscape during early spring, but also as a time or a location where Innu would gather (and continue to gather) to hunt, fish and meet with family and friends. The cultural importance of such features is a dominant aspect of Innu society during spring.

Ashkui are considered as productive areas, in that they may be considered an 'oasis' of open water habitat surrounded by extensive ice cover. In situations where there is extensive open water, the concentration of wildlife and the predators or those engaged in land-use activities may still occur but would not be as predictable as with some ashkui. As with any habitat that provides an important role but is limited in distribution, ashkui tend to be areas of concentration by fish and wildlife but are also areas of risk for predation (Baille et al. 2004) or harvesting by Innu (Fletcher and Breeze 2000, Fletcher et al. 2000, Gorsebrook Research Institute 2001).

Given that the additional information presented above supports the characterization of ashkui in the EIS, there is no need to incorporate this information into the description and analysis of ashkui.

References:

Baille, S.M., C.D. Wilkerson and T.L. Newbury. 2004. "Ashkui" Venal Ice-cover Phenomena and Their Ecological Role in Southern Labrador. Canadian Field-Naturalist 118(2):267-269.

Fletcher, C. and H. Breeze. 2000. *Ashkui* sites in the Low-Level Flight Training Area, Labrador. Report to the Institute for Environmental Monitoring and Research, Happy Valley-Goose Bay, NL.

Fletcher, C., H. Breeze and T. Sable. 2000. A compilation of Innu traditional knowledge on ashkui in Labrador. Gorsebrook Research Institute, St. Mary's University, Halifax, N.S.

Gorsebrook Research Institute. 2001. Ashkui Research Project: Seal Lake Meeting Report. A report from an In-Country Meeting of Researchers and Innu Elders, May 2000.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.154**

Information Requested:

The Proponent is asked to:

b. Provide a statement as to whether this new information supports or contradicts the descriptions given and predictions made to date by the Proponent concerning ashkui;

Response:

The information provided by Baille et al. (2004), Fletcher and Breeze (2000), Fletcher et al. (2000) and the Gorsebrook Research Institute (2001) provide consistent support for the information (i.e., descriptions and predictions) presented in the Environmental Impact Statement (EIS) Volume IIA (e.g., Section 2.4.10.2), Volume IIB (e.g., Section 5.11.2.2), and IR# JRP.48. The new information does not change the conclusions in the EIS.

References:

Baille, S.M., C.D. Wilkerson and T.L. Newbury. 2004. "Ashkui" Venal Ice-cover Phenomena and Their Ecological Role in Southern Labrador. Canadian Field-Naturalist 118(2):267-269.

Fletcher, C. and H. Breeze. 2000. *Ashkui* sites in the Low-Level Flight Training Area, Labrador. Report to the Institute for Environmental Monitoring and Research, Happy Valley-Goose Bay, NL.

Fletcher, C., H. Breeze and T. Sable. 2000. A compilation of Innu traditional knowledge on ashkui in Labrador. St. Mary's University, Halifax, N.S.

Gorsebrook Research Institute. 2001. Ashkui Research Project: Seal Lake Meeting Report. A report from an In-Country Meeting of Researchers and Innu Elders, May 2000.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.154**

Information Requested:

The Proponent is asked to:

c. **Describe the range of effective mitigation and/or adaptive management measures that could be implemented if monitoring and/or follow-up programs show that new ashkui areas do not form as expected or do not have the same characteristics;**

Response:

As indicated in IR# JRP.48b, additional mitigation measures are not needed as ashkui are likely to occur at tributaries within the reservoirs because conditions such as water temperature and velocity at future deltas and tributaries will be similar to existing conditions (Hatch 2007). As Fletcher and Breeze (2000) indicate, ashkui are defined as areas that never freeze over and are open all winter, as well as the first openings in the ice that appear when weather warms in spring. While there will be less open water associated with the reservoirs during winter and early spring than is currently experienced on the lower Churchill River, it is logical to assume, as Fletcher and Breeze (2000) suggest, that an ashkui often occurs where a river or stream enters or leaves a lake, where there are fast-flowing currents, or where currents coincide (i.e., a confluence of two different watercourses). Therefore, it is likely that areas of open water will continue to form at the mouths of tributaries, where they enter the reservoirs. Such areas, in combination with other traditional ashkui within the lower Churchill River watershed (e.g., Minipi Lake) will provide habitat for early nesting waterfowl during spring such as Canada Goose. Further, it is likely that ashkui in the lower Churchill River, below Muskrat Falls, will continue to form as they currently do, and remain unaffected by the Project (Hatch 2007).

In the unlikely event that new ashkui do not form, or do not have the same characteristics, other ashkui that form in the lower Churchill River watershed that would be beyond the reservoirs will be available for use by wildlife and the Innu (Volume IIB, Figure 5-3). While Nalcor does not advocate deliberate action to enhance the size and number of ashkui directly, Project activities will indirectly enhance the productivity of ashkui. For example, some of the deltas in the reservoirs will be areas of habitat enhancement (e.g., creation of gravel bars and channels) for fish and wildlife resources as a mitigation measure that will also serve to encourage ashkui formation in future (Volume IIB, Table 7-1).

Effective adaptive management measures to promote ashkui creation within the Gull Island or Muskrat Falls reservoirs are not feasible. There are examples in the literature where manipulated water levels in a regulated river system have been used to enhance breakup of ice downstream of reservoirs (and below a dam). Techniques have involved a buildup of water in a reservoir in winter that is subsequently released during early spring to breakup downstream ice. Benjamin and Van Kirk (2000) reported that reservoir management was used to create greater open water for waterfowl in spring (e.g., Trumpeter Swan) on the regulated Snake River in Idaho. These authors reported however, that sufficient reservoir storage during winter (and increased release downstream in spring), was attainable only during average years but not during years when the initial reservoir content was low. Allowable winter flows were a function of inflow, length of storage season, reservoir content at the start of storage season, and potential for downstream capture of excess storage season water discharged above (Benjamin and Van Kirk 2000). As indicated, these techniques are not applicable for this Project where the area of interest is within the reservoir, and not downstream of the reservoir. A rapid release of water to portions of the river downstream of Gull Island and/or Muskrat Falls, to facilitate early ice breakup and open

water formation would conflict with other wildlife and land use, as well as generation plant operations (e.g., Muskrat Falls).

References:

Benjamin, L. and R.W. Van Kirk. 2000. Assessing instream flows and reservoir operations on an eastern Idaho river. Journal of the American Water resources Association.

Fletcher, C. and H. Breeze. 2000. *Ashkui* sites in the Low-Level Flight Training Area, Labrador. Report to the Institute for Environmental Monitoring and Research, Happy Valley-Goose Bay, NL.

Hatch Ltd. 2007. Ice Dynamics of the Lower Churchill River River. Prepared for Newfoundland and Labrador Hydro, St. John's, NL.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.154**

Information Requested:

The Proponent is asked to:

d. Describe the circumstances under which the Proponent would implement the proposed mitigation and/or adaptive management measures; and

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Response:

As noted in response to part c, ashkui will form in the reservoirs and additional mitigation and/or adaptive management measures would not be required. As indicated in IR# JRP.154c, alternative ashkui habitat is available elsewhere in the lower Churchill River watershed (Volume IIB, Figure 5-3), and Nalcor is confident that areas of open water will form first at locations where tributaries empty into the reservoirs during the operation and maintenance phase of the Project. Additionally, fish and wildlife habitat will be enhanced at selected delta sites that will indirectly, enhance conditions for the formation of future ashkui as well as biological productivity.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.154**

Information Requested:

The Proponent is asked to:

e. **Describe examples from other projects where ashkui conditions were restored after reservoir formation and compare and/or contrast these examples with pre- and post-Project conditions.**

Response:

No examples from other projects where ashkui conditions were restored after reservoir formation by way of specific mitigation measures could be located. The example described in IR# JRP.154c relates to creating open water conditions downstream of a reservoir, whereas in the case of this Project ashkui formation will remain unchanged. Nalcor is confident that ashkui [i.e., areas of open water that form first on an ice surface (Fletcher and Breeze 2000)] will occur at locations where tributaries empty into the reservoirs.

References:

Fletcher, C. and H. Breeze. 2000. *Ashkui* sites in the Low-Level Flight Training Area, Labrador. Report to the Institute for Environmental Monitoring and Research, Happy Valley-Goose Bay, NL.

IR# JRP.155

Wetlands

Requesting Organization – Joint Review Panel **Information Request No.: JRP.155**

Subject - Wetlands

References:

EIS Guidelines, Section 4.4.4.3 (Terrestrial Environment)

Minaskuat Ltd. 2008. *Wetland Assessment and Evaluation*. Prepared for Newfoundland and Labrador Hydro for the Lower Churchill Hydroelectric Generation Project.

Related Comments / Information Requests:

CEAR # 292 (Environment Canada)

IR # JRP.67

Rationale:

The EIS Guidelines (Section 4.4.4.3) require the Proponent to provide information on the composition, distribution and abundance of wetlands and to characterize them in terms of their ecological functions (habitat, water flow regulation, etc.). A previous Information Request asked the Proponent to provide additional information on these wetland-related aspects within the Project area (JRP.67).

The Proponent's response to JRP.67 does not provide all the information requested. In particular, no reference map was provided with the response which made it difficult to determine the location of the wetlands identified in Volume 6 of the response relative to the river and the different Project components. Also, in response to the question of wetland functions (JRP.67 (d)), the Proponent only provides a generic description of wetland functions with no specific information on those wetlands and wetland functions that would potentially be impacted by the Project.

The Panel also notes Environment Canada's comments on the response to JRP.67 which indicate that, based on the information provided by the Proponent, "CWS [Canadian Wildlife Service] cannot determine if the project will cause significant impacts of the abundance and distribution of wetlands and their provisioning of ecological functions" (CEAR # 292, p. 8).

Requesting Organization – Joint Review Panel **Information Request No.: JRP.155**

Information Requested:

The Proponent is asked to provide:

a. **A reference map showing the location of all wetlands that would be impacted by the Project;**

The Proponent may want to update the information contained in Volume 6 of the response and in Appendix E of the Minaskuat Ltd. (2008) report to complete the information requested above.

Response:

Reference maps showing wetland locations where detailed studies were completed by Nalcor Energy (Nalcor) (Minaskuat Inc. 2008a) have been developed and are attached as IR-JRP.155A, IR-JRP.155B, IR-JRP.155C, and IR-JRP.155D (Attachment A). This information is provided as a supplement to Volume 6 IR# JRP.67 – no other update to the information contained in Volume 6 is required.

These maps of the lower Churchill River valley illustrate the Project Ecological Land Classification (ELC) area, the reservoir limits (predicted area of inundation or flood zone), identify wetland locations where detailed studies were completed with a unique identifier (e.g., WL2016) and indicate whether the location is within or outside the proposed flood zone.

The table presented in IR# JRP.155b replaces Appendix E of Minaskuat Inc. (2008b).

References

Minaskuat Inc. 2008a. Wetland Assessment and Evaluation. Prepared for the Lower Churchill Hydroelectric Generation Project.

Minaskuat Inc. 2008b. Project Area Ecological Land Classification. Prepared for the Lower Churchill Hydroelectric Generation Project.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.155**

Information Requested:

The Proponent is asked to provide:

b. A summary table of information about these wetlands, including wetland identifier, wetland area, wetland type/class, and specific wetland ecological functions; and

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Response:

Table JRP.155.1 (Attachment B) replaces Appendix E of Minaskuat Inc. (2008a). This Table JRP.155.1 provides a series of parameters for wetlands that were assessed and evaluated in 2006 (Minaskuat Inc. 2008a) that includes:

- wetland identifier;
- wetland area;
- wetland type, class and form; and
- specific wetland ecological functions.

Unique wetland identifiers in the first column of this table correspond to wetlands shown in Figures IR-JRP.155A, IR-JRP.155B, IR-JRP.155C, and IR-JRP.155D provided in the response to IR# JRP.155a above.

A summary of the methods used to collect and evaluate the information in Table JRP.155.1 follows.

Data Collection

Initially, all wetlands within 2 km on either side of the Churchill River (from Churchill Falls to Muskrat Falls) were identified through the Project Area Ecological Land Classification (Minaskuat Inc. 2008b) in 2006 at a scale of 1:20,000 using a variety of methods and data sources, including:

- existing mapping of from Churchill Falls to Muskrat Falls (e.g., Beak and Hunter Associates 1978; Northland Associates 1980);
- 1:12,500 scale aerial photos (Government of Newfoundland and Labrador and Newfoundland and Labrador Hydro);
- dedicated field surveys; and
- geo-referenced Project specific digital aerial photography.

Approximately 650 wetlands were identified in this area by Minaskuat Inc. (2008b), with 53 of these wetlands located in the area of future inundation. Detailed wetland surveys were conducted in 103 of the wetlands that included 43 (of the 53) in the area of future inundation. The sampled wetlands represent approximately 81 percent of the wetlands within the inundation zone, including examples of all wetland types, and are therefore considered representative of the wetlands that will be affected by the Project.

Each of the 103 field investigated wetlands were described by a field team comprised of a wildlife biologist, a botanist and a field technician between August 25 and September 6, 2006. At each wetland a Wetland Habitat

Profile datasheet was completed, that recorded the wetland form, class and subclasses present (Canadian Wetland Classification System; NWWG 1997), as well as structural data, including:

1. Substrate type;
2. Level of interspersion;
3. Average water depth;
4. Flow rate;
5. Wetland seasonality;
6. Peat presence; and
7. Number of snags.

As the field team completed each transect across a wetland, vegetation was characterized as open water aquatics, emergent vegetation, meadow, low shrubs, tall shrubs or forest. A complete vegetation list for each sampling location was recorded, as well as all instances of wildlife or their sign, and any evidence of human use. Habitat potential or suitability of each wetland was rated for selected herpetiles, mammals, waterfowl and other avifauna known to occupy wetlands, and individual rankings were given to rate the suitability of the wetland to meet specific life history requirements, the results of which are presented in Minaskuat Inc. (2008a). These detailed structural, ecological and habitat suitability data were used to complete an evaluation of the individual function of each assessed wetland.

Wetland Function Assessment

Wetland functions are the natural processes (physical, chemical, biological) that occur in wetlands. While most wetland functions are generally present in all wetlands, the scale and significance of each function is highly variable. The value of the functions provided by a wetland is determined by the importance of the service (e.g., high capacity for retention of surface water runoff) and the need for the service (e.g., sensitive downstream environment). For this analysis, functions that are directly linked to products or services of likely value in the watershed are considered.

The wetland functions considered in this evaluation are Water Flow Moderation, Shoreline and Erosion Protection, Water Quality Treatment, Carbon Sequestration and Storage, Support for Biodiversity, Wildlife Habitat Potential, and Human Use. Groundwater recharge was considered, but not assessed, as it is a difficult function to assess even with in-situ instrumentation, due to the variability of contributing subsurface conditions.

The approach to wetland function assessment was to define and then apply the structural criteria used to determine individual wetland function. Due to the number of wetlands in this area, this assessment does not provide an estimate of the functional performance of each individual wetland, but rather an indication of the functional potential. Professional experience with a variety of function assessment methods informs the criteria selection and no one method was employed for this evaluation. The criteria used to determine individual wetland functions are defined in the following discussion.

- Water Flow Moderation

  Wetlands are valued for capturing, storing and slowly releasing water over a period of time, thereby reducing the impact of floods in down gradient environments. The capacity for storm flow moderation requires a fluctuating hydrological regime, and consequently, wetlands with consistent water levels at or near surface levels do not have capacity for additional storage during storms. Peat forms when water levels are maintained at or near the surface, and therefore, all wetlands with

peat presence, and substrate composition greater than 50 percent organics were considered as having no potential for water flow moderation. The exceptions were for certain wetland forms that may form peat but are known to have a high potential for flow moderation, including string fens, ribbed fen, floodplain swamp, basin marsh, and riparian marsh (due to multiple water sources or structural features, NWWG 1997). All wetlands of the bog class have been excluded because by definition bogs, do not receive surface water inputs and have stable water levels at or near surface. The remaining wetlands were identified as having potential for providing the "Water Flow Moderation" function.

- Shoreline and Erosion Protection:

  Emergent and floating wetland vegetation dissipates wave energy and the erosive nature of flows can also be dampened by the structural support provided by the roots of wetland plants. All riparian fluvial wetland forms have been assigned potential for providing shoreline and erosion protection.

- Water Quality Treatment

  Wetlands are commonly called the "kidneys of the earth" for their ability to improve water quality through physical and chemical processes. Physically, emergent and submerged wetland vegetation slows water velocity, allowing particles to settle out and accrete in wetland sediments. Wetlands may also cool water temperatures, buffer acidity, metabolize oxygen demand, precipitate and store certain metals, and uptake nutrients, depending on site-specific hydrology, biogeochemistry and vegetation (Kadlec and Wallace 2009).

  For a wetland to provide a water quality improvement function, a source of water quality degradation must be present. The identified sources of existing water quality degradation within the Project Area (Minaskuat Inc. 2008b) include decreased water quality downstream of the Black Rock Bridge (Minaskuat Inc. 2007).

  The Black Rock Bridge associated with the Trans Labrador Highway (TLH) between Happy Valley-Goose Bay and Cartwright was completed in 2006 and crosses the lower Churchill River approximately 20 km below Muskrat Falls. Downstream sampling stations at this location indicate poorer water quality (i.e., higher levels of TSS, TP, metals and ions) than upstream stations. The resulting higher river velocities after construction of the causeway and bridge may have affected the water quality. The deterioration of water quality downstream is particularly evident during spring melt, when TSS levels are high. It is assumed for this analysis that all riparian wetland forms on the Churchill River downstream of the Black Rock Bridge have potential for improving water quality by slowing water flows, accretion of sediment, nutrients and metals. The functional performance of these wetlands may be conservatively overestimated by this analysis because water quality improvement is linked strongly to vegetative structure, substrate, hydroperiod and chemistry, and each wetland may not provide the same level of treatment or the same type of treatment (Kadlec and Wallace 2009).

- Carbon Sequestration and Storage

  Wetland vegetation fixes atmospheric carbon through photosynthesis. Stable wetland water levels and the insolubility of oxygen in water result in slow decomposition rates of seasonal vegetation die-off and thus the long-term storage of fixed carbon in live and preserved (peat) biomass. Boreal peatlands are particularly effective at storing atmospheric carbon and are often credited with

slowing global climate change (Schlesinger 1997). The criteria used in this evaluation to determine potential for this function are that peat is present, organic soils were present at greater than 70 percent of the soil composition, and that the wetland was classified as permanent (versus semi-permanent or ephemeral). The rational for this determination is that peat formation is an indication of depressed decomposition of primary productivity and therefore, storage of atmospheric carbon (peat comprises > 70 percent of soil profile). In some cases, high primary productivity can result in high seasonal carbon sequestration, but on an annual basis or cyclical basis, carbon is released; semi-permanent or ephemeral wetlands are therefore not considered as having the "carbon sequestration" function (Schlesinger 1997). All wetlands that meet the established criteria are considered as having the potential for carbon sequestration.

- Support for Biodiversity

  Wetlands represent only 14 percent of Canada's land mass; however, one third of the species at risk listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) live in or near wetlands (Environment Canada 2009). Wetlands are therefore considered important habitats for supporting biodiversity. For this evaluation, species richness [species count based on vegetation plots in sampled wetlands (Minaskuat Inc. 2008a)] and regionally rare species presence are used as a measure of biodiversity. Functional potential was based on having measured richness values in the 4th quartile (>25 species, n=103) and the presence of one or more potentially regionally rare species, as defined and described in IR# JRP.158b.

- Wildlife Habitat Potential (Herpetile, mammals, other birds)

  During the baseline field studies, the habitat potential or suitability of each assessed wetland was rated for select herpetiles, mammals, and other bird species known to use wetlands (Minaskuat Inc. 2008a). Individual rankings were based on a scale of 0 to 3, where 3 is high potential/suitability, and considered the physiographic structure of the wetland to meet specific life history requirements. The herpetile habitat considered in this evaluation included that of the northern leopard frog, mink frog, wood frog and American toad. Habitat for moose, beaver, muskrat and otter was considered in the mammalian category. The habitat preferences for birds evaluated included that of the Greater Yellowlegs, Wilson's Snipe, Solitary Sandpiper, Spotted Sandpiper, Alder Flycatcher, Yellow Warbler, Northern Waterthrush, Wilson's Warbler, Savannah Sparrow, Lincoln's Sparrow, Swamp Sparrow and Song Sparrow. Detailed methods and results are available in Minaskuat Inc. (2008a).

  To assess the potential habitat function of the wetlands, these rankings were summed for each category (i.e., the individual rankings for the assessed mammal species were summed together for a "Mammal Habitat" habitat suitability rank). The quality of Wildlife Habitat in each category (herpetile, mammals and birds) was assigned to all wetlands with total habitat rankings in the 4th quartile.

- Waterfowl Habitat

  The potential value for waterfowl habitat was rated in each assessed wetland on a scale of 0 to 3, where 3 is high potential/suitability, and considered the physiographic structure of the wetland to meet specific life history requirements of select waterfowl groups. Estimates of suitability for waterfowl were subdivided into three classes based on seasonal use, namely: (1) Staging/Pair use, (2) Nesting, and (3) Moulting potential; and, for four distinct waterfowl groups, namely: (1) Canada

geese, (2) cavity-nesters, (3) dabbling ducks, and (4) diving ducks. The detailed criteria for ranking and a summary of results are available in Minaskuat Inc. (2008a).

To assess the performance of the wetlands in terms of the Waterfowl Habitat function, the rankings for each waterfowl group were summed (i.e., the individual rankings for each class of use was summed to provide an overall ranking for each waterfowl group). The potential for "Waterfowl Habitat" in a waterfowl group (e.g., Canada geese, cavity-nesters, dabbling ducks and diving ducks) was assigned to all wetlands with total habitat rankings in the 4th quartile.

- Human Use

During the wetland baseline studies, observations of human activity within the vicinity of the wetlands were noted (Minaskuat Inc. 2008a). It is unknown whether these observations of nearby human activity (typically presence of a cabin) indicate that the wetland is used by humans but it is assumed for this analysis that human presence near a wetland is somehow benefitting from the functions provided by the wetland (e.g., aesthetics, wildlife habitat for hunting or recreational observation). Potential functioning to the benefit of humans was therefore assigned to all wetlands with noted human use in the vicinity (i.e., within 100 m).

Hunting is often concentrated in open terrain and in wetlands. Specifically, hunting occurs in wetland habitat along the full length of Phase I of the TLH between Happy Valley-Goose Bay and Churchill Falls, and along the lower Churchill River (Minaskuat Inc. 2009). The potential wetland function for human use was also assigned to wetlands that occur within known hunting areas (Figures 6-3 to 6-7, Minaskuat Inc. 2009) and were identified as providing high wildlife habitat potential for mammals or waterfowl.

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Requesting Organization – Joint Review Panel **Information Request No.: JRP.155**

Information Requested:

The Proponent is asked to provide:

c. **A discussion on the proportions of each wetland type loss or impacted by the Project, and on the ecological and social significance of the loss of these wetlands.**

Response:

The area of future inundation is identified in IR-JRP.155A, IR-JRP.155B, IR-JRP.155C, and IR-JRP.155D, with affected wetlands noted. A total of 651 wetlands were identified within a 2 km wide buffer along either side of the Churchill River, from Churchill Falls to Muskrat Falls, comprising over 2,500 ha of wetland habitat. Of these wetlands, 53 are located in the area of future inundation and 598 are expected to remain unaffected by the Project. Of the 651 wetlands identified in the study area, 103 were studied in detail by Minaskuat Inc. (2008a) and are presented in Table JRP.155.1. Of the 103 sampled wetlands, 43 are located in the area of future inundation, representing more than 95 percent of the area of wetland habitat to be affected by the project. An additional ten wetlands (of a total of 53) were identified in the area of inundation but were not studied in detail because they were similar in structure, size and form to nearby wetlands (i.e., the sampled wetlands were considered a representative sampling of wetlands within the future inundation area). Wetland area measurements are not available for 13 of the 43 wetlands sampled in the inundation area either because they were too small to be mapped, or because they were seasonally inundated by the Churchill River at the time of the Ecological Land Classification work and were assigned an area of the river [note that mapping of wetlands within the Project Area Ecological Land Classification (Minaskuat 2008b) was completed at a scale of 1:20,000].

The predicted effects of the Project on wetland area and function are not likely to be significant. Specifically, the discussion below will show:

- a low proportion of wetlands in the study area will be affected;
- there will be potential for wetland habitat and function replacement in and along the created reservoirs; and
- the capacity for unaffected wetlands to provide similar functions to those wetlands that will be affected.

The details of these conclusions are discussed below.

Total Wetland Habitat Affected

Of the 651 wetlands identified in the study area, 53 are expected to be affected by the project (598 will remain unaffected). On an aerial basis, the total wetland habitat to be affected by inundation represents approximately 20 percent of the wetland habitat identified in the 2 km wide buffer along either side of the Churchill River (521 ha of 2,533 ha). As a proportion of total area of future inundation, wetlands represent <1 percent of the Gull Island Reservoir land mass and 6 percent of the Muskrat Falls Reservoir land mass.

Mitigative action to offset the loss of wetland habitat involves the creation of wetland habitat along the riparian area of the area of future inundation (Volume IIB, Section 5.11.1). To encourage the growth of shoreline vegetation reflecting a natural (pre-Project) riparian zone, vegetation on slopes less than 30 degrees will be cleared selectively. This includes the removal of trees and brush from an area within 3 m elevation above full

supply level (FSL) to 3 m below low supply level (LSL) (including trees below this level yet extending into this area) while retaining riparian vegetation (low trees, shrubs) to provide wildlife habitat until the impoundment of the reservoir. Nalcor will also enhance conditions for wetland establishment at locations in the lower Churchill River watershed (Volume IIB, Table 7-1). The functions provided by riparian marsh, shallow water and swamp wetlands will be provided by both the existing wetlands and the new wetlands that will be encouraged to form in the new riparian area. On an aerial basis, the net or residual loss of wetlands in the area of future inundation represents a low proportion of the total wetland area in the Project Area.

Wetland Types Affected

For each wetland type discussed below, wetland areas affected are expressed as a proportion of the population of wetlands that were studied in detail (103) and not the total number of wetlands identified in the study area (651) because specific classification data are not available for the wetlands that were not studied in detail.

- Bog

  One of the 17 bogs identified in the study area is located in the area of future inundation; it was identified as a basin bog with an aerial extent of 4.3 ha. The functional analysis of this wetland indicates that it has the potential to provide carbon sequestration and storage. Such wetlands are common in the lower Churchill River watershed and often associated with low-relief terrain (Minaskuat Inc, 2008a).

- Fen

  Among the sampled wetlands, 34 were classified as fen (comprising 315 ha). Three fens are located in the area of future inundation, comprise a total area of 11.6 ha, or 4 percent of fen habitat identified in the Study Area on an aerial basis. All three fens were noted for their carbon sequestration and storage potential. Two of the fens are of the riparian form (i.e., floating and shore fen) and were attributed as having potential for providing shoreline protection and dabbling duck habitat along the Churchill River. These functions were commonly associated with the fens identified in the Study Area.

- Marsh / Swamp Complex

  Nine marsh/swamp complexes were identified in the study area, all of which are in the area of future inundation. All of these wetlands were of the riparian form (various subforms). The total area of marsh / swamp complex habitat within the area of future inundation is greater than 135 ha (note that area data are not available for one marsh/swamp complex).

  These wetlands were noted for their contribution to flow moderation and shoreline protection along the Lower Churchill River. The presence of a vascular plant of interest to NL Wildlife Division (i.e., *Glyceria canadensis*) was confirmed in one of the riparian marsh/swamp complexes (IR# JRP.158b). The majority of these riparian marsh/swamp complexes were noted for providing habitat for dabbling ducks and birds, and to a lesser extent, herpetiles and mammals.

- Swamp

  One swamp, riparian channel subform, was identified in the area of future inundation, comprising a total area of 1.81 ha. Two examples of riparian channel swamp were identified during the detailed studies. This wetland was identified as having potential to provide shoreline erosion protection, and

suitable habitat for herpetiles and some waterfowl. It also has potential from a human use function perspective.

- Marsh

  Of the sampled wetlands, 23 were classified as marsh (comprising 231.5 ha). Fifteen of these wetlands (82 percent on an aerial basis) are located within the area of future inundation (note that area data are not available for three marshes). One marsh was classified as a linked basin marsh, the remainder were classified as riparian forms (delta, floodplain, meltwater or stream subforms). All of these wetlands were noted for providing water flow moderation in the watershed, and the riparian forms were noted for providing shoreline protection.

  Vascular plant species of interest to the NL Wildlife Division are present in four wetlands: *Equisetum palustre* was found in a riparian stream marsh; *Potamogeton richardsonii* was present in a riparian floodplain marsh; *Glyceria canadensis* was present in a lacustrine shore marsh; and *Glyceria canadensis* and *Equisetum palustre* were also found in a linked basin marsh (IR# JRP.158b).

  The majority of marshes in the inundation zone provided suitable habitat for dabbling ducks, cavity nesting waterfowl and Canada geese, and suitable habitat for mammals and herpetiles.

  Approximately 185.4 ha of the 337.2 ha (55 percent) of riparian marsh habitat identified within the study area will be inundated (based on 103 sampled wetlands). Prior to this study the presence of these wetlands along the lower Churchill River was not documented and so it is likely that the actual presence of this wetland form is more common than currently thought in Labrador.

- Shallow Water / Swamp Complex

  Three of the four shallow water / swamp complexes identified in the study area are located within the area of future inundation (at least 55 percent on an aerial basis; note that an area measurement is not available for one of the wetlands in the inundation area). These wetlands are of the riparian form (various subforms). All three wetlands are attributed the function of shoreline protection along the lower Churchill River. Two of the three are also contributing to flow moderation along the lower Churchill River. These functions have also been attributed to the shallow water / swamp complex outside of the inundation zone. High habitat suitability for avifauna was noted in all three shallow water / swamp complexes within the future inundation zone, and two were noted for providing high habitat suitability for mammals. Two of the wetlands provide habitat for vascular plants of interest (i.e., *Glyceria canadensis* is present in a riparian stream water/ floodplain swamp complex and both *Glyceria canadensis* and *Equisetum palustre* are present in a riparian floodplain water / floodplain swamp complex; IR# JRP.158b).

- Shallow Water

  Eleven of 14 shallow water wetlands identified within the study area are located in the area of future inundation (90 percent on an aerial basis; area data are not available for eight of the sampled wetlands). The shallow water wetlands within the area of future inundation are riparian form (floodplain and stream sub-forms) and have been uniformly attributed the function of providing shoreline protection. A minority of these wetlands (less than 30 percent) have been identified as functioning ecologically, in terms of having high biodiversity, or providing suitable habitat for mammals, birds, and waterfowl.

Wetland Functions Affected

Wetland classification and functional information is available for 103 of the 651 wetlands identified in this area (16 percent). Based on this sample size, it was concluded that all functions provided by wetlands in the area of future inundation are represented in the wetlands that will remain un-affected in the study area.

- Flood Moderation

  By nature of the riparian location of wetlands that will be affected by the Project, flood moderation and shoreline and erosion control protection were identified as an important function among the sampled wetlands. A total of 27 wetlands were determined to have the potential to contribute 430 ha of flow moderation services in the area of future inundation. On an aerial basis, this represents less than 40 percent of the total potential flow moderation function provided by the sampled wetlands (a much lower percentage of the total population of identified wetlands). This function is provided primarily by riparian marsh, with string fen and riparian shallow water wetland contributing to a lesser degree.

  The loss of flow moderation services in the area of inundation is not considered significant. The impoundment structure for hydroelectric power generation will provide flow moderation to down gradient resources. The wetlands unaffected by the Project will continue to provide this service to moderate the flow of water being delivered to the impoundment, as will the wetlands that establish along the shoreline of the area of future inundation.

- Shoreline Erosion Control

  A total of 40 wetlands were determined to have the potential to contribute over 480 ha of shoreline erosion control protection along the Lower Churchill River. This represents less than 40 percent of the total potential shoreline erosion control function provided by the sampled wetlands. This service is provided primarily by riparian marsh and riparian shallow water wetland habitats, with riparian swamp and riparian fen habitats contributing to a lesser degree. The impoundment of water for hydroelectric power generation will effectively shift the location of shoreline habitat. The loss of shoreline erosion control services provided by these specific wetlands will therefore have no net environmental effect. It is expected that the existing wetlands located in the area identified as the post-impoundment shoreline will contribute to shoreline erosion control protection.

- Water Quality Improvement

  Only one wetland was determined to be currently contributing to water quality improvement within the area of future inundation, a riparian shallow water wetland/swamp complex. This represents a future loss of 18 percent of the assessed wetland area that was attributed with providing water quality improvement services. Many more wetlands likely have the potential to provide water quality improvement services, however, due to the lack of contaminant sources they are not currently functioning in this respect. The loss of this individual wetland providing this service is not likely to have measureable environmental effect on down gradient water quality or overall watershed water quality.

- Carbon Sequestration

  Four wetlands were attributed the potential to provide carbon sequestration functions within the area of future inundation. Three of the wetlands are fen (riparian floating fen, riparian shore fen

and Atlantic ribbed fen subforms), and one is classified as a basin bog. The total contributing area is 16 ha, representing 3 percent of the assessed wetland area that was attributed with providing carbon sequestration services. Although the loss of 16 ha of wetland area providing carbon sequestration is a permanent loss of continued carbon sequestration, the existing stored carbon may remain in storage in the form of buried peat (Volume IIA, Section 3.7).

- Support for Biodiversity

  Five wetlands (riparian marsh and shallow water wetland subforms) within the area of future inundation were found to have high species richness; one of these is also habitat for a plant species of interest (i.e., *Glyceria canadensis*). Five additional wetlands within the area of future inundation are also confirmed habitat for regionally rare plant species, including *Glyceria canadensis* (found in basin marsh, riparian marsh and riparian shallow water wetland), *Equisetum palustre* (found in riparian water / floodplain swamp complex) and *Potamogeton richardsonii* (found in riparian marsh; IR# JRP.158c). Habitat for each of these species is also found outside of the area of future inundation. Further, attempts will be made to salvage species that are confirmed to be regionally rare from the area of future inundation to transplant them to areas that will not be affected by the Project (IR# JRP.158c).

- Habitat Suitability: Herpetile

  Thirty of the sampled wetlands (260 ha) were identified as providing suitable habitat for herpetiles, 17 of which are within the area of future inundation (representing 72 percent of sampled wetlands on an aerial basis). High habitat suitability was typically associated with fens, bogs and marshes. Fens and bogs represent the large majority of wetlands found within the study area, and therefore the loss of habitat for herpetiles is considered to be negligible.

- Habitat Suitability: Mammal

  Twenty-four of the sampled wetlands were identified as having high habitat suitability for mammals; 17 of which are located in the area of future inundation (representing 83 percent of sampled wetlands on an aerial basis). These wetlands are classed as riparian shallow water wet/ands, riparian marsh and swamp complexes, typically found at the confluence of tributaries to the Lower Churchill. To encourage development and re-establishment of delta areas and wetlands for mammal habitat post-inundation, scarification will be conducted at the inflow areas for major tributaries prior to inundation. The predicted Project effects on wetlands with high habitat suitability for mammals will be negligible because unaffected wetlands in the study area will continue to provide this habitat, and new riparian wetland habitat will be created on the new reservoir shoreline.

- Habitat Suitability: Other Birds

  Of 28 sampled wetlands identified as having high overall suitability for bird species, 21 are located in the area of future inundation (76 percent of sampled wetlands on an aerial basis). The wetlands providing this habitat are classified as riparian shallow water wetlands and riparian marsh and swamp complexes. To replace this habitat, vegetation will be cleared in a buffer on the future reservoirs shoreline; and there will be active wetland creation at selected areas, to encourage formation of riparian marsh at selected locations adjacent to the reservoirs. This will provide habitat for Wetland Sparrows, Rusty Blackbird, Olive-sided Flycatcher and other wildlife (herpetiles). Also unaffected wetlands in the study area will continue to provide habitat for the evaluated bird species post-impoundment, and habitat for species displaced to the new riparian areas.

- Habitat Suitability: Waterfowl

  Of the 103 wetlands that were studied in detail, 36 wetlands (48 percent of studied wetlands on an aerial basis) were identified as having high habitat suitability for dabbling ducks. High habitat suitability for dabbling ducks was identified in 28 wetlands in the area of future inundation (77 percent of studied wetlands providing this function on an aerial basis). This habitat is associated with riparian marsh, basin marsh, riparian fen, riparian swamp and riparian shallow water wetland habitats. Habitat suitability for dabbling ducks was identified in a large proportion of the studied wetlands, and riparian marsh and swamp habitat will be encouraged to form in the riparian areas of the new reservoirs.

  High habitat suitability for cavity nesting waterfowl was identified in 30 of the studied wetlands. Of the 30 wetlands, 22 are in the area of future inundation (220 ha of riparian marsh and 24 ha of other wetland types). This was a common function provided by the sampled wetlands in the study area, particularly in riparian marshes. To encourage the establishment of this type of habitat along the riparian area of the future reservoirs, vegetation will be cleared selectively and grades will be scarified in appropriate areas around the future reservoir. Habitat for cavity nesting waterfowl is provided in many wetlands in the study area, and this habitat will be encouraged to form in the riparian areas of the new reservoirs.

  Of the 17 sampled wetlands with high habitat suitability for diving ducks, five riparian marshes (112 ha) and one fen (5.86 ha) were located in the area of future inundation (representing 64 percent on an aerial basis). Wetlands suitable for diving ducks (particularly riparian fens) are common in the study area and Labrador (Minaskuat Inc. 2008a).

  Of the 23 sampled wetlands identified to have high habitat suitability for Canada geese, 14 are within the area of future inundation. This represents, on an aerial basis, 58 percent of the sampled wetlands in the study area that were attributed this function. Wetlands (particularly string bogs) suitable for breeding are widespread and common in the study area. The amount of primary habitat lost through the creation of the reservoirs is 2.4 km^2, or 6.3 percent of the primary habitat within the lower Churchill River valley (0.3 percent of the primary habitat within the study area; Volume IIB, Section 5.14.8), and is not significant.

- Human Use

  There were no direct human uses attributed to these wetlands. Potential for recreational (hunting) use was identified in 48 wetlands (451 ha), 18 of which are in the area of future inundation (182 ha). Of the 18 wetlands, 12 are riparian marsh habitat (170 ha); the remainder are riparian shallow water wetland, basin bog and riparian swamp habitats. As the loss of wetland habitat for game animals was predicted to be not significant (Volume III, Section 5.6), the Project affects on associated human use function of these wetlands would be provided in alternative wetlands unaffected by the Project.

References

Minaskuat Inc. 2008a. Wetland Assessment and Evaluation. Prepared for the Lower Churchill Hydroelectric Generation Project.

Minaskuat Inc. 2008b. Project Area Ecological Land Classification. Prepared for the Lower Churchill Hydroelectric Generation Project.

ATTACHMENT A

INFORMATION RESPONSES
LOWER CHURCHILL PROJECT

JOINT REVIEW PANEL

Wetlands

IR# JRP.155

Maps
IR-JRP.155A, IR-JRP.155B, IR-JRP.155C, and IR-JRP.155D

May 2010

nalcor energy
LOWER CHURCHILL PROJECT

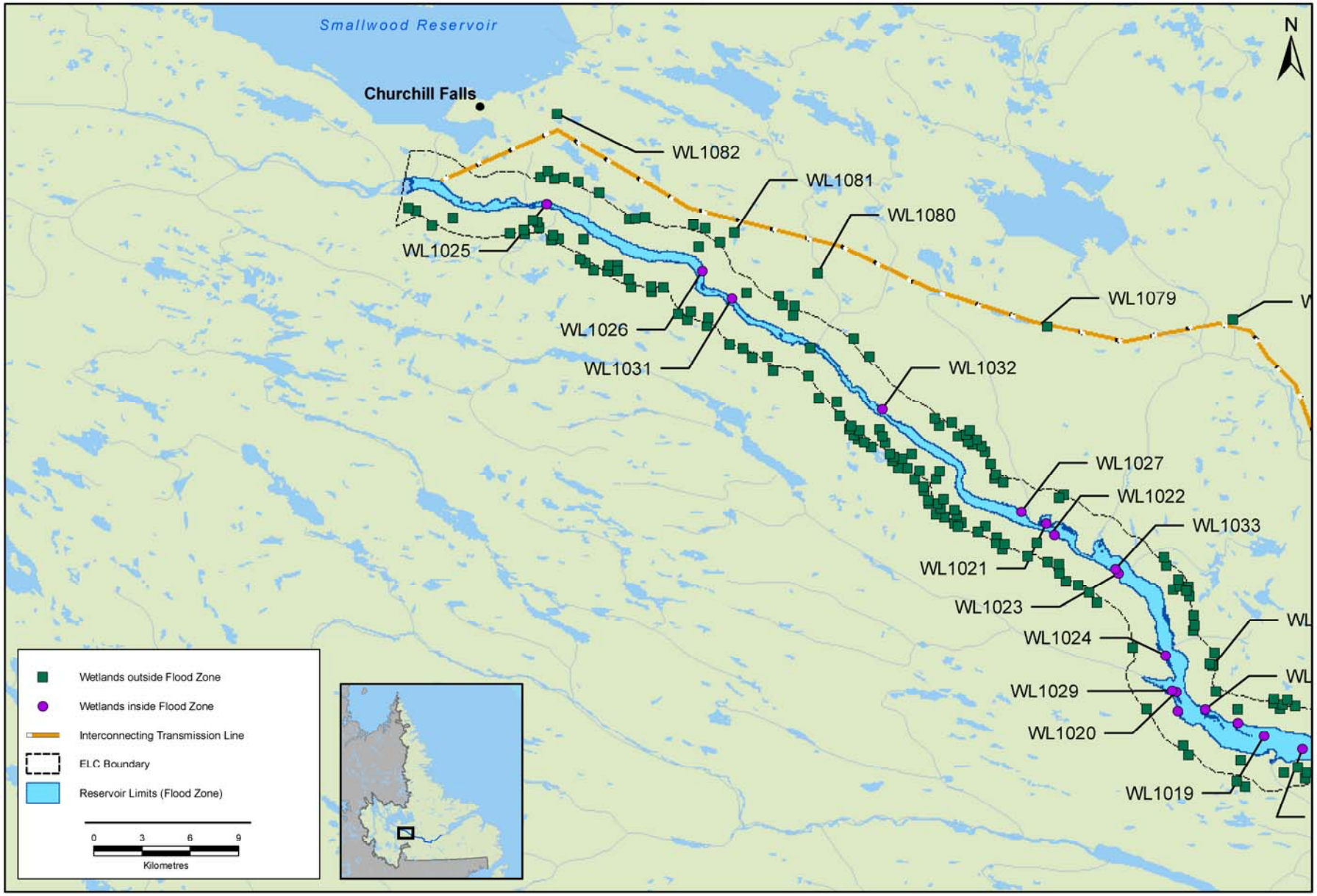

FIGURE NO:		DRAFT DATE:
IR-JRP.155A	IR-JRP.155 - Wetland Assessment and Evaluation Survey Area	07/28/2009
		REVISION DATE: 07/28/2009

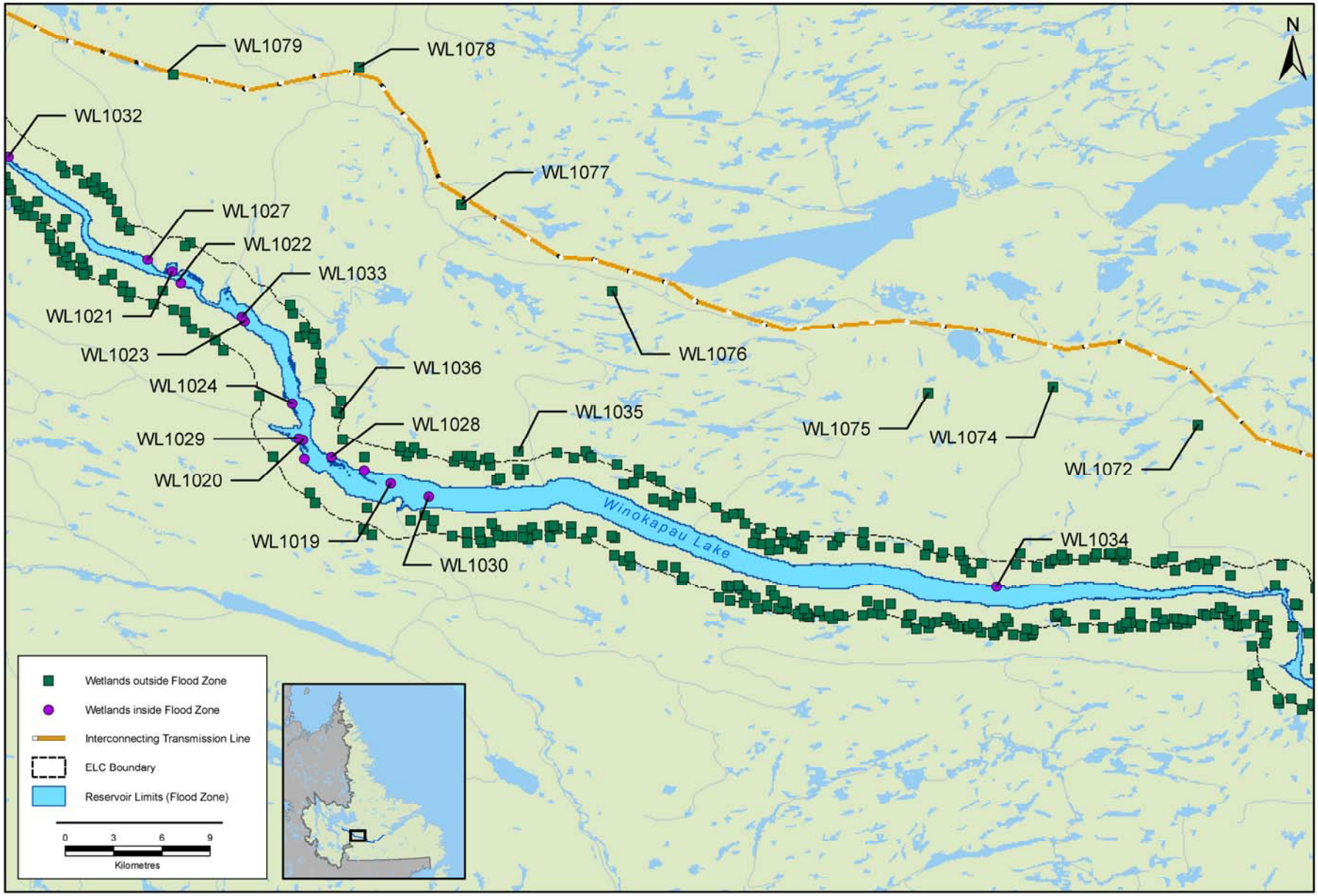

FIGURE NO:		DRAFT DATE:
IR-JRP.155B	IR-JRP.155 - Wetland Assessment and Evaluation Survey Area	07/28/2009
		REVISION DATE: 07/28/2009

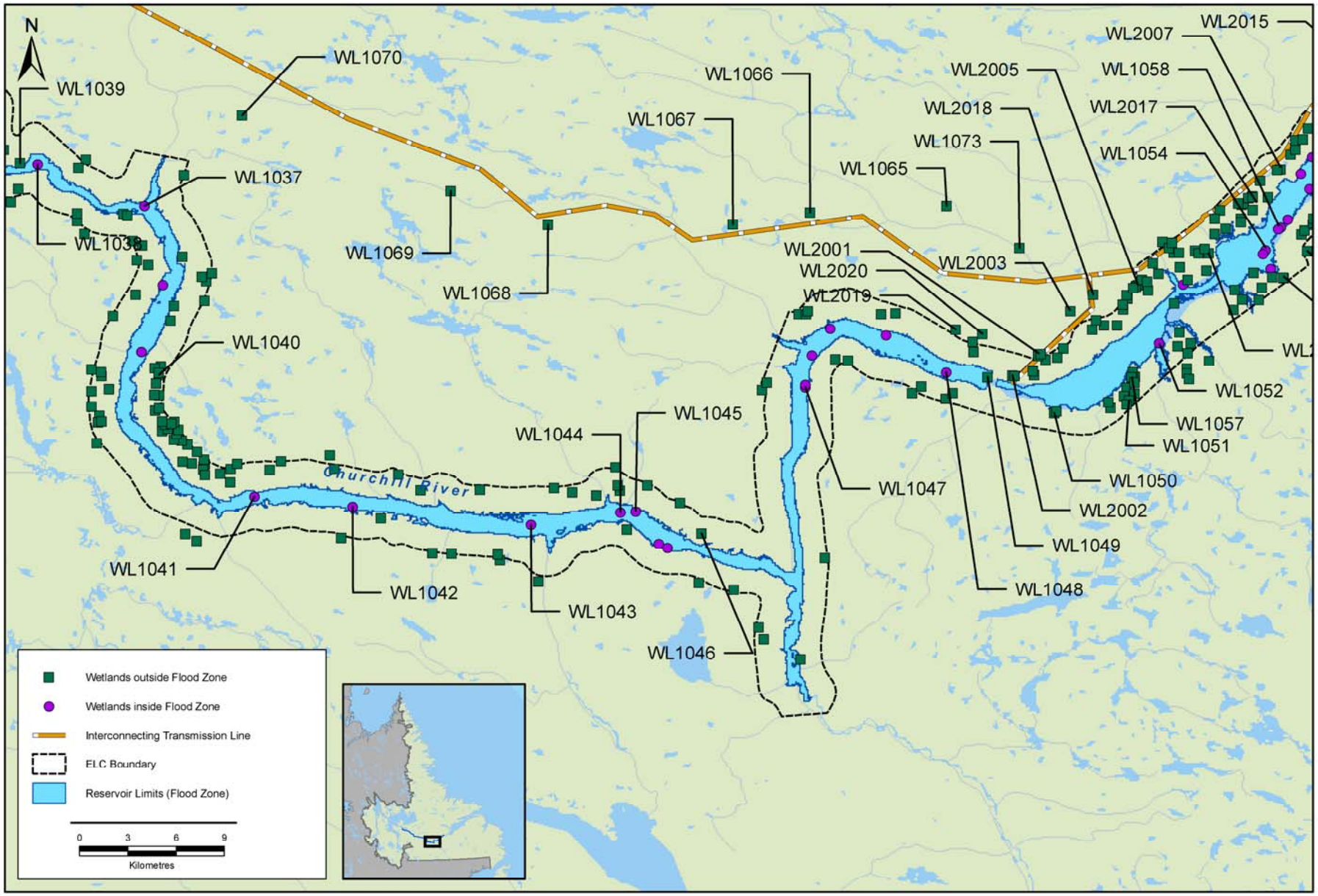

FIGURE NO:		DRAFT DATE:
IR-JRP.155C	IR-JRP.155 - Wetland Assessment and Evaluation Survey Area	07/28/2009
		REVISION DATE: 07/28/2009

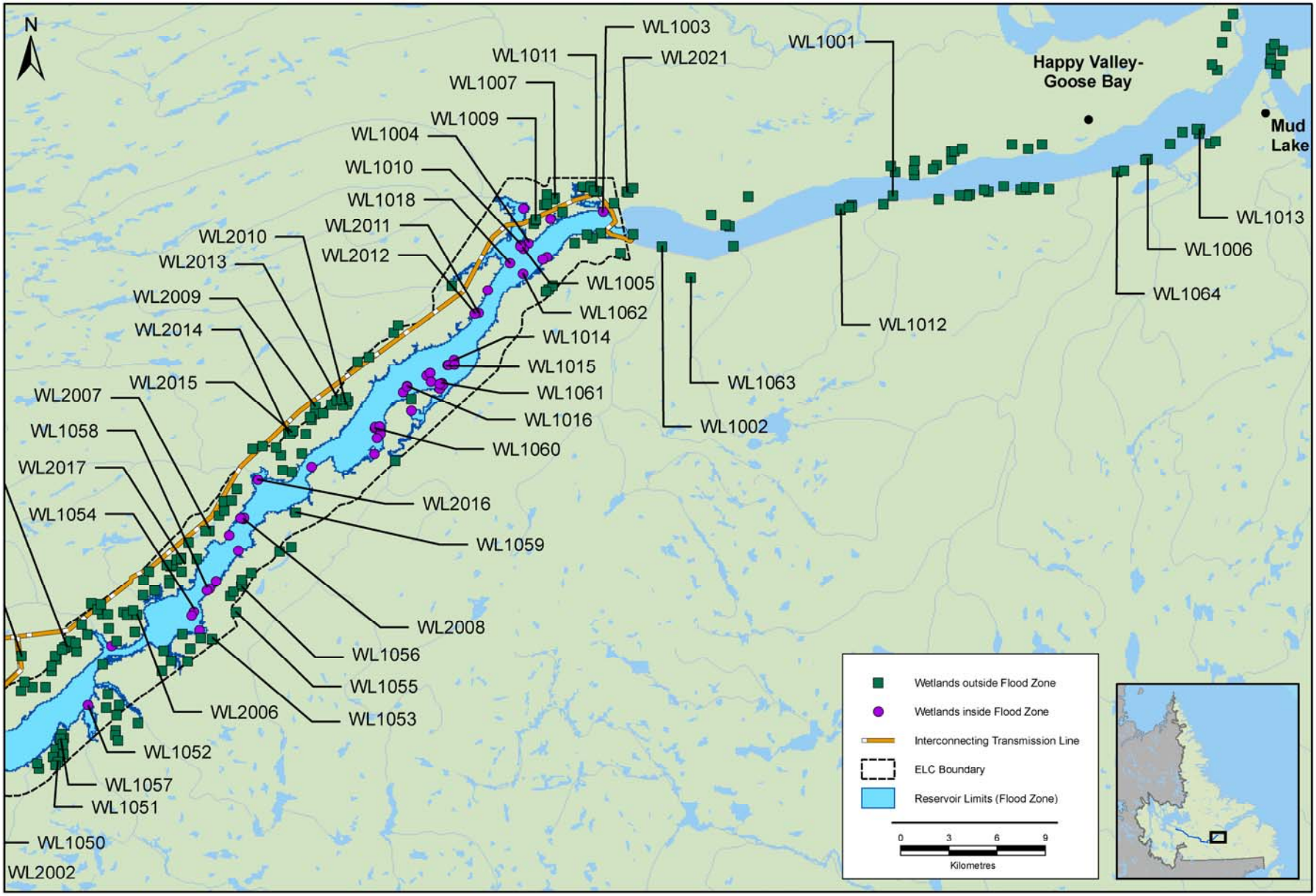

FIGURE NO:		DRAFT DATE:
IR-JRP.155D	**IR-JRP.155 - Wetland Assessment and Evaluation Survey Area**	07/28/2009
		REVISION DATE: 07/28/2009

ATTACHMENT B

INFORMATION RESPONSES
LOWER CHURCHILL PROJECT

JOINT REVIEW PANEL

Wetlands

IR# JRP.155

Table JRP.155.1
Summary of 103 Wetlands Sampled for the
Lower Churchill Hydroelectric Generation Project

May 2010

nalcor energy
LOWER CHURCHILL PROJECT

Table JRP.155.1 Summary of 103 Wetlands Sampled for the Lower Churchill Hydroelectric Generation Project

Wetland	Area (ha)*	Wetland Class Type	Form 1	Sub-form 1	Form 2	Sub-form 2	Ecological Land Classification (ELC) Wetland Interpretation	ELC Mapping Notes	Wetland Field Comments	Functions														
										Flow Moderation	Shoreline Protection	Water Quality	Carbon Sequestration	Biodiversity	Regionally Rare Plant Species	High Habitat Suitability			Waterfowl				Human Use	Flow Moderation
																Herpetile	Mammals	Birds	Canada Goose Habitat	Cavity Nester Habitat	Dabbling Duck Habitat	Diving Duck Habitat		
WL1001	0.00	Marsh	Riparian Marsh	Riparian Stream Marsh			not mapped	Sampled in river	Upstream of TLH-Churchill River crossing	P	P						P	P		P		P		P
WL1002	17.28	Shallow Water / Swamp Complex	Riparian Water	Riparian Stream Water	Riparian Swamp	Floodplain Swamp	riparian meadow	Wetland too small to map in ELC	Alluvial meadow; Spring swamp	P	P	P					P	P				P		P
WL1003 (within inundation)	11.51	Marsh	Riparian Marsh	Riparian Stream Marsh			riparian thicket	Wetland too small to map in ELC		P	P					P		P			P	P	P	P
WL1004 (within inundation)	22.24	Marsh / Swamp Complex	Riparian Marsh	Riparian Stream Marsh	Riparian Swamp	Floodplain Swamp	riparian thicket	Wetland too small to map in ELC	Alder thicket	P	P					P					P	P	P	P
WL1005 (within inundation)	22.24	Marsh / Swamp Complex	Riparian Marsh	Riparian Floodplain Marsh	Riparian Swamp	Floodplain Swamp	riparian thicket	Wetland too small to map in ELC	Surrounded by alder thicket	P	P					P	P	P	P	P	P	P		P
WL1006	2.33	Fen	Riparian Fen	Floating Fen			fen		Old burn / logging operation in vicinity		P	P				P		P	P	P	P		P	
WL1007	25.04	Bog	String Bog				low shrub bog						P			P	P		P	P	P			
WL1008	5.69	Shallow Water / Fen Complex	Basin Water	Isolated Basin Water	Riparian Fen	Shore Fen	open water / undifferentiated wetland		Kettle pond		P						P	P						
WL1009	23.19	Bog	Plateau Bog	Northern Plateau Bog			low shrub bog		Possible water input from adjacent pond				P			P	P	P					P	
WL1010 (within inundation)	1.10	Fen	Riparian Fen	Floating Fen			fen				P		P			P	P	P	P	P	P			
WL1011	2.92	Bog	String Bog				low shrub bog		Near powerline				P			P	P	P	P	P	P		P	
WL1012	9.78	Fen	Riparian Fen	Floating Fen			fen / low shrub bog		Adjacent alder thicket (W and E; extensive)		P	P								P	P			
WL1013	1.14	Marsh	Riparian Marsh	Riparian Floodplain Marsh			marsh		Surrounded by tall shrubs / trees	P	P	P								P	P	P		P
WL1014 (within inundation)	9.85	Marsh	Riparian Marsh	Riparian Delta Marsh			marsh		Extensively grazed	P	P							P			P	P		P
WL1015 (within inundation)	9.85	Marsh	Riparian Marsh	Riparian Meltwater			marsh		Surrounded by alder thicket; Spring swamp	P	P											P		P
WL1016 (within inundation)	5.88	Marsh / Swamp Complex	Riparian Marsh	Riparian Stream Marsh	Riparian Swamp	Riverine Swamp	marsh		Surrounded by alder thicket; Spring swamp	P	P										P	P		P
WL1017	83.06	Shallow Water / Swamp Complex	Riparian Water	Riparian Floodplain Water	Riparian Swamp	Floodplain Swamp	riparian thicket / open water		Adjacent alder thicket (E)	P	P					P	P	P		P	P			P
WL1018 (within inundation)	0.00	Shallow Water / Swamp Complex	Riparian Water	Riparian Stream Water	Riparian Swamp	Riverine Swamp	not mapped	Sampled in river	Adjacent alder thicket (NE; extensive)		P					P	P	P	P	P	P			

Wetland	Area (ha)*	Wetland Class Type	Form 1	Sub-form 1	Form 2	Sub-form 2	Ecological Land Classification (ELC) Wetland Interpretation	ELC Mapping Notes	Wetland Field Comments	Functions														
										Flow Moderation	Shoreline Protection	Water Quality	Carbon Sequestration	Biodiversity	Regionally Rare Plant Species	High Habitat Suitability			Waterfowl				Human Use	Flow Moderation
																Herpetile	Mammals	Birds	Canada Goose Habitat	Cavity Nester Habitat	Dabbling Duck Habitat	Diving Duck Habitat		
WL1019 (within inundation)	0.00	Marsh / Swamp Complex	Riparian Marsh	Riparian Stream Marsh	Riparian Swamp	Riverine Swamp	not mapped	Sampled in river	Alluvial meadow; Spring swamp	P	P									P	P		P	P
WL1020 (within inundation)	16.57	Marsh	Riparian Marsh	Riparian Delta Marsh			riparian thicket / marsh		Alluvial meadow; topographically confined bowl	P	P					P			P		P	P	P	P
WL1021 (within inundation)	19.96	Marsh	Riparian Marsh	Riparian Delta Marsh			riparian meadow	Sampled in river	Alluvial meadow; topographically confined bowl	P	P					P					P	P	P	P
WL1022 (within inundation)	13.03	Marsh	Riparian Marsh	Riparian Stream Marsh			gravel bar	Wetland too small to map in ELC	Alluvial meadow; end point Churchill R.	P	P					P				P	P		P	P
WL1023 (within inundation)	25.14	Marsh	Riparian Marsh	Riparian Floodplain Marsh			riparian thicket / gravel bar / marsh		Alluvial meadow	P	P				P					P	P		P	P
WL1024 (within inundation)	47.93	Marsh / Swamp Complex	Riparian Marsh	Riparian Floodplain Marsh	Riparian Swamp	Floodplain Swamp	riparian thicket / marsh		Adjacent alder thicket (E)	P	P													P
WL1025 (within inundation)	0.00	Shallow Water	Riparian Water	Riparian Stream Water			not mapped	Sampled in river	Examined to characterize class		P									P			P	
WL1026 (within inundation)	0.00	Marsh	Riparian Marsh	Riparian Stream Marsh			not mapped	Sampled in river	Alluvial meadow	P	P			P									P	P
WL1027 (within inundation)	8.06	Marsh	Riparian Marsh	Riparian Stream Marsh			riparian thicket	Wetland too small to map in ELC	Alluvial meadow	P	P						P					P	P	P
WL1028 (within inundation)	63.07	Marsh	Riparian Marsh	Riparian Meltwater			riparian thicket / marsh		Alluvial meadow with large pools	P	P						P	P	P	P	P	P	P	P
WL1029 (within inundation)	17.44	Marsh	Riparian Marsh	Riparian Delta Marsh			riparian thicket / marsh		Alluvial meadow	P	P							P						P
WL1030 (within inundation)	0.00	Marsh	Riparian Marsh	Riparian Stream Marsh			not mapped	Sampled in river	Island spring swamp	P	P							P		P			P	P
WL1031 (within inundation)	2.31	Marsh	Riparian Marsh	Riparian Meltwater			gravel bar / marsh		Alluvial meadow	P	P							P		P			P	P
WL1032 (within inundation)	1.81	Swamp	Riparian Swamp	Channel Swamp			gravel bar	Wetland too small to map in ELC	Spring swamp channel		P												P	
WL1033 (within inundation)	0.00	Shallow Water	Riparian Water	Riparian Stream Water			not mapped	Sampled in river	Made comments on shoal vegetation (end 476401E,5906107N)		P						P	P		P	P		P	
WL1034 (within inundation)	0.00	Shallow Water	Riparian Water	Riparian Stream Water			not mapped	Sampled in river	Examined to characterize class		P					P	P	P	P	P	P		P	
WL1035	2.36	Bog	String Bog				not mapped	Outside of ELC boundary					P	P		P	P	P	P	P	P			
WL1036	5.11	Bog	Basin Bog				low shrub bog / open water						P						P		P			
WL1037 (within inundation)	0.00	Shallow Water	Riparian Water	Riparian Stream Water			not mapped	Sampled in river	Cache River secondary channel (presently dry bed)		P					P	P	P	P	P	P			

Wetland	Area (ha)*	Wetland Class Type	Form 1	Sub-form 1	Form 2	Sub-form 2	Ecological Land Classification (ELC) Wetland Interpretation	ELC Mapping Notes	Wetland Field Comments	Functions														
										Flow Moderation	Shoreline Protection	Water Quality	Carbon Sequestration	Biodiversity	Regionally Rare Plant Species	High Habitat Suitability			Waterfowl				Human Use	Flow Moderation
																Herpetile	Mammals	Birds	Canada Goose Habitat	Cavity Nester Habitat	Dabbling Duck Habitat	Diving Duck Habitat		
WL1038 (within inundation)	6.14	Shallow Water	Riparian Water	Riparian Floodplain Water			riparian thicket / river	Wetland too small to map in ELC			P				P	P			P		P			
WL1039	4.36	Marsh	Lacustrine Marsh	Lacustrine Bay Marsh			open water / marsh		Iris-dominated marsh	P									P		P	P		P
WL1040	8.79	Fen	Riparian Fen	Floating Fen			fen / open water				P		P	P										
WL1041 (within inundation)	0.00	Shallow Water	Riparian Water	Riparian Stream Water			not mapped	Sampled in river			P			P				P			P			
WL1042 (within inundation)	0.00	Marsh	Riparian Marsh	Riparian Stream Marsh			not mapped	Sampled in river	Alluvial meadow	P	P			P			P			P	P	P		P
WL1043 (within inundation)	0.00	Shallow Water	Riparian Water	Riparian Floodplain Water			not mapped	Sampled in river			P													
WL1044 (within inundation)	7.97	Marsh / Swamp Complex	Riparian Marsh	Riparian Stream Marsh	Riparian Swamp	Channel Swamp	riparian thicket	Wetland too small to map in ELC	Alluvial meadow; alder thicket (n)	P	P			P	P		P	P		P		P		P
WL1045 (within inundation)	0.00	Shallow Water	Riparian Water	Riparian Stream Water			not mapped	Sampled in river	Made comments on shoal vegetation (end 582914E,5861904N)		P			P			P	P						
WL1046	10.13	Marsh	Lacustrine Marsh	Lacustrine Shore Marsh			open water / marsh								P	P		P			P	P		
WL1047 (within inundation)	4.31	Bog	Basin Bog				low shrub bog						P			P					P		P	
WL1048 (within inundation)	5.70	Shallow Water	Riparian Water	Riparian Stream Water			riparian thicket	Wetland too small to map in ELC	Transect crosses alder thicket		P					P	P	P	P	P	P	P	P	
WL1049	3.27	Shallow Water	Riparian Water	Riparian Stream Water			riparian thicket	Wetland too small to map in ELC			P	P				P		P	P	P	P		P	
WL1050	10.85	Fen / Bog Complex	Riparian Fen	Floating Fen	Basin Bog		fen				P					P	P		P	P	P			
WL1051	10.15	Fen	String Fen	Atlantic Ribbed Fen			fen		Large peatland complex	P			P	P			P	P					P	P
WL1052 (within inundation)	0.13	Marsh	Riparian Marsh	Riparian Floodplain Marsh			open water / marsh			P	P					P	P	P				P	P	P
WL1053	12.08	Fen	String Fen	Atlantic Ribbed Fen			fen			P			P	P	P	P	P	P	P	P	P			P
WL1054 (within inundation)	16.84	Marsh / Swamp Complex	Riparian Marsh	Riparian Stream Marsh	Riparian Swamp	Riverine Swamp	gravel bar	Wetland too small to map in ELC	Alder / willow thicket	P	P					P	P	P	P	P	P	P		P
WL1055	14.65	Fen	Riparian Fen	Shore Fen			not mapped	Outside of ELC boundary			P		P							P	P			
WL1056	10.49	Fen	Riparian Fen	Shore Fen			fen				P		P							P	P			
WL1057	1.61	Fen	Riparian Fen	Floating Fen			fen		Large peatland complex		P		P	P				P			P		P	

Wetland	Area (ha)*	Wetland Class Type	Form 1	Sub-form 1	Form 2	Sub-form 2	Ecological Land Classification (ELC) Wetland Interpretation	ELC Mapping Notes	Wetland Field Comments	Functions														
										Flow Moderation	Shoreline Protection	Water Quality	Carbon Sequestration	Biodiversity	Regionally Rare Plant Species	High Habitat Suitability			Waterfowl				Human Use	Flow Moderation
																Herpetile	Mammals	Birds	Canada Goose Habitat	Cavity Nester Habitat	Dabbling Duck Habitat	Diving Duck Habitat		
WL1058 (within inundation)	5.86	Fen	Riparian Fen	Shore Fen			marsh / fen		Alder thicket (S and E backshore)		P		P											
WL1059	3.11	Shallow Water	Basin Water	Isolated Basin Water			open water		Kettle pond												P			
WL1060 (within inundation)	6.57	Marsh / Swamp Complex	Riparian Marsh	Riparian Floodplain Marsh	Riparian Swamp	Floodplain Swamp	marsh		Adjacent alder thicket (W, E, S; extensive)	P	P					P	P	P		P	P	P		P
WL1061 (within inundation)	4.43	Marsh / Swamp Complex	Riparian Marsh	Riparian Floodplain Marsh	Riparian Swamp	Floodplain Swamp	marsh		Alluvial meadow	P	P					P	P	P	P	P	P			P
WL1062 (within inundation)	41.26	Shallow Water	Riparian Water	Riparian Floodplain Water			gravel bar	Sampled in river			P									P	P			
WL1063	4.87	Fen	Riparian Fen	Floating Fen			not mapped	Outside of ELC boundary			P	P	P			P			P		P			
WL1064	5.06	Marsh	Riparian Marsh	Riparian Meltwater			fen / marsh			P	P	P				P					P	P		P
WL1065	1.69	Bog	Riparian Bog	Shore Bog			not mapped	Outside of ELC boundary			P		P			P				P	P			
WL1066	4.25	Fen	Riparian Fen	Floating Fen			undifferentiated wetland				P	P		P	P					P	P		P	
WL1067	0.96	Fen	Riparian Fen	Shore Fen			undifferentiated wetland				P	P	P	P									P	
WL1068	4.17	Fen	Riparian Fen	Floating Fen			undifferentiated wetland		Basin Fen with extensive floating mat		P		P	P	P					P			P	
WL1069	4.58	Bog	String Bog				not mapped	Outside of ELC boundary	Large peatland complex				P	P	P									
WL1070	12.21	Bog	Riparian Bog	Shore Bog			not mapped	Outside of ELC boundary			P		P				P							
WL1071	5.64	Fen	String Fen	Atlantic Ribbed Fen			not mapped	Outside of ELC boundary	Large peatland complex	P			P	P	P		P	P	P	P	P			P
WL1072	2.71	Fen	Riparian Fen	Shore Fen			not mapped	Outside of ELC boundary			P		P					P					P	
WL1073	0.16	Shallow Water	Basin Water	Linked Basin Water			not mapped	Outside of ELC boundary		P		P						P		P			P	P
WL1074	16.40	Fen	String Fen	Atlantic Ribbed Fen			not mapped	Outside of ELC boundary	Large peatland complex	P			P	P				P		P			P	P
WL1075	2.83	Fen	Riparian Fen	Floating Fen			not mapped	Outside of ELC boundary	Large peatland complex		P		P	P									P	
WL1076	1.19	Fen	Riparian Fen	Shore Fen			not mapped	Outside of ELC boundary			P						P	P		P	P		P	
WL1077	38.51	Bog	String Bog				undifferentiated wetland		Large peatland complex				P			P	P	P	P	P	P		P	
WL1078	5.11	Fen	String Fen	Atlantic Ribbed Fen			undifferentiated wetland		Large peatland complex	P			P	P	P	P	P	P	P	P	P			P
WL1079	6.96	Bog	String Bog				undifferentiated wetland					P	P	P					P		P		P	

Wetland	Area (ha)*	Wetland Class Type	Form 1	Sub-form 1	Form 2	Sub-form 2	Ecological Land Classification (ELC) Wetland Interpretation	ELC Mapping Notes	Wetland Field Comments	Functions													
										Flow Moderation	Shoreline Protection	Water Quality	Carbon Sequestration	Biodiversity	Regionally Rare Plant Species	High Habitat Suitability			Waterfowl				Human Use	Flow Moderation
																Herpetile	Mammals	Birds	Canada Goose Habitat	Cavity Nester Habitat	Dabbling Duck Habitat	Diving Duck Habitat		
WL1080	1.10	Fen	Riparian Fen	Floating Fen			not mapped	Outside of ELC boundary			P		P			P	P	P	P	P	P			
WL1081	0.71	Fen	Riparian Fen	Shore Fen			not mapped	Outside of ELC boundary			P	P	P	P		P			P		P		P	
WL1082	8.56	Fen	String Fen	Atlantic Ribbed Fen			not mapped	Outside of ELC boundary		P			P						P		P			P
WL2001	3.97	Bog / Fen Complex	Plateau Bog	Northern Plateau Bog	String Fen	Atlantic Ribbed Fen	low shrub bog			P			P										P	P
WL2002	13.34	Bog	Basin Bog				low shrub bog						P					P			P		P	
WL2003	42.14	Bog	Slope Bog				not mapped	Outside of ELC boundary					P				P			P	P			
WL2004	18.02	Fen	String Fen	Atlantic Ribbed Fen			fen		Large peatland complex	P			P											P
WL2005	12.38	Fen	String Fen	Atlantic Ribbed Fen			fen		Large peatland complex	P			P				P	P		P			P	P
WL2006	66.22	Fen	String Fen	Atlantic Ribbed Fen			fen		Large peatland complex	P			P	P			P	P						P
WL2007	6.74	Marsh	Lacustrine Marsh	Lacustrine Shore Marsh			marsh / fen					P	P			P		P			P		P	
WL2008 (within inundation)	4.65	Fen	String Fen	Atlantic Ribbed Fen			fen			P			P			P					P			P
WL2009	17.42	Fen	String Fen	Atlantic Ribbed Fen			undifferentiated wetland		Large peatland complex	P			P			P	P	P	P	P	P		P	P
WL2010	15.84	Fen	Basin Fen				fen		Large peatland complex				P		P	P		P	P	P	P		P	
WL2011 (within inundation)	83.06	Shallow Water / Swamp Complex	Riparian Water	Riparian Floodplain Water	Riparian Swamp	Floodplain Swamp	riparian thicket / open water		Adjacent alder thicket (W and E; extensive)	P	P				P	P	P		P	P	P	P		P
WL2012 (within inundation)	5.36	Marsh	Basin Marsh	Linked Basin Marsh			marsh		Beaver dam-related (water level same as 1998 air photo)	P					P		P	P						P
WL2013	5.41	Bog	Basin Bog				fen		Large peatland complex				P			P	P	P					P	
WL2014	6.72	Fen	Riparian Fen	Floating Fen			fen		Large peatland complex		P	P	P			P	P	P	P	P	P		P	
WL2015	6.72	Fen	String Fen	Atlantic Ribbed Fen			fen		Large peatland complex	P		P	P			P	P	P	P	P	P		P	P
WL2016 (within inundation)	0.00	Shallow Water	Riparian Water	Riparian Stream Water			not mapped	Sampled in river	Adjacent alder thicket (S)		P									P	P			
WL2017	16.48	Fen	String Fen	Atlantic Ribbed Fen			fen			P		P	P	P						P	P		P	P
WL2018	1.84	Marsh	Basin Marsh	Isolated Basin Marsh			not mapped	Outside of ELC boundary	Kettle marsh	P								P			P		P	P
WL2019	1.82	Bog	Basin Bog				not mapped	Outside of ELC boundary					P		P									

Wetland	Area (ha)*	Wetland Class Type	Form 1	Sub-form 1	Form 2	Sub-form 2	Ecological Land Classification (ELC) Wetland Interpretation	ELC Mapping Notes	Wetland Field Comments	Functions														
										Flow Moderation	Shoreline Protection	Water Quality	Carbon Sequestration	Biodiversity	Regionally Rare Plant Species	High Habitat Suitability			Waterfowl				Human Use	Flow Moderation
																Herpetile	Mammals	Birds	Canada Goose Habitat	Cavity Nester Habitat	Dabbling Duck Habitat	Diving Duck Habitat		
WL2020	4.83	Fen	Riparian Fen	Floating Fen			not mapped	Outside of ELC boundary	Basin Fen with extensive floating mat		P		P								P			
WL2021	28.22	Bog	Plateau Bog	Northern Plateau Bog			low shrub bog						P			P	P	P		P	P		P	

* A number of sites surveyed during the dedicated wetland program were later mapped as being in the river by the Ecological Land Classification (ELC). This was likely the result of differences in water level between the time the wetland field surveys were conducted and the time the air photos were acquired for the ELC program. As such, those sites are not discernable as wetlands from the air photos are given an area of 0.

P - Potential for function is present based on applied criteria.

IR# JRP.156

Mercury Levels in Fish

Requesting Organization – Joint Review Panel **Information Request No.: JRP.156**

Subject - Mercury Levels in Fish

References:

EIS Guidelines, Section 4.4.4.2 (Aquatic Environment) and Section 4.4.4.3 (Terrestrial Environment)

Minaskuat Ltd. 2008. *Existing Mercury Concentrations in Osprey and Ecological Risk Assessment*. Prepared for the Lower Churchill Hydroelectric Generation Project.

Related Comments / Information Requests:

CEAR # 292 (Environment Canada)

IR # JRP.20, 21, 22

Rationale:

Sections 4.4.4.2 and 4.4.4.3 of the EIS Guidelines indicate that the Proponent shall describe the relevant components of the environment including mercury concentrations, mobility and fate within the ecosystem.

A number of Information Requests were previously directed to the Proponent related to peak mercury levels and increase factor in fish (JRP.20 and 21) and mercury risks to fish-eating wildlife such as osprey and river otter (JRP.22).

In its comments on the Proponent's response to JRP.20 (a), Environment Canada notes that the Proponent did not re-calculate peak fish mercury values in fish from the Smallwood reservoir using the method requested.

In addition, Environment Canada indicates that, in response to JRP.21 (a) on the regression analysis, the Proponent should have included new data from the Long Spruce or Limestone reservoirs, and should have verified whether a non-linear regression would yield the best fit to the data to predict fish mercury levels for Gull Island and Muskrat Falls reservoirs. Moreover, the Proponent should have substantiated the conclusion that the additional analysis conducted in response to JRP.20 (a) did not result in higher predicted peak increase factors or peak fish mercury concentrations for the Project than those presented in the EIS.

Regarding the response to JRP.22 (b), Environment Canada notes that there appear to be errors in the ecological risk assessment calculations as described in Appendix B of Minaskuat Ltd. (2008) given the Proponent's explanation provided in response to JRP.22 (b). In particular, the Hazard Quotient (HQ) for osprey should be 1.4 instead of 0.67, which indicates a potential risk of mercury toxicity for osprey if the Project proceeds as proposed.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.156**

Information Requested:

The Proponent is asked to:

a. **Re-calculate peak fish mercury levels in the Smallwood reservoir using the method requested by Environment Canada for JRP.20 (a) (Environment Canada specified that Af/(Q+0.032At) should not be used in these re-calculations (CEAR # 292));**

Response:

Peak fish mercury (Hg) levels for Smallwood Reservoir were re-calculated using an updated regression model described in part (c) of this response. The method for updating the regression model was discussed with and accepted by Environment Canada at a meeting on March 5, 2010. While the observed Hg levels in northern pike (700 mm) were approximately 2.3X above background levels when sampled sixteen years after flooding, the updated regression model predicts that peak concentrations would be approximately 3.2X above background. Estimated peak concentrations for five fish species are provided below.

The information request is correct in stating that monitoring of fish Hg concentrations in Smallwood Reservoir may not have detected peak levels, because sampling was only completed once (i.e., six years post flood) in the first 15 years after flooding (Jacques Whitford 2006). An updated calibration of the regression model used for the Environmental Impact Statement (EIS) was developed (IR# JRP.156c) that included data from additional reservoirs in Quebec and Manitoba, and excluded data from Smallwood Reservoir (due to the potential for the observed levels to have missed the actual peak increase). The recalibrated model predicted that peak increase factors for 700 mm northern pike in Smallwood Reservoir would have been approximately 3.2X above baseline levels, higher than the estimated 2.3X increase observed sixteen years after flooding. As requested in IR# JRP.20a, the revised peak increase factors were combined with the maximum observed concentrations from Smallwood Reservoir after flooding to estimate peak fish Hg levels. Assuming that actual peak Hg concentrations for all species would have been higher than those observed by a ratio of 1.39 (3.2/2.3), the following peak concentrations would have occurred in Smallwood Reservoir:

Northern pike (700 mm):	1.60 ug/g (vs 1.16 observed);
Lake whitefish (400 mm):	0.48 ug/g (vs 0.34 observed);
Longnose sucker (400 mm):	0.61 ug/g (vs 0.44 observed);
Lake trout (600 mm):	1.94 ug/g (vs 1.40 observed); and
White sucker (400 mm):	0.44 ug/g (vs 0.32 observed).

References:

Jacques Whitford. 2006. Statistical Analysis of Mercury Data from Churchill Falls (Labrador) Corporation Reservoirs. Prepared for Churchill Falls (Labrador) Corporation. Report No. 1005158.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.156**

Information Requested:

The Proponent is asked to:

b. Add data from the Long Spruce and Limestone reservoirs to the regression used in response to JRP.21(a);

Response:

The regression model for northern pike (IR# JRP.21a) has been updated with data from Long Spruce and Limestone Reservoirs, as well as data from other reservoirs in Manitoba and Quebec (Bodaly et al 2007; Schetagne et al. 2003). The updated regression for northern pike (700 mm length) now includes observations from 11 reservoirs. Additional information on the data used and recalibration of the model is provided in IR# JRP.156c.

References:

Bodaly, R.A., W. A. Jansen, A.R. Majewski, R.J.P. Fudge, N.E. Strange, A.J. Derksen and D.J. Green. 2007. Postimpoundment Time Course of Increased Mercury Concentrations in Fish in Hydroelectric Reservoirs of Northern Manitoba, Canada. Archives of Environmental Contamination and Toxicology. 53: 379–389.

Schetagne, R., J. Therrien, J. and R. Lalumière. 2003. Environmental Monitoring at the La Grande Complex. Evolution of Fish Mercury Levels. Summary Report 1978–2000. Direction Barrages et Environnement, Hydro-Québec Production and Groupe conseil GENIVAR inc. 185 p. and appendix.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.156**

Information Requested:

The Proponent is asked to:

c. **Determine whether a non-linear regression would yield the best fit to the data, and to re-calculate the predicted fish mercury levels for Gull Island and Muskrat Falls reservoirs based on the comments provided by Environment Canada on the response to JRP.21 (a);**

Response:

The model used to predict fish mercury (Hg) levels for Gull Island and Muskrat Falls was non-linear. The model was transformed into a linear form for presentation purposes only. Predicted peak fish Hg levels were re-calculated for these reservoirs using data from elsewhere that became available after the submission of the Environmental Impact Statement (EIS). In response to IR# JRP.21a, the re-estimated peak fish Hg concentrations for Gull Island and Muskrat Falls Reservoirs are 2.3X above baseline values. This value is higher than the 1.8X increase estimated with the data available at the time of the EIS. Additional results and discussion are presented below:

Non-Linearity

The existing regression model is non-linear, having the following form:

Peak increase factor = PIF = a * [Af / (Q + b At)] + c

where:

PIF = Peak increase factor for fish Hg concentration

Af = Flooded area (km^2)

At = Total area (km^2)

Q = Mean annual flow (km^3)

a,b, and c are fitted constants

For the purposes of presenting model predictions as a function of reservoir conditions (extent of flooding and flow) conveniently on an x-y graph, the expression (Af/(Q+ bt)) was treated as an independent variable "x", and the equation took on the general linear form y = mx + b.

Model Enhancements Subsequent to the EIS

Additional data for standardized 700 mm northern pike became available from other reservoirs in Manitoba (associated with studies by Bodaly et al. 2007) subsequent to the EIS. These data provided additional observations for the regression and allowed the development of improved criteria to assess situations that warranted the inclusion of upstream flooding effects. As a result, additional reservoirs in Quebec (Schetagne et al. 2003) were also added to the analysis. The full set of reservoirs included in the regression now consists of the following:

- Caniapiscau Reservoir, Opinaca Reservoir, Laforge 2 Reservoir, La Grande 4 Reservoir, La Grande 3 Reservoir, and Robert Bourassa Reservoir (Quebec); and
- Southern Indian Lake Reservoir, Rat Lake Reservoir, Threepoint Reservoir, Limestone Reservoir, and Long Spruce/Stephens Reservoir (Manitoba).

Criteria were established to better assess when to include the effects of upstream flooding for reservoirs in series along a river system. The effects of upstream flooding were included in the analysis if: (1) the upstream flooding occurred within a decade of the reservoir being assessed; (2) the reservoirs are not separated by more than 200 km; and (3) no major inflows occurred in the water reach separating the reservoirs. Where upstream effects were considered relevant, the approach used was to combine the areas of the upstream reservoir(s) with the current (downstream) reservoir, as though a single reservoir existed that increased in size travelling downstream.

The requirement was removed that the constant "c" in the regression have a value of 1 (i.e., the intercept of the linearized version of the model was not forced to be the point (0,1) where no flooding occurred and no increase in fish Hg occurred). The additional data indicated that the model performance was improved without a forced intercept.

Revised Predictions

A plot of predicted versus observed peak increase factors for 700 mm northern pike was completed for the recalibrated model (Figure 1). Predicted peak increase factors as a function of the extent of flooding and flow [specifically the expression Af/(Q + b*At)] are shown in Figure 2. Sites with higher observed peak increase factors tended to have greater relative extents of flooding and less flow dilution (i.e., greater values on the x-axis). The revised model predicted a peak increase factor of 2.3X (rounded value) for 700 mm northern pike in Gull Island and Muskrat Falls Reservoirs, compared to the estimate of 1.8X used in the EIS. The predicted peak increase for Smallwood Reservoir using the recalibrated model was 3.2X. With the addition of data from more reservoirs, the predictions for the Lower Churchill Hydroelectric Generation Project (Project) reservoirs are now encompassed within the observed range of x axis values. It should be noted that the current calibration of the model suggests that there is an initial increase in fish Hg on the order of 1.6X associated with run-of-the-river reservoirs with relatively low flooding and high flows (Figure 2).

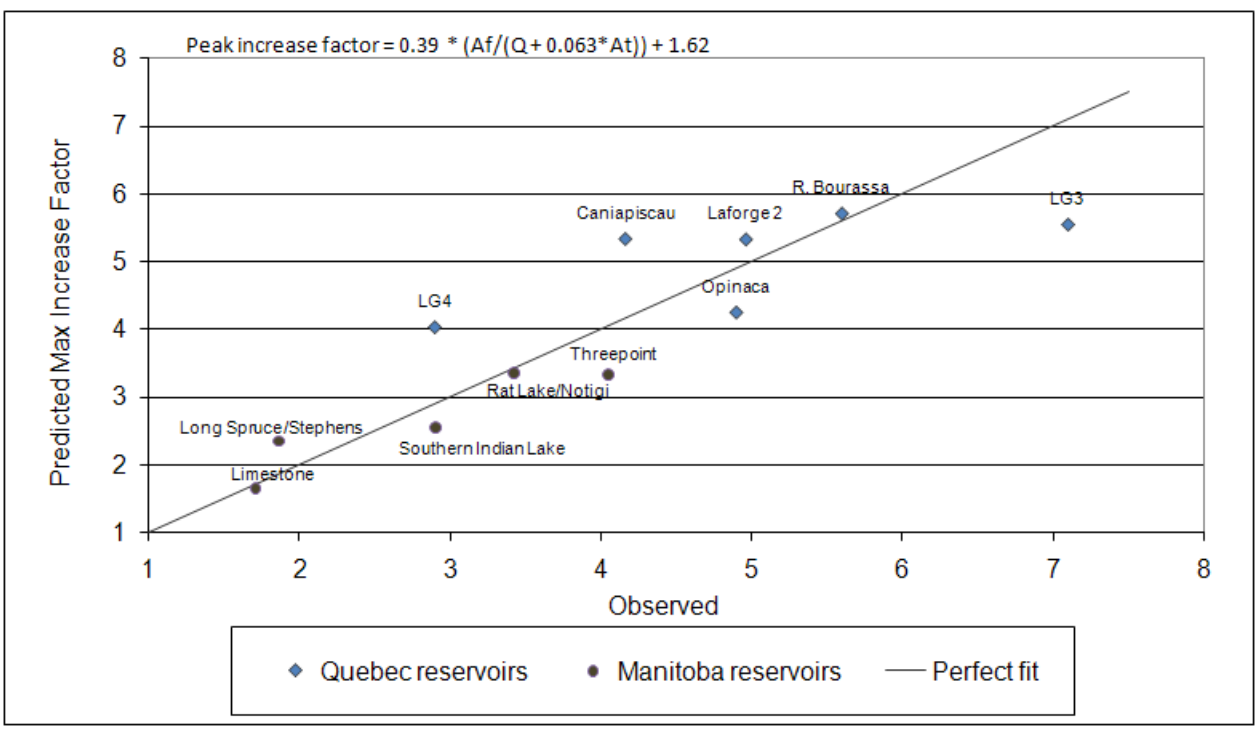

Figure 1 Predicted Versus Observed Peak Increase Factors for 700 mm Northern Pike, based on the Revised Model Regression PIF = 0.39 * (Af/Q + 0.063*At) + 1.62. Model Fit was Optimized to Minimize the Sum of Squares Error.

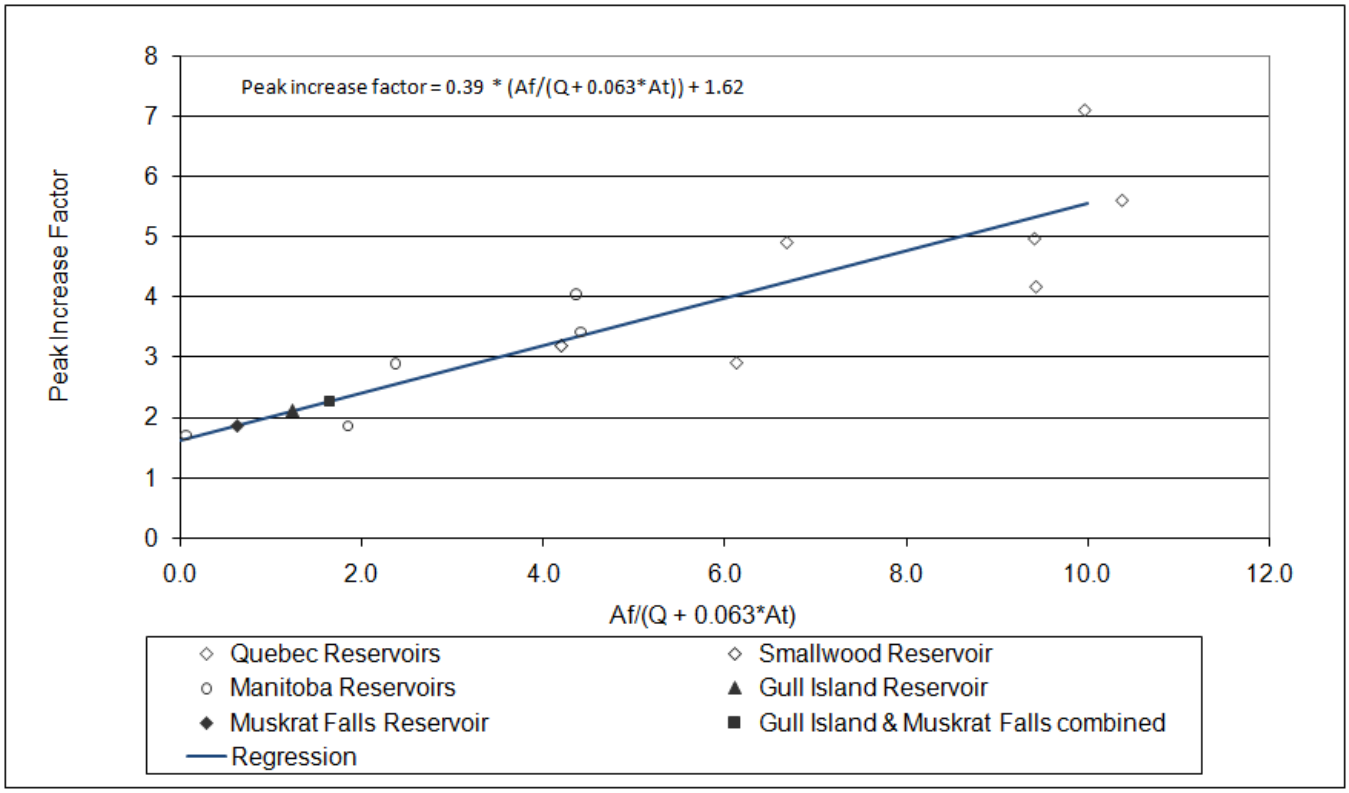

Figure 2 Predicted Peak Increase Factors for 700 mm Northern Pike Versus Af/(Q + 0.063*At), based on the Revised Model Regression PIF = 0.39 * (Af/Q + 0.063*At) + 1.62. The Predicted Value for the Combined Gull Island and Muskrat Falls Sites was a PIF of 2.3. Solid Points are Predictions for the Project. Open Points are Observations, except Smallwood Reservoir (Predicted).

The revised peak increase factor (2.3X) was used as the basis to recalculate predicted fish Hg concentrations for the Gull Island and Muskrat Falls Reservoirs. Using the same approach presented in the EIS, this value was considered as a minimum for all fish species and sizes. Re-calculated peak increase factors and concentrations for standard length fish are provided in Table 1.

While recognizing that increased fish Hg concentrations are always expected to occur in connection with flooding, the predicted 2.3 fold relative increase in fish Hg levels for the Lower Churchill Development is in the low to moderate range of observations from reservoirs overall. When combined with estimates of existing baseline Hg concentrations in different fish species, the resulting predictions for peak fish Hg levels are similarly in the low to moderate range in terms of what has been observed for new reservoirs. For example, the low category would apply to whitefish (400 mm), currently in the 0.2 ug/g range, predicted to reach peak values in the range of 0.4-0.5 ug/g. The moderate category is more applicable to species where baseline levels on record are relatively high already (0.8 ug/g baseline, 1.8 ug/g peak for 700 mm northern pike).

Subsequent to the submission of the EIS, and given the additional data that were obtained, tasks were undertaken to improve estimates of peak Hg levels in 300 mm fish for use in the Ecological Risk Assessment (ERA). The analysis for the EIS estimated peak increase factors for 300 mm fish by starting with the increase factor for adult size fish, and multiplying this value by the estimated ratio of peak increase factors for 300 mm and adult fish ($PIF_{300mm} = PIF_{adult\ length} * (PIF_{300mm}/PIF_{adult\ length})$. This was done separately for the seven species shown in Table 1. The ratio of $PIF_{300mm}/PIF_{adult\ length}$ was estimated in each case using observations from Smallwood Reservoir. For the revised analysis presented here, data were obtained for nine reservoirs in Quebec and Manitoba to estimate peak increase factors for 300 mm northern pike, and the associated ratio of $PIF_{300mm}/PIF_{adult\ length}$. Estimated ratios of $PIF_{300mm}/PIF_{adult\ length}$ are shown in Table 2, ranging from 1.1 to 2.5 with a mean of 1.9 (i.e. 300 mm pike increased almost twice in relative terms compared to 700 mm pike, on average).

Table 1 Updated Peak Fish Hg Concentrations (Standard Lengths Related to Sample Means) Associated with the Project

Site	Species and Standard Length		Estimated Baseline Concentration	Peak Increase Factor Used	Predicted Peak Concentration		Maximum Concentration Observed from Smallwood Reservoir (Sandgirt or Lobstick)	Notes
Gull Island Reservoir			ug/g wet muscle		ug/g wet muscle	ug/g whole body	ug/g wet muscle	
	Lake Trout (600mm)		0.95	2.27	2.16	1.66	1.40	4
	Northern Pike (700 mm)		0.81	2.27	1.83	1.41	1.16	1
	White Sucker (400 mm)		0.26	2.27	0.60	0.46	0.32	6
	Longnose Sucker (400 mm)		0.25	2.27	0.57	0.44	0.44	3
	Lake Whitefish (400 mm)		0.19	2.27	0.42	0.32	0.34	2
	Brook Trout (300 mm)		0.08	6.00	0.49	0.38	No data	5
	Ouananiche (300 mm)		0.08	6.00	0.48	0.37	No data	7
Muskrat Falls Reservoir and Downstream	**Species and Standard Length**		**Estimated Baseline Concentration**	**Peak Increase Factor Used**	**Predicted Peak Concentration**		**Maximum Concentration Observed for Winokapau Lake or Gull Lake**	
(if different to above)								
	Lake Whitefish (400mm)		0.19	4.94	0.91	0.70	0.75	8
	Longnose Sucker (400 mm)		0.25	3.24	0.81	0.63	0.80	9
	White Sucker (400mm)		0.26	2.27	0.60	0.46	0.34	10
Notes:								

1- Baseline from Gull and Winokapau 2004. Max observed from Sandgirt 1987
2- Baseline from Gull and Winokapau 2004. Max observed from Lobstick 1977. Peak increase factor assumed same as northern pike.
3- Baseline from Gull and Winokapau 1999. Max observed from Lobstick 1977. Peak increase factor assumed same as northern pike.
4- Baseline from Atikonak and Shipiskan. Max observed from Sandgirt 1977. Peak increase factor assumed same as northern pike.
5- Baseline from Gull Lake 2004. No observations during peak years. Peak ratio assumed to be same as for 300 mm pike (largest observed increase for any species, without turbine effects downstream)
6- Baseline from Gull Lake and Winokapau 2004. Max observed from Sandgirt 1977 . No regional baseline. Peak increase factor assumed same as northern pike.
7- Baseline from Winokapau 1999. No observations during peak years. Peak ratio assumed to be same as for 300 mm pike (largest observed increase for any species, without turbine effects downstream)
8- Baseline from Winokapau and Gull 2004. Higher levels observed for 350 mm size
9- Baseline from Shipiskan. Max observed from Winokapau 1977.
10- Baseline from Winokapau 1999. No observations during peak years.

Table 2 Peak Concentrations, Increase Factors, and Ratios of Peak Increase Factors (300mm/700 mm) for Northern Pike from 9 Reservoirs in Quebec and Manitoba. Quebec Data Derived from Hydro Quebec and Genivar (2002) and Hydro Quebec and Genivar (2000). Manitoba Data Derived from Data Associated with Bodaly et al. (2007).

Reservoir	300 mm			700 mm	Ratio of peak observed increase factors for 300 mm and 700 mm
	Peak observed concentration (ug/g wet muscle)	Baseline concentration (ug/g wet muscle)	Peak observed increase factor	Peak observed increase factor	
Caniapiscau, PQ	1.1	0.11	10.3	4.2	2.5
Opinaca, PQ	1.1	0.11	10.3	4.9	2.1
La Grande 4, PQ	0.7	0.11	6.6	2.9	2.3
La Grande 3, PQ	1.4	0.11	13.0	7.1	1.8
R. Bourassa, PQ	1.6	0.11	14.1	5.6	2.5
Southern Indian Lake, MB	0.3	0.10	3.4	2.9	1.2
Rat Lake, MB	0.4	0.10	3.6	3.4	1.1
Threepoint, MB	0.8	0.10	7.7	4.1	1.9
Long Spruce, MB	0.3	0.10	2.7	1.9	1.5
				Average	**1.9**

These data suggest that the use of a value of 2.6 in the original assessment for the ratio of PIF_{300mm}/PIF_{700mm} was representative of the highest values observed for a broader set of reservoirs. It was considered appropriate for the revised analysis to use the additional data and the average value of 1.9 for northern pike and other species for which data were not available from Smallwood Reservoir. The resulting re-calculated peak increase factors and concentrations for 300 mm fish (used as the basis for wildlife exposure) are shown in Table 3. The mean concentration for the seven species in Table 3 is 0.53 ug/g wet muscle (geometric mean). When downstream concentrations were predicted to be higher than in the reservoir, the higher value was used. This concentration (0.53 ug/g wet muscle) was used in the wildlife exposure calculations presented below in JRP.156d, and is higher than the estimate used in the EIS (0.47 ug/g wet muscle).

An alternative approach to estimate peak concentrations for 300 mm fish was also tested, developing a direct regression of observed peak increase factors for 300 mm pike versus (Af/Q + b*At), as was done for 700 mm pike. The resulting regression predicted a peak increase factor of 2.8 for 300 mm pike for the Project, at the low end of observations (see Table 2), and a mean Hg concentration 0.4 ug/g for seven species. Given the uncertainties inherent to all methods attempted, the value of 0.53 ug/g wet muscle was used for wildlife exposure estimates.

Table 3 Updated Peak Fish Hg Concentrations (300 mm Length Standard) Associated with the Proposed Lower Churchill River Project

Site	Species	Baseline Concentration (ug/g wet muscle)	Peak Increase Factor for adult fish	Ratio of PIF for 300mm/adult fish*	Peak Increase Factor for 300 mm fish	Predicted Peak Concentration (ug/g wet muscle)	Peak Observed Concentration from Smallwood Reservoir (Lobstick or Sandgirt) (ug/g wet muscle)	Notes
Gull Island Reservoir								
	Lake Trout	0.33	2.3	1.9	4.3	1.42	1.30	4
	Longnose sucker	0.18	2.3	1.7	3.9	0.69	0.46	3
	White Sucker	0.15	2.3	1.3	2.9	0.43	0.22	6
	Lake Whitefish	0.11	2.3	1.5	3.4	0.36	0.35	2
	Northern Pike	0.10	2.3	1.9	4.3	0.43	0.61	1
	Brook Trout	0.08	2.3	1.9	4.3	0.35	No data	5
	Ouananiche	0.08	2.3	1.9	4.3	0.35	No data	7
Muskrat Falls Reservoir and Downstream (if different to above)	**Species**	**Baseline Concentration (ug/g wet muscle)**	**Peak Increase Factor for adult fish**	**Ratio of PIF for 300mm/adult fish***	**Peak Increase Factor for 300 mm fish**	**Predicted Peak Concentration (ug/g wet muscle)**	**Peak Observed Concentration for Winokapau Lake or Gull Lake**	**Notes**
	Lake Whitefish	0.11	4.9	1.0	4.9	0.52	0.38	8
	Longnose Sucker	0.18	3.2	1.2	4.0	0.70	0.68	9
	White Sucker	0.15	2.3	1.3	3.0	0.43	0.24	10

Notes:
* 1.9 is average from 9 sites in Quebec and Manitoba. Used for predators and species with no data from Smallwood. Other values based on Smallwood observations
1 -Baseline from Shipiskan. Winokapau 2004 data did not extend to 300 mm. Max observed from Sandgirt 1977
2- Baseline from Atikonak and Shipiskan. Max observed from Sandgirt 1977
3- Baseline from Gull and Winokapau 1999 (visually estimated). Max observed from Lobstick 1977
4- Baseline from Winokapau 1999 (estimated visually). Atikonak and Shipiskan were out of range. Max observed from Sandgirt 1977.
Peak ratio assumed to be same as for 300 mm pike
5- Baseline from Gull Lake 2004. No observations during peak years. Peak ratio assumed to be same as for 300 mm pike
6- Baseline from Winokapau 2004. Peak value is extrapolated based on Sandgirt 1977. No regional baseline.

7- Baseline from Winokapau 1999. No observations during peak years. Peak ratio assumed to be same as for 300 mm pike
8- Baseline from Atikonank and Shipiskan. Max observed from Winokapau 1977.
9- Baseline from Winokapau and Gull Lake 1999 (Visual est.). Max obsserved from Winokapau 1977.
10- Baseline from Winokapau 1999. No observations during peak years.

References:

Bodaly, R.A., W. A. Jansen, A.R. Majewski, R.J.P. Fudge, N.E. Strange, A.J. Derksen and D.J. Green. 2007. Postimpoundment Time Course of Increased Mercury Concentrations in Fish in Hydroelectric Reservoirs of Northern Manitoba, Canada. Archives of Environmental Contamination and Toxicology 53: 379–389.

Hydro Quebec and Genivar. 2002. Annexe 1 – Évolution des teneurs en mercure des poisons du complexe La Grande. Statistiques descriptives du secteur oust (1978 – 2000). Tests de comparaisons multiples issus d'analyses de regression polynomial avec variable indicatrices.

Hydro Quebec and Genivar. 2000. Annexe 1 – Évolution des teneurs en mercure des poisons du secteur est du complexe La Grande. Statistiques descriptives. Tests de comparaisons multiples issus d'analyses de regression polynomial avec variable indicatrices.

Schetagne, R., J. Therrien, J. and R. Lalumière. 2003. Environmental Monitoring at the La Grande Complex. Evolution of Fish Mercury Levels. Summary Report 1978–2000. Direction Barrages et Environnement, Hydro-Québec Production and Groupe conseil GENIVAR inc. 185 p. and appendix.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.156**

Information Requested:

The Proponent is asked to:

d. **Re-do regression calculations based on the above (JRP.21 (b)), re-calculate Fish Consumption Advisories (JRP.21 (c)) and ecological risk assessment for mercury (JRP.22 (a)), or substantiate that predicted fish mercury concentrations are unchanged from the original EIS and that there is no need to re-calculate Fish Consumption Advisories, or mercury risks for Osprey and river otter; and**

Response:

The model regressions have been re-calibrated as described in IR# JRP.156c, and are consistent with IR# JRP.21b. As a result of the inclusion of new data becoming available, the regression model predicts peak fish mercury (Hg) concentrations that are 2.3X above baseline values, compared to the 1.8X increase estimated in the EIS. Accordingly, fish consumption advisories and ecological risks have been recalculated. River otter are still estimated to have a Hazard Quotient greater than 0.8, considered as a conservative threshold for concern, under the Baseline plus Project scenario. The HQ for Osprey remains below the level of concern. Given the overall conservatism applied throughout the Ecological Risk Assessment (ERA), it is expected that adverse effects will not manifest in River Otter, however monitoring for both species will continue throughout the Project as indicated in the EIS.

Additional Discussion and Results

IR# JRP.21b requested that peak fish Hg concentrations levels in Gull Island and Muskrat Falls reservoirs be re-estimated "*using directly re-calculated Peak Increase Factors for fish mercury in Smallwood Reservoir (see IR# JRP.20)*". IR# JRP.20a requested "*a more accurate estimate of peak fish mercury levels for each fish species in Smallwood reservoir using the average trend in fish mercury levels from the four Quebec reservoirs along with the existing fish mercury data from Smallwood reservoir*". Predictions of peak fish Hg levels in IR# JRP.156c address these requests as the updated regression includes data from the four Quebec reservoirs in question.

As a result of the re-calculated fish Hg concentrations, the anticipated Fish Consumption Advisories and calculated risk to River Otter and Osprey have also updated from those presented in the EIS.

Revised Predicted Peak Hg Concentrations in Fish and Human Fish Consumption Advisories

Revised predicted peak fish Hg concentrations indicate that Hg levels in adult lake trout, northern pike, lake whitefish, longnose sucker, and now white sucker, are expected to exceed Health Canada's 'commercially sold' limit for Hg concentrations in fish of 0.5 µg/g (Health Canada 2007) (Table 1). Peak Hg concentrations in fish are still expected within 5-15 years after flooding, declining thereafter to levels associated with natural lakes after a period of about 30 years, as described in the EIS.

Revised Expected Fish Consumption Advisories Based On Anticipated Peak Hg-Fish Concentrations

Expected fish consumption advisories based on maximum daily allowable consumption (DACmax; kg/fish/day) and expected monthly consumptions (CAmm; meals/month) for each fish species were calculated in the Human Health Mercury Effects Assessment and updated based on the revised predicted peak methylmercury (MeHg) concentrations in fish (Table 4 and Table 5). These consumption advisories are lower than presented in the EIS due to the increased fish Hg predictions.

Table 4 Comparison of Maximum Allowable Daily Fish Intake (DACmax) for People Eating Fish from the Lower Churchill River Based on Predicted Peak MeHg Concentrations

Species		Peak MeHg (ug/kg)[A]	DACmax (g/day)					
			Toddler	Child	Teen	Teenage mothers	Adult Woman[B]	Adult[C]
Lake Trout	Revised value	2160	1.5	3	13	5.5	5.8	15
	EIS value	1670	2	3.9	17	7.1	7.6	20
Northern Pike	Revised value	1830	1.8	3.6	15	6.5	6.9	18
	EIS value	1420	2.3	4.6	20	8.4	8.9	23
Lake Whitefish	Revised value	910	3.6	7.2	31	13	14	37
	EIS value	710	4.6	9.3	40	17	18	47
Longnose Sucker	Revised value	810	4.1	8.1	35	15	16	41
	EIS value	630	5.2	10	45	19	20	53
White Sucker	Revised value	600	5.5	11	47	20	21	55
	EIS value	460	7.2	14	61	26	27	72
Brook Trout	Revised value	490	6.7	13	57	24	26	68
	EIS value	380	8.7	17	74	31	33	87
Ouananiche	Revised value	480	6.9	14	58	25	26	69
	EIS value	370	8.9	18	76	32	34	90

Notes: [A]Predicted peak concentrations; [B]Women of childbearing age; [C]Men and women combined, DACmax values have been rounded to 2 significant digits.

Table 5 Revised Recommended Fish Consumption (meals per month assuming only one fish species is consumed) (CAmm) for People Eating Fish from the Lower Churchill River Based on Predicted Peak MeHg Concentrations

Species		Peak MeHg (ug/kg)[A]	CAmm (meals/month)					
			Toddler	Child	Teen	Teenage mothers	Adult Woman[B]	Adult[C]
Lake Trout	Revised value	2160	0.5	1	2	1	1	2
	EIS value	1670	1	1	3	1	1	3
Northern Pike	Revised value	1830	1	1	2	1	1	3
	EIS value	1420	1	1	3	1	1	4
Lake Whitefish	Revised value	910	1	1	5	2	2	6
	EIS value	710	1	2	6	3	3	7
Longnose Sucker	Revised value	810	1	1	5	2	2	6
	EIS value	630	2	2	7	3	3	8
White Sucker	Revised value	600	2	2	7	3	3	8
	EIS value	460	2	3	9	4	4	11
Brook Trout	Revised value	490	2	2	9	4	4	10
	EIS value	380	3	3	11	5	5	13
Ouananiche	Revised value	480	2	2	9	4	4	11
	EIS value	370	3	3	12	5	5	14

Notes: [A]Predicted peak concentrations; [B]Women of childbearing age; [C]Men and women combined; values of CAmm have been shown as whole numbers, except for the toddler-lake trout scenario using the EIS MeHg concentration, where use of a whole number would result in a 0.

Dietary Unit System for Planning Meals

By reanalysing the variables used for the DACmax and CAmm calculations, a "dietary unit system" was derived to provide guidance for people with dietary choices. Based on the revised predicted MeHg concentrations in fish, "µg of MeHg/meal" and "units/meal", advisory limits for human consumption of fish meals are lower than presented in the Human Health Mercury Effects Assessment relative to a recommended level of MeHg ingestion (Table 6 to Table 12).

Table 6 Revised Dietary Unit System Adult Men and Women

Adult men and women	**Value**	**Units**	
Acceptable level of MeHg ingestion (pTDI x BM x 30.4)	1010	ug/day	
Meal size	0.2	kg	
1 food unit	10	ug consumed	
Allowable food points / month (Acceptable level/food point)	**101**		
Fish species	**Fish MeHg concentration (ug/kg)**	**ug/meal**	**units / meal**
Lake Trout	**2160**	432	43.2
Northern Pike	**1830**	366	36.6
Lake Whitefish	**910**	182	18.2
Longnose Sucker	**810**	162	16.2
White Sucker	**600**	120	12.0
Brook Trout	**490**	98	9.8
Ouananiche	**480**	96	9.6

Table 7 Revised Dietary Unit System for Women of Childbearing Age

Women of child-bearing age	**Value**	**Units**	
Safe level of MeHg ingestion (pTDI x BM x 30.4)	384	ug/month	
Meal size	0.2	kg	
1 food point	10	ug consumed	
Allowable food points / month (Safe level/food point)	**38**		
Fish species	**Fish MeHg concentration (ug/kg)**	**ug/meal**	**points / meal**
Lake Trout	**2160**	432	43.2
Northern Pike	**1830**	366	36.6
Lake Whitefish	**910**	182	18.2
Longnose Sucker	**810**	162	16.2
White Sucker	**600**	120	12.0
Brook Trout	**490**	98	9.8
Ouananiche	**480**	96	9.6

Table 8 Revised Dietary Unit System for Teens

Teen	Value	Units	
Safe level of MeHg ingestion (pTDI x BM x 30.4)	853	ug/month	
Meal size	0.2	kg	
1 food point	10	ug consumed	
Allowable food points / month (Safe level/food point)	**85**		
Fish species	**Fish MeHg concentration (ug/kg)**	**ug/meal**	**points / meal**
Lake Trout	**2160**	432	43.2
Northern Pike	**1830**	366	36.6
Lake Whitefish	**910**	182	18.2
Longnose Sucker	**810**	162	16.2
White Sucker	**600**	120	12.0
Brook Trout	**490**	98	9.8
Ouananiche	**480**	96	9.6

Table 9 Revised Dietary Unit System for Teenage Mothers

Teenage mothers	Value	Units	
Safe level of MeHg ingestion (pTDI x BM x 30.4)	363	ug/month	
Meal size	0.2	kg	
1 food point	10	ug consumed	
Allowable food points / month (Safe level/food point)	**36**		
Fish species	**Fish MeHg concentration (ug/kg)**	**ug/meal**	**points / meal**
Lake Trout	**2160**	432	43.2
Northern Pike	**1830**	366	36.6
Lake Whitefish	**910**	182	18.2
Longnose Sucker	**810**	162	16.2
White Sucker	**600**	120	12.0
Brook Trout	**490**	98	9.8
Ouananiche	**480**	96	9.6

Table 10 Revised Dietary Unit System for Children

Child	Value	Units	
Safe level of MeHg ingestion (pTDI x BM x 30.4)	200	ug/month	
Meal size	0.17	kg	
1 food point	10	ug consumed	
Allowable food points / month (Safe level/food point)	**20**		
Fish species	**Fish MeHg concentration (ug/kg)**	**ug/meal**	**points / meal**
Lake Trout	**2160**	367	36.7
Northern Pike	**1830**	311	31.1
Lake Whitefish	**910**	155	15.5
Longnose Sucker	**810**	138	13.8
White Sucker	**600**	102	10.2
Brook Trout	**490**	83	8.3
Ouananiche	**480**	82	8.2

Table 11 Revised Dietary Unit System for Toddlers

Toddler	Value	Units	
Safe level of MeHg ingestion (pTDI x BM x 30.4)	100	ug/month	
Meal size	0.1	kg	
1 food point	10	ug consumed	
Allowable food points / month (Safe level/food point)	**10**		
Fish species	**Fish MeHg concentration (ug/kg)**	**ug/meal**	**points / meal**
Lake Trout	**2160**	216	21.6
Northern Pike	**1830**	183	18.3
Lake Whitefish	**910**	91	9.1
Longnose Sucker	**810**	81	8.1
White Sucker	**600**	60	6.0
Brook Trout	**490**	49	4.9
Ouananiche	**480**	48	4.8

Revised Predicted Peak Hg Concentrations in Fish and the Ecological Risk Assessment

Based on the revised predictions of MeHg in fish and following all assumptions and methodologies used in the ERA completed for the EIS, the results remain similar for the wildlife receptors examined: River Otter are the only receptors predicted to exceed a threshold Hazard Quotient (HQ) level of concern of 0.8 under the Baseline plus Project scenario (i.e., the scenario based on predicted peak MeHg concentrations) (Table 12).

Table 12 Updated Hazard Quotients for Wildlife Based on MeHg Concentrations in Fish Estimated in Part C compared Those Presented in the EIS

Receptor		Hazard Quotient		
		Baseline	Project	Baseline + Project
River Otter	Revised value	0.23	0.70	**0.93**
	EIS value	0.23	0.6	**0.83**
Osprey	Revised value	0.19	0.57	0.76
	EIS value	0.19	0.49	0.66
Note: Bold and highlighted values indicate an exceedance of the toxicity threshold of 0.8				

The exceedance of the threshold HQ suggests that River Otter may be exposed to concentrations of MeHg in their diet that could result in adverse effects [i.e., weight loss, behavioral abnormalities, and mortality (Wobeser, Nielsen and Schiefer 1976a,b)] from this modelled scenario. However, given the inherent conservatism in the ERA, the calculated risk to River Otter is likely greater than what would manifest in this species as a result of Project-related activity, for the following reasons:

- The predicted peak MeHg concentration in each fish was used to calculate the geometric mean used as the Exposure Point Concentration (EPC) (Table 13) even though not all fish species will reach peak MeHg levels at the same time (peak concentrations in forage fish are expected to occur within 10 years of reservoir development and between 5 and 15 years for piscivorous fish). Further, Lake Trout, the fish species with the highest predicted MeHg concentrations in muscle tissue (essentially double the next highest species), was included in the calculation of EPCs even though it is expected that these fish will be relatively inaccessible to both River Otter and Osprey due to their preferred deep-water habitat and comprise only a small portion of the diet. Given these assumptions, actual exposure of wildlife to MeHg after Project development will likely be lower than what was used in the ERA.

Table 13 Predicted Hg concentrations in fish species and the EPC used in risk calculations

Site	Fish Species	Baseline MeHg Concentration (mg/kg wet muscle)	Project MeHg Concentration (mg/kg wet muscle)	Baseline + Project MeHg Concentration (mg/kg wet muscle)
Gull Island and Muskrat Falls Reservoir and Downstream	Lake Trout	0.33	1.09	1.42
	Longnose Sucker	0.18	0.52	0.70
	White Sucker	0.15	0.28	0.43
	Lake Whitefish	0.11	0.41	0.52
	Northern Pike	0.1	0.33	0.43
	Brook Trout	0.08	0.27	0.35
	Ouananiche	0.08	0.27	0.35
	Geometric mean (EPC)	***0.13***	***0.40***	***0.53***

- Even though River Otter eat whole fish rather than preferentially selecting muscle from their prey (as is often the case for Osprey), the predicted peak MeHg concentration from muscle was used to calculate the geometric mean used for the EPC for both species, rather than the whole body prediction, which is approximately 30 percent less. As a result, the estimated amount of MeHg consumed by River Otter is possibly elevated leading to a conservative estimate of HQ.

- Although the amount of Hg predicted in fish was as total Hg, it was assumed that 100 percent of that total would be in the form of MeHg. While MeHg is the main form of Hg found in fish, studies have shown that the percentage can be much lower between and among fish species, ranging from roughly 45 to 95 percent depending on the species tested (Health Canada 2007). Knowing that the amount of MeHg in fish assessed in this study could be lower than 100 percent, but without the ability to quantify this, the assumption that River Otter and Osprey will be exposed to only MeHg is conservative yet protective and could likely lead to a conservative estimate of HQ.

Given that the ERA was a predictive risk assessment to support the EIS process for a project not yet created, the main source of uncertainty in the ERA is in the reliance of predicted MeHg concentrations in fish to assess risk. The commitment in the EIS to monitoring the influence of Project-related activites on wildlife will remain.

References:

Health Canada. 2007. Human Health Risk Assessment of Mercury in Fish and Health Benefits of Fish Consumption. Bureau of Chemical Safety Food Directorate Health Products and Food Branch. March 2007.

Wobeser, G., N.D. Nielsen and B. Schiefer. 1976a. Mercury and mink I: The use of mercury contaminated fish as a food for ranch mink. *Can. J. Comp. Med.* 40:30-33.

Wobeser, G., N.D. Nielsen and B. Schiefer. 1976b. Mercury and mink II: Experimental methyl mercury intoxication. *Can. J. Comp. Med.* 40:34-45

Requesting Organization – Joint Review Panel **Information Request No.: JRP.156**

Information Requested:

The Proponent is asked to:

e. **Confirm that the recalculated Hazard Quotient for osprey is 1.4 and re-evaluate the potential risk of mercury toxicity and potential health effects for osprey based on this higher HQ value.**

Response:

One of the Environment Canada comments posed in IR# JRP.22 was that the Ecological Risk Assessment (ERA) should have been based on Osprey being exposed to Hg throughout the year, although they only occur in the lower Churchill River watershed for only approximately six months of the year. It had been suggested that the analyses should assume Osprey are exposed to baseline Hg exposure elsewhere during winter. Given that baseline conditions were assessed along with the effects of the Project, and since there is no way of quantifying what Osprey are exposed to when "off-site", it is asserted that the ERA based on 50 percent residency remains valid and defensible, particularly when analysed with a reduce HQ threshold of toxicity of 0.80.

Note that in IR# JRP.22, it was erroneously reported that Osprey were assessed in the ERA assuming 100 percent residency. This error was also presented in the intake factor (IF) shown in Table 1 of Appendix B of the component study (Minaskuat Inc. 2008) although the presented HQ were calculated with a residency time of 50 percent. In summary, the HQs for Osprey shown in Table 1 of Appendix B of the component study were correct (i.e., the HQ of 0.66 for Osprey under the Baseline plus Project scenario was calculated correctly and should not be 1.4). Based on this revised presentation and the revised predicted peak concentrations in fish (IR# JRP.156d). presented in Table 13, and updated to reflect the typographical errors, a revised Table 1 of Appendix B of the component study is presented below (Table 14).

References:

Minaskuat Limited Partnership. 2008. Existing Mercury Concentrations in Osprey and Ecological Risk Assessment. Prepared for the Lower Churchill Hydroelectric Generation Project.

Table 14 Updated "Table 1" of Appendix B of the Component Study

Receptor	IF	AF	EPC			IR	f_{site}	BW	ADD			TRV	HQ		
	kg/kg-d		mg/kg			kg/d		kg	mg/kg-d			mg/kg-d			
			Baseline	Project	Baseline + Project				Baseline	Project	Baseline + Project		Baseline	Project	Baseline + Project
River Otter	0.128	1	0.13	0.40	0.53	1.02	1	8	0.0166	0.051	0.0676	0.07	0.23	0.70	**0.93**
Osprey	0.099					0.297	0.5	1.5	0.0129	0.0396	0.0525	0.069	0.19	0.57	0.76

Notes: IF (Intake factor); AF (absorption factor); EPC (exposure point concentration); IR (ingestion rate); f_{site} (fraction consumed); BW (body weight); ADD (average daily dose); TRV (toxicity reference value); HQ (hazard quotient). Bold and highlighted HQ indicates an exceedance of the toxicity threshold of 0.8

IR# JRP.157

Red Wine Mountain Caribou

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Subject - Red Wine Mountain Caribou

References:

EIS Guidelines, Section 3.1 (Study Strategy and Methodology)

Related Comments / Information Requests:

CEAR # 280 (Protected Areas Association of Newfoundland and Labrador)
CEAR # 287 (Grand Riverkeeper Labrador Inc.)
CEAR # 289 (Innu Nation)
CEAR # 291 (Sierra Club Atlantic)
CEAR # 307 (Government of Newfoundland and Labrador – Wildlife Division)

IR # JRP.93

Rationale:

The EIS Guidelines (Section 3.1) state that the Proponent shall explain and justify all methods used in the preparation of the EIS. Several reviewers, including the Government of Newfoundland and Labrador's Wildlife Division (Wildlife Division), raised concerns with respect to the methodology employed in the modelling of caribou habitat and the determination of significance. The Wildlife Division provided extensive commentary on the methodology employed to assess potential impacts to the Red Wine Mountain (RWM) caribou herd and the Proponent should also refer to CEAR # 307 for additional information and rationale.

Information Request JRP.93 requested that the Proponent address deficiencies in the habitat modelling for RWM Caribou to ensure that conclusions about habitat associations remain valid. While this has been done, several reviewers noted that the dataset used for modelling RWM habitat use represents only a fraction of the RWM herd's range and does not represent the entire Assessment area. The Wildlife Division notes that "as a result, the representativeness of both the caribou use information and the landscape are not reflected, and model results may not be applicable when considered at the scale of the population and the range" (CEAR # 307, p. 7). The Wildlife Division also raised both specific and general concerns that the limited habitat data used in the model reduces the power of the model to detect habitat preferences, and to make inferences regarding habitat selection and avoidance at the population level, particularly where little information pertaining to the stability of the model is provided.

The Wildlife Division presented a critical view of the Sorenson *et al.* (2008) reference cited by the Proponent as supporting their view that there will be no significant impacts to the RWM herd as a result of the Project. The Wildlife Division indicated that the paper has been widely criticized for inaccurately estimating the ability of caribou to persist in ranges that are heavily impacted by industrial developments and furthermore states that, "studies indicate that many of the populations considered stable in Sorenson *et al* (2008) are actually in decline as the study failed to take into account a time lag in the population response to these changes" (CEAR # 307, p. 9).

While the Proponent and reviewers have noted that the main causes of the current decline of the RWM population is likely linked to the mortality of adult animals, reviewers continue to raise concerns that an expanded industrial footprint and associated human activity within the RWM range may further compromise the population and continue to question the actual risks to this population posed by the Project.

In response to JRP.93, the Proponent states that "although there will likely be local disruptions of movement around construction sites, and a potential reduction in crossing the TLH as a result of increased Project traffic, regional movements are expected to be maintained". However, the Proponent has not provided data on the proximity of winter or calving ranges to existing and proposed roads and the likelihood of road crossings based on the telemetry data provided to support this statement.

Reviewers also raise concerns with respect to the lack of a broader consideration of habitat disturbance which may lead to an increase in the density of primary wolf prey such as moose, which may result in an increase in more efficient and mobile predators such as wolves.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Information Requested:

The Proponent is asked to provide the following technical information with respect to the model:

a. **The least cost pathway analysis, including an assessment of the use of subjective values rather than likelihood estimates from the Resource Selection Function (RSF);**

Response:

The results of the Least-Cost Pathway (LCP) analysis are not likely to change regardless of whether subjective values or output from the Resource Selection Functions (RSFs) are used in the analysis. The objectives of the LCP analysis were to determine possible crossing locations of woodland caribou along the lower Churchill River, and whether these locations are clumped or widely distributed (Minaskuat Inc. 2009; Nalcor 2009). Landscape friction values used for the LCP analysis were assigned to habitat and slope classes based on the literature (Minaskuat Inc. 2009) and applied professional experience. Actual collar locations prior to and after river crossing, and less than five weeks apart, were used as source and destination points (Minaskuat Inc. 2009; Nalcor 2009). The results of the analysis indicated that caribou cross the river at all times of the year, and that crossing locations are broadly distributed.

Given the availability of telemetry collar location data from the Red Wine Mountain (RWM) Caribou Herd, and its application as the foundation for the original LCP analysis, re-doing the analysis using RSF output would not change the outcome. Indeed, the same conclusions as those found through the LCP analysis can be arrived at, and more succinctly, through use of the telemetry collar data alone. As shown in Table 1, Figure 1, caribou cross the river at all times of the year in both directions and crossing locations are broadly distributed.

Caribou movement across the lower Churchill River is expected to decrease during reservoir clearing, but since clearing activities will not occur in the entire project area simultaneously, and will only occur at select locations at any given time, a variety of crossing locations will remain available, resulting in negligible effects on movement (EIS, Volume IIB, Section 5.14.2.1, p. 5-80). Due to a decrease in water velocity (i.e., due to a reservoir being present, rather than a river), and the related increase in stable ice cover during the winter, the effects of the reservoirs on caribou movement during operation and maintenance are expected to be positive (EIS, Volume IIB, Section 5.11.2.5, p. 5-69).

Table 1 Number of Crossings of the Lower Churchill River By Red Wine Mountain Caribou within the Forest Inventory Area, by Season, as determined by Class 2 and Class 3 Collar[1] Observations Less Than Five Weeks Apart

Caribou Collar ID	Number of Crossings		
	Calving	Post-calving	Winter
RW2001001	1 north	0	1 south
RW2001002	2 north	1 north	1 north
RW2001006	1 north, 1 south	1 north	0
RW2002004	1 north	1 north	0
RW2002008	0	1 north	0
RW88001	4 north, 4 south	3 north, 3 south	0
RW94102	1 south	0	0
RW95103	0	1 north, 1 south	0
RW96003	1 south	1 north, 1 south	1 south
RW96007	1 north, 1 south	0	0
RW96013	2 south	0	0
RW96016	0	1 north, 1 south	0
RW96017	2 north	2 north, 1 south	0
RW96026	1 north	0	0
RW96027	1 south	1 north	0
RW96028	0	0	1 north
RW97005	2 north	0	0
RW97010	2 north	1 south	2 north, 3 south
RW97014	0	0	1 north, 2 south
RW97016	0	1 north, 1 south	0

Note:
[1] Collar locations accurate to within 350 m and 150 m, respectively (CLS 2008, website)

References:

Minaskuat Inc. (Minaskuat). 2009. The Lower Churchill Hydroelectric Generation Project Environmental Baseline Report: Caribou (*Rangifer tarandus caribou).* Prepared for the Lower Churchill Hydroelectric Generation Project.

Nalcor Energy (Nalcor). 2009. Volume II Part A: Biophysical Assessment. Lower Churchill Hydroelectric Generation Project Environmental Impact Statement. 368 pp.

Websites Cited:

CLS (Collecte Localisation Satellites). 2008. *Argos User Manual.* Available at: http://www.argossystem.org/documents/userarea/argos_manual_en.pdf

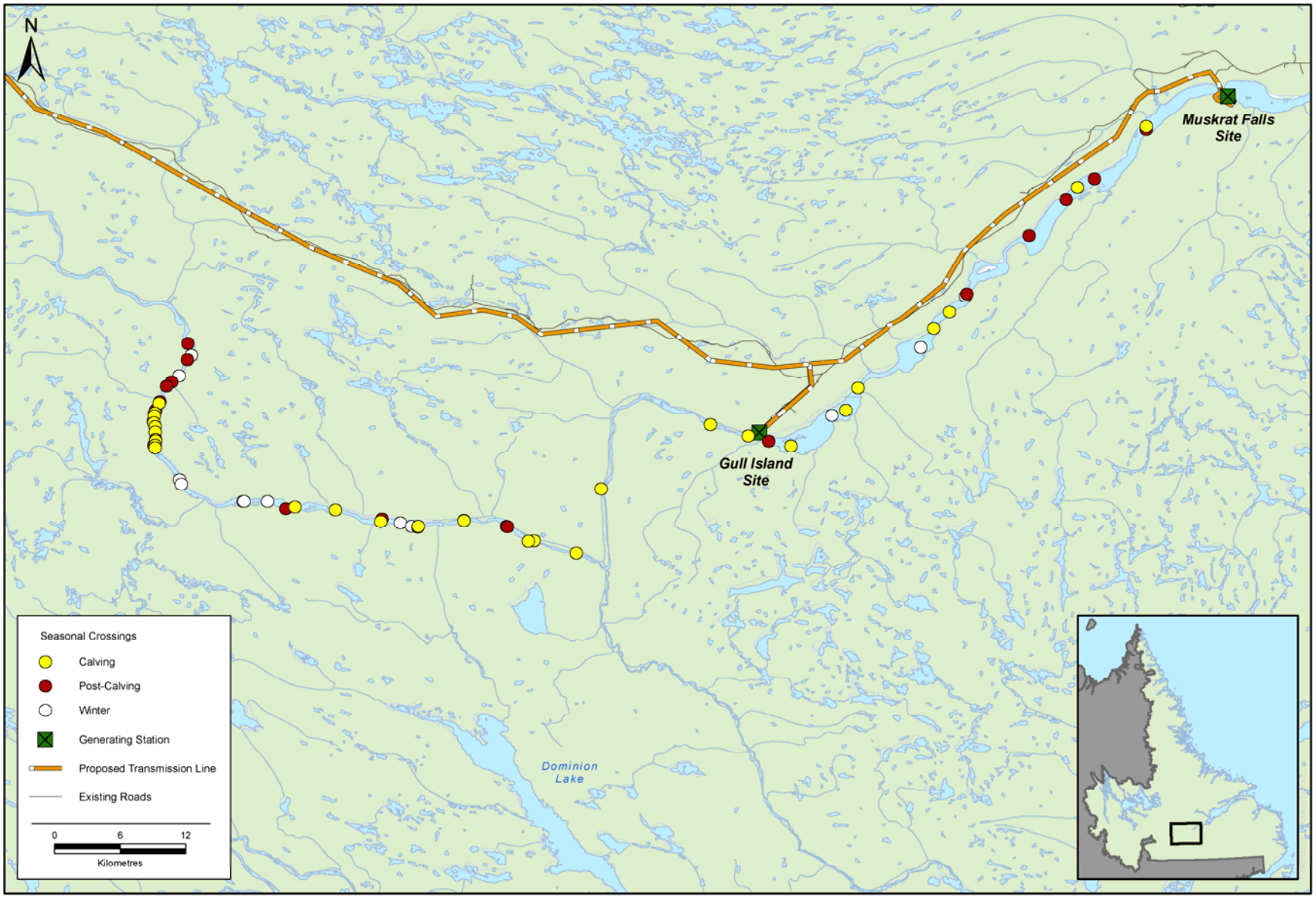

Figure 1 Locations of Red Wine Mountain Caribou Crossing the Lower Churchill River

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Information Requested:

The Proponent is asked to provide the following technical information with respect to the model:

b. Details regarding how lichen estimates were collected or derived and how this information was incorporated with Forestry Inventory stand types;

Response:

Percent cover of lichen was estimated visually at 20 m x 20 m (400 m^2) Ecological Land Classification (ELC) sample plots during the baseline program (Minaskuat Inc. 2008). The location of these sample plots were then incorporated with locations represented by the classified Forest Inventory (FI) data (Government of Newfoundland and Labrador 2000) to calculate the average percent cover of lichen per FI stand type. Some of the FI cover types were not represented in the ELC data, so in these situations, classes of lichen cover were assigned based on ecological knowledge of the cover types within the FI data extent and applied professional experience.

References:

Government of Newfoundland and Labrador. 2000. Provincial forest inventory. Department of Forest Resources and Agrifoods – Forestry Branch.

Minaskuat Inc. 2008. Project Area Ecological Land Classification. Prepared for the Lower Churchill Hydroelectric Generation Project. Available online at: http://www.ceaa.gc.ca/050/documents_staticpost/26178/31993/aq-o-05.pdf

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Information Requested:

The Proponent is asked to provide the following technical information with respect to the model:

c. A statement as to whether biomass of lichen was measured and if so, how;

Response:

The amount of lichen per sample plot was measured using estimates of percent cover by species (Minaskuat Inc. 2008). Biomass of lichen was not measured on vegetation sampling sites. Biomass of lichen is not required for the assessment of effects of the Project on caribou because percent cover of lichen is an appropriate indicator of woodland caribou habitat selection (Mayor et al. 2007).

References:

Mayor, S.J., J.A. Schaefer, D.C. Schneider and S.P. Mahoney. 2007. New Approaches to detecting the scale-dependent response to habitat. Ecology 88(7): 1634-1640.

Minaskuat Inc. 2008. Project Area Ecological Land Classification. Prepared for the Lower Churchill Hydroelectric Generation Project.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Information Requested:

The Proponent is asked to provide the following technical information with respect to the model:

d. A contingency table summarizing kappa coefficients between validation stations (ELC data) and FI stand types, if these were used to validate FI data and modify habitat categories.

Response:

A kappa coefficient is a quantitative tool for measuring the agreement between categories (Cohen 1960). Due to the fact that actual percent lichen cover measures from the Ecological Land Classification (ELC) data were not available for some Forest Inventory (FI) cover types (Government of Newfoundland and Labrador 2000), and were infrequent in others, kappa coefficients cannot be calculated. However, kappa coefficients measuring the association between lichen percent cover and stand types are not necessary for determining the accuracy of the Resource Selection Functions (RSFs) or any other component of the assessment. To evaluate model accuracy, the seasonal RWM caribou Resource Selection Functions (RSF) models were validated using the established, peer-reviewed approach of Boyce et al. (2002). Validation results demonstrated that the seasonal models are strong predictors of the relative probability of caribou habitat selection within the FI data extent (see the response to IR# JRP.93).

The associations between FI cover types and the amount of lichen cover were informed by data collected at ELC sample plots (Minaskuat Inc. 2008). Due to the limited representation of some FI cover types in the ELC data, assigning final levels of lichen cover per FI cover type required application of professional experience. It is important to note that although estimates of lichen cover per FI cover type were used to delineate stand types considered to be important for determining habitat selection by RWM Caribou Herd (Minaskuat Inc. 2009), validation of the RSF model is the indicator of model accuracy. Any weaknesses in the strength of association between lichen availability, FI cover types, and the importance of those cover types to RWM caribou may lower model accuracy, but this would be represented in validation results.

The Boyce et al. (2002) approach of RSF validation involves cross-validation and Spearman-rank correlations to measure the reliability of the models to differentiate between 10 different classes of relative probabilities of habitat selection. As stated in the response to IR# JRP.93, and in Table 2, the calving, post-calving, and winter caribou RSF models all displayed strong, significant Spearman-rank correlations. These correlations indicate that these models are strong predictors of the relative probability of caribou habitat selection across the FI data extent. As these models are strong predictors of caribou habitat selection patterns, they are appropriate for use in predicting likely Project effects to caribou habitat, particularly within the FI area.

Table 2 Spearman-Rank Correlations between Bin and Associated Area-Adjusted Observation Ranks for the Seasonal Caribou RSF Models

Season[1]	Average Spearman-Rank Correlation
calving	0.87
post-calving	0.91
winter	0.94

Note:
[1] Refer to Volume IIA, Section 2.4.4.3

References:

Boyce, M.S., P.R. Vernier, S.E. Nielsen and F.K.A. Schmiegelow. 2002. Evaluating resource selection functions. Ecological Modelling 157: 281-300.

Cohen, J. 1960. A coefficient of agreement for nominal scales, Educational and Psychological Measurement 20(1): 37–46.

Government of Newfoundland and Labrador. 2000. Provincial forest inventory. Department of Forest Resources and Agrifoods – Forestry Branch.

Minaskuat Inc. 2009. The Lower Churchill Hydroelectric Generation Project Environmental Baseline Report: Caribou (*Rangifer tarandus caribou).* Prepared for the Lower Churchill Hydroelectric Generation Project.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Information Requested:

The Proponent is asked to provide the following technical information with respect to the model:

e. Definitions of qualifying terms used to describe the quality of caribou habitat;

Response:

Estimates of lichen per Forest Inventory (FI) class were derived through a combination of field samples of percent lichen cover and application of professional experience (see the response to IR# JRP.157 1b). These estimates were then expressed as qualifying terms describing the relative availability of lichen in each FI class. As descriptors of relative lichen abundance, definitions of these qualifying terms are only meaningful in relation to each other. Functional definitions of qualifying terms used for describing lichen availability per FI class are:

- High – these land cover classes contain the highest lichen availability within the FI area.
- Moderate – less lichen availability than in high-classed habitats, and more lichen availability than in low-classed habitats.
- Low – much less lichen availability than in high-classed habitats, less lichen availability than in moderate-classed habitats, and more lichen availability than in very low-classed habitats.
- Very low – lichen is present in trace amounts only. Lichen availability is less than in habitats classed low for lichen availability.

Qualifying terms that describe the relative probability of occurrence for woodland caribou from the RWM Caribou Herd include 'primary', 'secondary' and 'tertiary'. For ease of interpretation, 'primary' may be defined as high quality habitat, 'secondary' as moderate quality, and 'tertiary' as low quality habitat (Minaskuat Inc. 2009). However, a more direct interpretation of the model output would define 'primary' habitat as more likely to be selected than 'secondary' or 'tertiary' habitat, and 'tertiary' habitat the least likely to be selected. 'Primary' habitat may also be defined as habitat with the greatest relative probability of being selected by RWM caribou within the FI area.

References:

Minaskuat Inc. 2009. The Lower Churchill Hydroelectric Generation Project Environmental Baseline Report: Caribou (*Rangifer tarandus caribou).* Prepared for the Lower Churchill Hydroelectric Generation Project.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Information Requested:

The Proponent is asked to provide the following technical information with respect to the model:

f. **An explanation as to why only areas that have burned in the last 30 years are included in the habitat model and the impact this has on predicting available habitat;**

Response:

Areas burned during the last 50 years were used in the habitat model, which is consistent with the ecology of woodland caribou and enhanced the predictive accuracy of the seasonal RWM Caribou Herd Resource Selection Functions (RSFs).

As stated in the responses to IR# JRP.93 and IR# JRP.157(1d), validation results show that the calving, post-calving, and winter caribou RSF models are strong predictors of the relative probability of caribou habitat selection within the extent of the Forest Inventory (FI) data. It is within the FI data extent that all Project infrastructure (e.g., dams, transmission lines) is located, and where the effects of the Project are likely the greatest.

Terrestrial lichen cover begins to peak approximately 40 years following disturbance in coniferous stands in Labrador (Foster 1985). However, caribou in Alaska and Manitoba have been found to avoid burns less than 50 years old (Joly et al. 2003; Joly et al. 2007; Lander 2006; Schaefer and Pruitt 1991). Therefore, the RSF models included areas that were burned in the previous 50 years.

The FI data obtained from the Government of Newfoundland and Labrador had areas classified as burned, wherever burns had been identified from 1960 through to 2000 (Jennings, pers. comm. 2010). Data describing the location of areas burned were provided by the Government of Newfoundland and Labrador to update the FI data with areas burned between 2000 and 2009. When combined, the final version of the FI data used for modeling described the locations of burns that occurred from 1960 through to 2009 (i.e., burns that were up to 50 years old). Using land cover data describing the distribution of burns up to 50 years old is consistent with the ecology of woodland caribou and contributed to the very strong predictive accuracy of the RSF models.

References:

Foster, D. R. 1985. Vegetation development following fire in Picea mariana (black spruce)-Pleurozium forests of south-eastern Labrador, Canada. Journal of Ecology. 73: 517-534.

Joly, K., B.W. Dale, W.B. Collins and L.G. Adams. 2003. Winter habitat use by female Caribou in relation to wildlife fires in interior Alaska. Canadian Journal of Zoology 81: 1,192-1,201.

Joly, K. P. Bente and J. Dau. 2007. Response of overwintering caribou to burned habitat in northwest Alaska. Arctic 60(4):401-410.

Lander, C.-A. 2006. Distribution and movements of Woodland Caribou on disturbed landscapes in west-central Manitoba: implications for forestry. Master's thesis. University of Manitoba. Winnipeg, Manitoba.

Schaefer, J.A. and W.O. Pruitt. 1991. Fire and Woodland Caribou in southeastern Manitoba. Wildlife Monographs No 116.

Personal Communications:

Jennings, D. (Computer Systems Analyst, Forest Resources and Agrifoods). 2007. Department of Natural Resources, Government of Newfoundland and Labrador. Telephone conversation with Brock Simons (Golder) on March 26, 2010.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Information Requested:

The Proponent is asked to provide the following technical information with respect to the model:

g. A table that summarizes all of the variables that were initially input into the model (e.g. distance to water bodies and elevation) and provide the thresholds used for collinearity;

Response:

Numerous variables were considered for inclusion in the seasonal woodland caribou Resource Selection Function (RSF) models that did not appear in the final models, either due to issues with collinearity and multicollinearity, or relatively low explanatory power (Table 3). Univariate correlations between variables were considered to be potentially problematic if the Pearson correlation coefficient describing their strength of relationship was ≥ 0.7 (Tabacknick and Fidell 2001). Multicollinearity was assumed to be present if the Variance Inflation Factors (VIFs) for any variables within a model exceeded a value of 10 (Kutner et al. 2005).

Table 3 Variables Considered for Inclusion in Seasonal Woodland Caribou Resource Selection Functions and Associated Descriptions

Variable[(a)]	Description
dist_burn	Distance to the nearest burned area
dist_cabin	Distance to the nearest cabin
dist_cult	Distance to the nearest cultural feature (i.e., human disturbances such as building and facilities)
dist_cultncabin	Distance to the nearest cultural feature or cabin
dist_cut	Distance to the nearest clearcut
dist_road	Distance to the nearest road
dist_tline	Distance to the nearest transmission line
dist_wpoly	Distance to the nearest river or lake
dist_wline	Distance to the nearest stream
dist_water	Distance to the nearest stream, river or lake
dist_dist	Distance to the nearest natural or human disturbance
slope_per	Percent slope (on a 0-100 scale)
hab_barren	Unvegetated land dominated by rock, soil and/or sand
hab_bsd	Black spruce dominated upland forest habitat of age >40 years
hab_cd	Coniferous dominated upland forest of age >40 years
hab_hyng	Hardwood-dominated stands and young stands
hab_ss	Softwood scrub stand (black-spruce dominated)
hab_bog	Non-treed bog
hab_trebog	Treed bog
hab_allbog	Combined Non-treed and treed bog
hab_wat	Water
hab_burn	Burned area
hab_cut	Logging disturbance ≤20 years old
hab_dist	Disturbance (includes linear features, cultural features, natural disturbance, cut-overs)
dist_cult2	A polynomial term describing the squared distance to the nearest cultural feature
dist_cut2	A polynomial term describing the squared distance to the nearest logging disturbance
dist_dist2	A polynomial term describing the squared distance to the nearest human or natural disturbance

Note:
[(a)]Model variable names starting with "hab_" represent a percentage (on a 0-100 scale) of a given habitat type within a 350 m radius circle around each location (see the response to IR# JRP.93).

References:

Kutner, M.H., C.J. Nachtsheim, J. Neter and W. Li. 2005. Applied Linear Statistical Models: Fifth Edition. McGraw Hill. Boston, MA.Tabachnick, B.G. and L.S. Fidell. 2001. Using multivariate statistics. Allyn and Bacon. Boston, MA.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Information Requested:

The Proponent is asked to provide the following technical information with respect to the model:

h. Additional information with respect to the stability of the model;

Response:

The Resource Selection Functions (RSFs) predict the relative probabilities of occurrence of caribou from the RWM Caribou Herd in the calving, post-calving and winter seasons within the extent of the available Forest Inventory (FI) data. The results of model validation demonstrate that these models are stable within the extent of the FI area. To evaluate model accuracy, the seasonal RWM caribou RSF models were validated using the established, peer-reviewed approach of Boyce et al. (2002). This evaluation involves cross-validation and Spearman-rank correlations to measure the reliability of the models for differentiating between 10 different classes of relative probabilities of habitat selection. As stated in response to IR# JRP.93 and reiterated in Table 1 of IR# JRP.157(1d), the calving, post-calving, and winter caribou RSF models all displayed strong, significant Spearman-rank correlations. These validation results show that these models are strong predictors of the relative probability of caribou habitat selection within the FI data extent. As these models are strong predictors of caribou habitat selection patterns, they are appropriate for use in assessing likely Project effects to caribou habitat, particularly within the FI area. It is within the FI area that all Project infrastructure (e.g., dams, transmission lines) is located, and where the effects of the Project are likely the greatest.

The percentage of the telemetry-collared caribou that had ranges that extended into the FI data extent were calving (50 percent), post-calving (38 percent), and winter (44 percent) seasons (Table 4). Of those collared caribou with ranges within the FI area, on average 48 percent (calving season), 53 percent (post-calving season) and 49 percent (winter season) of the total class 2 and 3 collar locations (i.e., accurate to within 350 m and 150 m, respectively; CLS 2008, website) of those animals also fall within the FI area (Table 4, Table 5). Therefore, a substantial proportion of the total collared caribou population is represented within the FI area in each season, along with approximately one-half of the high resolution data from those animals' collars. This strong representation, combined with strong validation results confirming predictive accuracy, provide further support for the stability of the model as a predictive tool for assessing the effects of the Project on RWM caribou within the FI area. It is within the FI area that all Project infrastructure is located, and where the effects of the Project are likely the greatest.

The seasonal RSFs predict that tertiary-classed habitats will be disproportionately affected by inundation within the FI area, and model validation results strongly support this prediction. All Project infrastructure will be located within the FI area. Beyond the FI area, reservoir inundation will directly affect 0.4 percent of each of the calving and post-calving ranges, and 0.3 percent of the winter range of the RWM Caribou Herd (EIS, Volume IIB, Section 5.11.1.4, Table 5-12, p. 5-43). However, peer-reviewed literature, supported by professional experience of the Project experts, strongly suggests that habitat near rivers represents high predation risk for caribou (Rettie and Messier 1998; Stuart-Smith et al. 1997). Therefore, RSF model predictions within the FI area and professional knowledge of the RWM Caribou Herd Range result in the prediction that inundation will have a negligible effect on the availability of primary habitat within the RWM Caribou Herd range. In addition, it is predation and hunting, not the availability of habitat, which are described as the primary limitations on the RWM caribou herd (Bergerud et al. 2008; Schmelzer et al. 2004). Therefore, the Project was assessed as having

no significant effects on the RWM Caribou Herd during construction or operations and maintenance (EIS, Volume II Part B, Section 5.14.1, Table 5-29, p. 5-79).

Table 4 Characteristics of Telemetry Collar Data for Red Wine Mountain Caribou within the Forest Inventory Area, by Season

Season	Percentage of Collared Caribou With Ranges That Penetrate Into the Forest Inventory Area	Average Percentage of Class 2 and 3 Telemetry Collar Points Within the Forest Inventory Area Per Caribou Range Within The Forest Inventory Area
calving	50.0	48.4
post-calving	37.5	53.3
winter	43.8	49.1

Table 5 Percent of Class 2 and 3 Collar Observations within the Forest Inventory Area, by Season

Caribou Collar ID	Collar Observations Within the Forest Inventory Area (%)		
	Calving	Post-calving	Winter
RW2002008	0.0	50.0	0.0
RW2004001	0.0	0.0	50.0
RW2004002	100.0	100.0	50.0
RW330	0.0	0.0	0.0
RW82013	100.0	100.0	0.0
RW86001	0.0	0.0	0.0
RW86002	0.0	0.0	0.0
RW86004	0.0	0.0	0.0
RW86006	15.8	100.0	0.0
RW86007	2.3	0.0	0.0
RW86008	0.0	0.0	0.0
RW86009	0.0	0.0	0.0
RW87002	0.0	0.0	0.0
RW87003	0.0	0.0	0.0
RW87004	0.0	0.0	0.0
RW87008	0.0	0.0	0.0
RW87009	100.0	100.0	0.0
RW88001	4.2	16.0	0.0
RW88003	0.0	0.0	0.0
RW93101	71.4	0.0	20.6
RW93104	0.0	0.0	36.4
RW93106	23.5	0.0	51.1
RW93107	28.6	20.0	0.0
RW93109	70.0	0.0	48.1
RW93111	0.0	0.0	86.4
RW93112	0.0	0.0	100.0
RW93113	55.6	50.0	17.3
RW93114	0.0	0.0	100.0
RW93115	0.0	0.0	52.2
RW93116	50.0	87.5	22.0
RW94101	52.6	0.0	0.0
RW94102	30.4	43.8	31.6
RW94103	28.6	6.7	19.7
RW95103	47.1	13.6	43.5
RW95104	40.0	58.8	0.0
RW95105	0.0	0.0	13.3

Caribou Collar ID	Collar Observations Within the Forest Inventory Area (%)		
	Calving	Post-calving	Winter
RW95106	0.0	0.0	60.6
RW96001	14.3	0.0	0.0
RW96002	80.0	0.0	57.5
RW96026	27.8	4.5	44.1
RW96027	31.6	17.2	100.0
RW97002	100.0	72.4	26.1
RW97003	14.3	62.5	0.0
RW97004	0.0	0.0	0.0
RW97010	0.0	0.0	0.0
RWF041	0.0	0.0	0.0
RWF050	73.3	56.0	0.0
RWF054	0.0	0.0	0.0

References:

Bergerud, C. S.N. Luttich and L. Camps. 2008. The Return of Caribou to Ungava. McGill-Queen's Native and Northern Series, 50. McGill-Queen's University Press, Montreal, QC. 586 pp.

Rettie, W.J. and F. Messier. 1998. Dynamics of woodland caribou populations at the southern limit of their range in Saskatchewan. Canadian Journal of Zoology 76: 251-259.

Schmelzer, I., J. Brazil, T. Chubbs, S. French, B. Hearn, R. Jeffery, L. LeDrew, H. Martin, A. McNeill, R. Nuna, R. Otto, F. Phillips, G. Mitchell, G. Pittman, N. Simon, and G. Yetman. 2004. *Recovery strategy for three Woodland Caribou herds (Rangifer tarandus caribou; Boreal population) in Labrador*. Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook.

Stuart-Smith, A.K., C.J. Bradshaw, S. Boutin, D.M. Hebert and A.B. Rippin. 1997. Woodland caribou relative to landscape patterns in northeastern Alberta. Journal of Wildlife Management 61: 622-633.

Websites Cited:

CLS (Collecte Localisation Satellites). 2008. *Argos User Manual.* Available at: http://www.argossystem.org/documents/userarea/argos_manual_en.pdf

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Information Requested:

The Proponent is asked to provide the following technical information with respect to the model:

i. **Mean relocation interval (and its variation) and range of associated buffer sizes used;**

Response:

The temporal and spatial mean relocation intervals (and associated standard deviations) between successive collar location points are shown in Table 6. Similar relocation intervals within each season were grouped, and 95th percentile distances were defined for each interval grouping in SAS (SAS Systems 2002). The ranges of those 95th percentile distance buffers are also shown in Table 6.

Table 6 Relocation Intervals and 95th Percentile Distances for Woodland Caribou Satellite Telemetry Collars

Season[1]	Relocation Interval (days)		Relocation Distance (m)		Range of 95th Percentile Distance Buffers (m)
	Mean	Standard Deviation	Mean	Standard Deviation	
Calving	4.5	4.8	4,529	6,682	9,367 – 38,150
post-calving	5.8	6.8	5,922	5,681	11,250 – 37,459
Winter	5.0	2.6	2,448	2,559	6,462 - 13,954

Note:
[1] Refer to Volume IIA, Section 2.4.4.3

References:

SAS Systems. 2002. SAS/STAT Release 9.1.3. SAS Institute. Cary, NC.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Information Requested:

The Proponent is asked to provide the following technical information with respect to the model:

j. Revised statements pertaining to the scope of the model inference in order to accurately reflect the limitations of the model;

Response:

As stated in the response to IR# JRP.93 and Table 1 of IR# JRP.157(1d), validation results for the calving, post-calving, and winter caribou RSF models show that these models are strong predictors of the relative probability of caribou habitat selection within the FI data extent. As these models are strong predictors of caribou habitat selection patterns, they are appropriate for use in predicting likely Project effects to caribou habitat, particularly within the FI. It is within the FI area that all Project infrastructure (e.g., dams, transmission lines) is located, and where the effects of the Project are likely the greatest. In addition, a substantial proportion of the total collared caribou population is represented within the FI area in each season, along with approximately one-half of the high resolution data from those animals' collars (IR# JRP.157(1h)). This strong representation, combined with strong validation results confirming predictive accuracy, provide additional support for the strength of the model as a tool for predicting the likely effects of the Project on RWM caribou within the FI area.

Within the FI area, tertiary-classed habitats are disproportionately affected by inundation, followed by secondary-classed habitats. This is consistent with the research that shows that habitat near rivers represents high predation risk, and would not be considered primary habitat even if cover and food were available (Rettie and Messier 1998; Stuart-Smith et al. 1997). The primary effect on caribou habitat outside of the FI area will be vegetation clearing along the lower Churchill River, followed by reservoir inundation. Therefore, with or without model inference outside the FI area, it is predicted that inundation will have little effect on the availability of primary habitat within the RWM Caribou Herd range. In addition, it is predation and hunting, rather than the availability of habitat, which are described as the primary limitations on the RWM Caribou Herd (Schmelzer et al. 2004; Bergerud et al. 2008).

For the reasons stated above, the Project was assessed as having no significant effect on the RWM Caribou Herd during construction or operations and maintenance (EIS, Volume II Part B, Section 5.14.1, Table 5-29, p. 5-79).

References:

Bergerud, C. S.N. Luttich and L. Camps. 2008. The Return of Caribou to Ungava. McGill-Queen's Native and Northern Series, 50. McGill-Queen's University Press, Montreal, QC. 586 pp.

Rettie, W.J. and F. Messier. 1998. Dynamics of woodland caribou populations at the southern limit of their range in Saskatchewan. Canadian Journal of Zoology 76: 251-259.

Schmelzer, I., J. Brazil, T. Chubbs, S. French, B. Hearn, R. Jeffery, L. LeDrew, H. Martin, A. McNeill, R. Nuna, R. Otto, F. Phillips, G. Mitchell, G. Pittman, N. Simon, and G. Yetman. 2004. *Recovery strategy for three Woodland Caribou herds (Rangifer tarandus caribou; Boreal population) in Labrador*. Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook.

Stuart-Smith, A.K., C.J. Bradshaw, S. Boutin, D.M. Hebert and A.B. Rippin. 1997. Woodland caribou relative to landscape patterns in northeastern Alberta. Journal of Wildlife Management 61: 622-633.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Information Requested:

The Proponent is asked to provide the following technical information with respect to the model:

k. The thresholds and their metric (e.g. are the maps probability of occupancy, or do they correspond to each of the three separate validation models?) used to define 'primary' 'secondary' and 'tertiary' habitat suitability; and

---

Response:

Thresholds were not used to define primary, secondary and tertiary habitat suitability. Instead, habitat suitability classes were defined by splitting the landscape into roughly equal amounts of each within the Forest Inventory (FI) area. This is an appropriate approach for expressing the output of Resource Selection Functions (RSFs) (Johnson et al. 2006). The RSF output maps express the distribution of relative probabilities of woodland caribou occupancy (Manly et al. 2002). Validation models were used to evaluate the predictive accuracy of the seasonal RSF models, but were not used to subdivide the landscape into classes. For ease of interpretation, 'primary' was defined as high quality, 'secondary' as moderate quality, and 'tertiary' as low quality habitat (Minaskuat Inc. 2009). However, a more direct interpretation of the model output would describe 'primary' habitat as more likely to be selected than 'secondary' or 'tertiary' habitat, and 'tertiary' habitat the least likely to be selected.

As the seasonal woodland caribou RSF models were developed using data derived from a used-available sampling scheme, model output is properly expressed using an exponential function and takes the form of relative probabilities of use (Manly et al. 2002). Therefore, output is not constrained between 0 and 1, and is not easily divided into classes by thresholds. However, splitting classes such that they contain roughly equal areas (i.e., quantile splits) is an accepted and objective approach (Johnson et al. 2006). Therefore, 'primary', 'secondary' and 'tertiary' habitat classes were produced by splitting the FI area into roughly equal areas. Quantile habitat classes describing the relative probability of caribou occurrence are effective for showing the spatial distribution of habitat classes, as well as the proportion of Project effects per class.

Validation models were used to evaluate model accuracy through cross-validation, but were not involved in final output classification (see the response to IR# JRP.93 for a detailed description of validation methods). Validation results demonstrated that the calving, post-calving and winter caribou RSF models were reliable in their ability to differentiate between classes of relative probability of use.

References:

Johnson, C.J., S.E. Nielsen, E.H. Merrill, T.L. McDonald, M.S. Boyce. 2006. Resource selection functions based on use-availability data: theoretical motivation and evaluation methods. Journal of Wildlife Management 70(2):347-357.

Manly, B.F.J., L.L. Macdonald, D.L. Thomas, T.L. McDonald, W.P. Erickson. 2002. Resource selection by animals. Kluwer Academic Publishers, Netherlands.

Minaskuat Inc. 2009. The Lower Churchill Hydroelectric Generation Project Environmental Baseline Report: Caribou (*Rangifer tarandus caribou).* Prepared for the Lower Churchill Hydroelectric Generation Project.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Information Requested:

The Proponent is asked to provide the following technical information with respect to the model:

l. A discussion on the observed suitability of secondary and tertiary habitats based on telemetry data.

Response:

The relative suitability of secondary and tertiary habitats is predicted by Resource Selection Function (RSF) output, which was developed and tested with telemetry data. The seasonal woodland caribou RSF models were validated using the Boyce et al. (2002) approach. As described in the response to IR# JRP.93 and IR# JRP.157(1d), validation results showed that the calving, post-calving and winter caribou RSF models were reliable in their ability to differentiate between 10 classes of relative probability of use. Primary-classed habitat has a higher probability of woodland caribou occurrence relative to secondary-classed habitat, which has a higher probability of caribou occurrence relative to tertiary-classed habitat.

To clarify, the observed suitability of each of the primary, secondary, and tertiary habitat classes can be quantified using RSF output, telemetry data and Manly's standardized selection ratio. Manly's standardized selection ratio (Manly et al. 1972, 2002) quantifies apparent habitat preference (primary, secondary and tertiary classes) by estimating the probability that a particular habitat suitability class would be selected if each class were equally available. It does this by comparing the proportion of telemetry locations found in each suitability class to the proportion of the landscape that class represents. A G-test may be used to detect statistically significant differences between observed frequencies of observation per habitat class and frequencies expected by chance (Sokal and Rohlf 1995). Using Manly's selection ratio, primary habitat would have about three to four times the probability of being selected as secondary habitat, assuming equal availability (Table 7). The probability of secondary habitat being selected is about three to six times the probability of tertiary habitat being selected. Apparent selection for habitat classes was statistically significant for all seasons.

Table 7 Manly's Standardized Selection Ratio Results for the Seasonal Woodland Caribou Habitat Suitability Index Model

Season[1]	Habitat Class	Manly's selection ratio	G-Test
Calving	primary	0.78	significant
	secondary	0.19	
	tertiary	0.03	
post-calving	primary	0.67	significant
	secondary	0.25	
	tertiary	0.08	
Winter	primary	0.74	significant
	secondary	0.19	
	tertiary	0.07	

Note:
[1] Refer to Volume IIA, Section 2.4.4.3

References:

Boyce, M.S., P.R. Vernier, S.E. Nielsen and F.K.A. Schmiegelow. 2002. Evaluating resource selection functions. *Ecological Modelling* 157: 281-300.

Manly, B.F.J., L.L. Macdonald, D.L. Thomas, T.L. McDonald, W.P. Erickson. 2002. Resource selection by animals. Kluwer Academic Publishers, Netherlands.

Manly, B.F.J., P. Miller, L.M. Cook. 1972. Analysis of a selective predation experiment. The American Naturalist 106(952): 719-735.

Sokal, R.R. and F.J. Rohlf. 1995. *Biometry*. W.H. Freeman and Company. New York, NY.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Information Requested:

The Proponent is also asked to discuss the following:

m. How the precautionary principle has been applied to the data gaps resulting from the use of a model that does not cover the entire RWM range or the entire assessment area;

Response:

As indicated in the response to IR# JRP.19, when considering the assumptions, uncertainties, and limitations in the EIS, it is important to understand how the Project was assessed in a careful and precautionary manner in accordance with Section 2.5 of the EIS Guidelines. For the Project and its EIS, a precautionary approach has been applied to be conservative in the assessment of environmental effects and design mitigative measures that will result in residual effects that are likely to be not significant. Discussion of this approach is also provided in Section 9.12 of Volume IA of the EIS.

This precautionary approach included application of the "Precautionary Principle" (i.e., "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."). The use of a precautionary approach means that:

- Environmental effects predictions are based on conservative values or modeling inputs and assumptions (at the high end of the scale when predictions result in a range of possibilities) and are used to address uncertainty and propose mitigation that will prevent and reduce adverse effects;
- The lack of scientific certainty regarding the probability of an environmental effect occurring has not been used as a reason to postpone mitigation (i.e., the precautionary principle);
- Mitigation has been proposed for project effects, including those that are not likely to be significant and adverse; and
- Follow-up and monitoring have been proposed.

This has allowed the prediction of likely residual environmental effects (after the application of mitigation measures) to be made with a high level of certainty.

A precautionary approach to the assessment of Project effects was employed by:

- assessing Project effects during construction as if all areas within the Project footprint are affected simultaneously, when in fact that will not be the case; and,
- assessing Project effects on RWM caribou by assuming that all habitat affected by the Project beyond the FI data extent is primary habitat (although it is likely mostly tertiary habitat).

Even though construction will take place over 10 years and the entire Project area will not be affected in any one year, a precautionary approach was taken in the assessment by assuming that the full area that may be affected by construction would be affected simultaneously (EIS, Volume IIB, Section 5.11.1.4, pp. 5-44 to 5-45). In this way, the effects of the Project on sensory disturbance of RWM caribou were assessed in a precautionary manner.

The majority of Project effects in the RWM Caribou Herd range beyond the FI boundary will be due to clearing and inundation associated with the Gull Island Reservoir. Within the FI area, tertiary-classed habitats are disproportionately affected by inundation (see the response to IR# JRP.157(2b) for more detail). This finding is consistent with known caribou ecology, which shows that habitat near rivers represents increased predation risk and is generally avoided (Rettie and Messier 1998; Stuart-Smith et al. 1997). Therefore, it is likely that the majority of habitat affected by inundation of the Gull Island Reservoir outside of the FI area will also be tertiary habitat. The effects of roads required for Project construction beyond the FI boundary will be mitigated by restricted access, and the plans to construct roads in the inundation area and/or follow-up with reclamation as soon as each road is no longer needed (EIS, Volume IIB, Section 5.11.2.5, p. 5-67).

Due to the concentration of tertiary habitat near the lower Churchill River (both according to model predictions and reinforced by knowledge of caribou ecology) and the mitigation of effects associated with access roads, it is likely that the majority of Project effects on primary and secondary habitat are concentrated within the FI area and have been explicitly quantified. However, even if tertiary habitat is not concentrated along the river outside of the FI boundary, the area of the Gull Island Reservoir within the RWM Caribou Herd range outside of the FI area makes up only 0.4 percent, 0.4 percent, and 0.3 percent of the calving, post-calving and winter ranges. Therefore, because the area affected by the Project outside of the FI area is such a small percentage of the RWM Caribou Herd range, if that area was entirely primary-classed habitat there would still be no significant effect of the Project on the RWM Caribou Herd. Furthermore, it is predation and hunting, rather than the availability of habitat, which are described as the primary limitations on the RWM Caribou Herd (Bergerud et al. 2008). Based on the above information, the Project was assessed as having no significant effect on the RWM Caribou Herd during construction or operations and maintenance (EIS, Volume II Part B, Section 5.14.1, Table 5-29, p. 5-79).

Consistent with the precautionary principle, a lack of full scientific certainty was not used as a reason for postponing mitigation, and mitigation to minimize Project effects will be applied, including low speed limits along access roads, the education of Project staff about woodland caribou, zero tolerance for wildlife harassment, restricting access, and reclamation of access roads as soon as they are no longer needed (EIS, Volume IIB, Section IIB, pp. 5-80 to 5-81).

References:

Bergerud, C. S.N. Luttich and L. Camps. 2008. The Return of Caribou to Ungava. McGill-Queen's Native and Northern Series, 50. McGill-Queen's University Press, Montreal, QC. 586 pp.

Government of Newfoundland and Labrador. 2000. Provincial forest inventory. Department of Forest Resources and Agrifoods – Forestry Branch.

Rettie, W.J. and F. Messier. 1998. Dynamics of woodland caribou populations at the southern limit of their range in Saskatchewan. Canadian Journal of Zoology 76: 251-259.

Stuart-Smith, A.K., C.J. Bradshaw, S. Boutin, D.M. Hebert and A.B. Rippin. 1997. Woodland caribou relative to landscape patterns in northeastern Alberta. Journal of Wildlife Management 61: 622-633.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Information Requested:

The Proponent is also asked to discuss the following:

n. The availability of primary habitat within the RWM range after inundation;

Response:

The availability of primary habitat within the RWM Caribou Herd range after inundation will be similar to existing conditions. This is because inundation will affect less than 1 percent of the range of the RWM Caribou Herd, and of this less than 1 percent, very little of it is considered primary habitat. Habitat near rivers represents high predation risk for caribou and would not be considered primary habitat even in the presence of other factors such as cover and food availability (Rettie and Messier 1998; Stuart-Smith et al. 1997).

As reservoir inundation will affect less than 1 percent of the range of the RWM Caribou Herd, the assessment relied, in part, on the FI area. It is within the FI area that all Project infrastructure (e.g., dams, transmission lines) is located, and where the effects of the Project are likely the greatest. Within the FI data extent, primary-classed habitat is only about 2 percent, 1 percent and 9 percent of the habitat affected by inundation in the calving, post-calving and winter seasons, respectively (see Volume IIA, Section 2.4.4.3 for a description of how seasonal ranges are defined). Although there are roughly equal amounts of primary, secondary and tertiary-classed habitats within the FI area (see the response to IR# JRP.157(1k)), tertiary-classed habitats are disproportionately affected by inundation, followed by secondary-classed habitats. This is consistent with the prediction that habitat near rivers represents high predation risk, and would not be considered primary habitat even if cover and food were available (Rettie and Messier 1998; Stuart-Smith et al. 1997).

Using zone of influence buffers around Project components and the extent of the reservoirs, sensory disturbance during construction may result in avoidance or reduced occupancy of up to 12.2 percent of the calving range (4.9 percent increase over baseline), 9.1 percent of the post-calving range (4.4 percent increase) and 14.7 percent of the winter range (8.3 percent increase) (EIS, Volume II Part B, Section 5.11.1.4, p. 5-44). These estimates are conservative because construction activities will not occur throughout the entire Project footprint in any one year. No additional direct habitat loss is expected during operation and maintenance. However, sensory disturbance for the RWM Caribou Herd will continue because of Project activities, albeit reduced. Less than one percent of direct change to habitat is expected within the calving, post-calving and winter ranges of the RWM Caribou Herd during operation and maintenance compared to baseline conditions (EIS, Volume II Part B, Section 5.11.2.5, p. 5-67).

In addition to the above, it is predation and hunting, rather than the availability of habitat, which appear to be the primary limitations on the RWM caribou herd (Bergerud et al. 2008; Schmelzer et al. 2004).

Based on the above information, the Project was assessed as having no significant effect on the RWM Caribou Herd during construction or operations and maintenance (EIS, Volume II Part B, Section 5.14.1, Table 5-29, p. 5-79).

References:

Bergerud, C. S.N. Luttich and L. Camps. 2008. The Return of Caribou to Ungava. McGill-Queen's Native and Northern Series, 50. McGill-Queen's University Press, Montreal, QC. 586 pp.

Minaskuat Inc. (Minaskuat). 2009. The Lower Churchill Hydroelectric Generation Project Environmental Baseline Report: Caribou (*Rangifer tarandus caribou).* Prepared for the Lower Churchill Hydroelectric Generation Project.

Rettie, W.J. and F. Messier. 1998. Dynamics of woodland caribou populations at the southern limit of their range in Saskatchewan. Canadian Journal of Zoology 76: 251-259.

Schmelzer, I., J. Brazil, T. Chubbs, S. French, B. Hearn, R. Jeffery, L. LeDrew, H. Martin, A. McNeill, R. Nuna, R. Otto, F. Phillips, G. Mitchell, G. Pittman, N. Simon, and G. Yetman. 2004. *Recovery strategy for three Woodland Caribou herds (Rangifer tarandus caribou; Boreal population) in Labrador*. Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook.

Stuart-Smith, A.K., C.J. Bradshaw, S. Boutin, D.M. Hebert and A.B. Rippin. 1997. Woodland caribou relative to landscape patterns in northeastern Alberta. Journal of Wildlife Management 61: 622-633.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Information Requested:

The Proponent is also asked to discuss the following:

o. **The broader implications of habitat disturbance, particularly predator-prey interactions, with respect to RWM caribou;**

Response:

The broader implications of habitat disturbance, particularly predator-prey interactions, are expected to result in conditions for the RWM Caribou Herd that are similar to those that currently exist. Although clearing activities associated with the Project will create some early succession habitats that may benefit moose, clearing along the lower Churchill River will remove critical winter range that will be detrimental to moose. Therefore, the expectation is that the Project itself will not result in an increase in moose densities, and will not result in any associated increase in predator (i.e., wolf) densities. Therefore, the Project will not result in additional predation pressure on caribou (EIS, Volume IIB, Section 5.14.2.2, p. 5-81).

Increases in the amount of herb and shrub cover due to reservoir and transmission line clearing may support increased densities of ungulates such as moose, which in turn can support higher densities of wolves (Wittmer et al. 2007). However, development of the transmission line right-of-way is not expected to substantially increase forage availability for moose. In addition, the loss of key riparian habitat along the lower Churchill River will be detrimental to moose. Therefore, moose populations along the transmission corridor are not likely to increase measurably, resulting in little or no increase in the local wolf population and subsequent predation on the RWM Caribou Herd (EIS, Section 5.11.2.5, p. 5-69).

References:

Vors, L.S., M.S. Boyce. 2009. Global declines of caribou and reindeer. Global Change Biology 15: 2626-2633.

Wittmer, H.U., B.N. McLellan, R. Serrouya and C. Apps. 2007. Changes in landscape composition influence the decline of a threatened woodland caribou population. Journal of Animal Ecology 76: 568-579.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Information Requested:

The Proponent is also asked to discuss the following:

p. **Whether and how the significance determination took into consideration effects of the Project on RWM caribou that may extend beyond the amount of Caribou Habitat within Disturbance Zones of Influence in the Forest Inventory Area (JRP.93, Table 6); and**

Response:

The determination of no significant effect of the Project on caribou from the RWM Caribou Herd during construction or operations and maintenance (EIS, Volume IIB, Section 5.14.1, p. 5-79) took into consideration effects of the Project on habitat, movement, and mortality of RWM caribou throughout their range (i.e., within and beyond disturbance zones of influence in the Forest Inventory (FI) area). The way in which Project effects were taken into consideration was summarized in Section 5.14.1 of Volume IIB of the EIS.

The determination of no significant effect of the Project on RWM caribou during construction or operations was arrived at by predicting that construction will result in increases in disturbed area of 4.9 percent, 4.4 percent, and 8.3 percent for calving, post-calving and winter seasonal ranges, respectively, relative to baseline conditions (EIS, Volume IIB, Section 5.14.2.1, p.5-80). Predation and hunting, rather than the availability of habitat, are the primary limitations on the RWM Caribou Herd (Bergerud et al. 2008; Schmelzer et al. 2004), so these small amounts of habitat disturbance are predicted to have no significant effect on the RWM Caribou Herd. Movement opportunities will be maintained during construction, and predation risk is not expected to increase.

During operation and maintenance, no further direct habitat loss or alteration is anticipated, and sensory disturbance will decrease (EIS, Volume IIB, Section 5.14.2.2, p. 5-81). Habitat availability will be similar to baseline conditions across the seasonal ranges. Movement across the transmission line rights-of-way will not be impeded, and movement across the lower Churchill River will be facilitated by developed shorelines, lower water velocities and more stable ice cover (EIS, Volume IIB, Section 5.14.2.2, p. 5-81).

There is likely to be only negligible changes in predation pressure to RWM caribou, if any. This is because the Project is not likely to increase moose population densities (EIS Section 5.11.2.5, p. 5-67). As a result, wolf density will also not likely increase, thereby resulting in no likely additional predation pressure on caribou (EIS, Volume IIB, Section 5.14.2.2, p. 5-81).

References:

Bergerud, C. S.N. Luttich and L. Camps. 2008. The Return of Caribou to Ungava. McGill-Queen's Native and Northern Series, 50. McGill-Queen's University Press, Montreal, QC. 586 pp.

Schmelzer, I., J. Brazil, T. Chubbs, S. French, B. Hearn, R. Jeffery, L. LeDrew, H. Martin, A. McNeill, R. Nuna, R. Otto, F. Phillips, G. Mitchell, G. Pittman, N. Simon, and G. Yetman. 2004. *Recovery strategy for three Woodland Caribou herds (Rangifer tarandus caribou; Boreal population) in Labrador*. Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.157**

Information Requested:

The Proponent is also asked to discuss the following:

q. Further rationale for the "not significant" Project effects determination for RWM Caribou in light of the information requested above.

Response:

The information provided throughout the entire response to IR# JRP.157 reinforces the assessed 'not significant' residual environmental effect on RWM caribou. Specifically:

- re-doing the LCP analysis using RSF output would not change the outcome. Indeed, the same conclusions as those found through the LCP analysis can be arrived at, and more succinctly, through use of the telemetry collar data alone, which was done to validate the analysis;
- although lichen cover percentages were used to help form stand types for habitat suitability modeling, model validation is the ultimate measure of predictive accuracy, and the validation demonstrates that the models are accurate and reliable;
- areas burned within the last 50 years were used in the habitat model, which is consistent with the ecology of woodland caribou, and aided in the production of reliable habitat suitability models;
- validation results demonstrate that the calving, post-calving and winter caribou RSF models were reliable in their ability to differentiate between habitat suitability classes;
- assessing Project effects on RWM caribou by assuming that all habitat affected by the Project beyond the FI data extent is primary habitat (although it is likely mostly tertiary habitat). However, regardless of the quality of habitat affected beyond the FI extent, the conclusion of no significant effect on the RWM Caribou Herd would be unchanged;
- based on model predictions within the FI area and known caribou ecology outside the FI area, the availability of primary habitat after inundation will be similar to existing conditions because inundation will affect little primary habitat within the RWM Caribou Herd range;
- the broader implications of habitat disturbance, particularly predator-prey interactions, are expected to result in conditions for RWM caribou that are similar to those that currently exist; and
- the determination of no significant effect of the Project on the RWM Caribou Herd took into consideration effects of the Project on habitat, movement, and mortality of RWM caribou throughout their range.

The Project was assessed as having no significant effect on the RWM Caribou Herd during construction or operations and maintenance (EIS, Volume II Part B, Section 5.14.1, Table 5-29, p. 5-79). Considering the above, the "not significant" Project effects determination for RWM caribou is appropriate.

IR# JRP.158

Rare Plants

Requesting Organization – Joint Review Panel **Information Request No.: JRP.158**

Subject - Rare Plants

References:

EIS Guidelines, Section 4.4.4.3 (Terrestrial Environment)

Related Comments / Information Requests:

CEAR # 307 (Government of Newfoundland and Labrador – Wildlife Division)

IR # JRP.42, 103

Rationale:

The EIS Guidelines (Section 4.4.4.3 (j)) state that the Proponent is to describe the composition, distribution and abundance of terrestrial flora, including forest inventories and ecological land classifications. However, the EIS Guidelines (Section 4.4.4.3 (p)) also specify that the Proponent is to describe species of special interest or conservation concern (including their habitat), with an emphasis on rare, vulnerable or threatened species (e.g., species listed in the *Endangered Species Act* or the *Species at Risk Act*). Although no legislatively listed rare species have been found, the Panel has noted the Government of Newfoundland and Labrador's Wildlife Division concerns that impoundment may potentially extirpate regionally rare species from Labrador. The EIS Guidelines direct the Proponent to place an emphasis on rare species listed under legislation, but does not indicate that other species of conservation concern can be excluded from the assessment.

The Government of Newfoundland and Labrador's Wildlife Division provided extensive commentary on this topic and the Proponent should also refer to CEAR # 307 for additional rationale.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.158**

Information Requested:

The Proponent is asked to:

a. **Establish a list of native rare plants that have been found within the flood zone, species that have a current "S1" ranking in Labrador, and species that are considered newly discovered for Labrador in the Proponent's research;**

Response:

An extensive search to identify vascular plants species considered rare or listed federally under the *Species at Risk Act (SARA)* or under the Newfoundland and Labrador *Endangered Species Act (NLESA)* was completed during the baseline field program in 2006 and 2007 (Minaskuat Inc. 2008). This search involved greater effort in areas of less common habitat and/or habitat associated with listed plants. None of the plant species listed under SARA or the NLESA were found in these the surveys.

Based on this baseline field program, and information on potentially rare plants in Labrador according to the Atlantic Canada Conservation Data Centre (ACCDC), a list of plants likely to be within the area of inundation was presented in Minaskuat Inc. (2008). Nalcor Energy (Nalcor) met with the Newfoundland and Labrador Department of Environment and Conservation in Corner Brook on 17 March 2010 to update the information in Minsakuat Inc. (2008) and discuss regulatory requirements. No rare plant species protected under law were identified within the area of inundation. However, and of interest to the Department of Environment and Conservation was the identification of 28 vascular plant species with limited observations in the known record. This list included species recorded as of 2007 that had fewer than 5 records (considered as S1 or newly discovered) or were located almost entirely within the proposed flood zone (Table 1).

Table 1 Vascular Plants of Interest in Labrador with Locations in the Proposed Area of Inundation as of 17 March 2010

Scientific Name	Common Name	ACCDC Status Rank for Labrador	Number of Observations outside Area of Inundation (Minaskuat Inc. 2008)	Number of Observations inside Area of Inundation (Minaskuat Inc. 2008)
Acer spicatum	Mountain maple	S1 (critically imperiled)	4	3
Botrychium lanceolatum	Triangle moonwort	S1 (critically imperiled)	0	1
Botrychium matricariifolium	Daisyleaf moonwort	S1 (critically imperiled)	0	1
Botrychium multifidum	Leathery grapefern	S1 (critically imperiled)	0	2
Carex buxbaumii	Buxbaum's sedge	S3 (vulnerable)	0	1
Carex crawfordii	Crawford's sedge	S1S2 (critically imperiled/imperiled)	1	7
Carex intumescens	Greater bladder sedge	S1S2 (critically imperiled/imperiled)	0	1

Scientific Name	Common Name	ACCDC Status Rank for Labrador	Number of Observations outside Area of Inundation (Minaskuat Inc. 2008)	Number of Observations inside Area of Inundation (Minaskuat Inc. 2008)
Dryopteris intermedia	Evergreen woodfern	New Record	0	1
Elymus trachycaulus	Bearded wheatgrass	SU (unrankable)	0	1
Equisetum palustre	Marsh horsetail	S1 (critically imperiled)	0	1
Glyceria Canadensis	Rattlesnake mannagrass	SU (unrankable)	0	1
Juncus alpinoarticulatus	Alpine rush	SNR (not ranked)	1	3
Malaxis unifolia	Green addersmouth	SU (unrankable)	1	1
Mentha arvensis	Wild mint	S3 (vulnerable)	1	11
Myriophyllum alterniflorum	Alternate-flowered watermilfoil	SNR (not ranked)	0	3
Onoclea sensibilis	Sensitive fern	S3 (vulnerable)	0	7
Osmunda cinnamomea	Cinnamon fern	New Record	0	1
Oxalis acetosella subsp. montana	Common woodsorrel	SU (unrankable)	2	4
Phalaris arundinacea	Reed canarygrass	New Record	1	1
Potamogeton oakesianus	Oake's pondweed	SH (possibly extinct)	0	1
Potamogeton richardsonii	Richardson's pondweed	SH (possibly extinct)	0	2
Ranunculus abortivus	Kidneyleaf crowfoot	S2 (imperiled)	1	6
Ranunculus lapponicus	Lapland Buttercup	S2S3 (imperiled/vulnerable)	0	4
Ranunculus pensylvanicus	Bristly crowfoot	S1 (critically imperiled)	1	3
Solidago Canadensis	Canada goldenrod	SNA (not applicable)	1	1
Streptopus lanceolatus	Rose twistedstalk	S1 (critically imperiled)	2	3
Taxus Canadensis	Canada yew	SR (reported but without persuasive documentation)	0	4
Veronica scutellata	Marsh speedwell	S2S3 (imperiled/vulnerable)	2	28

References:

Minaskuat Inc. 2008. Rare Plant Survey in the Lower Churchill River Valley. Prepared for the Lower Churchill Hydroelectric Generation Project.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.158**

Information Requested:

The Proponent is asked to:

b. Identify which of these species, when compared with the Wildlife Division's database and Atlantic Canada Conservation Data Centre rankings, are currently considered at extreme risk of extirpation, and identify their underlying ecotypes;

Response:

The list of 28 vascular plant species of interest presented in Table 1 was sent to the Atlantic Canada Conservation Data Centre (ACCDC) with a request for all records of these species from inside and outside the flood zone. The best resolution available for the data was plus or minus 5 km. As a conservative measure, any plant record within 5 km of the lower Churchill River was considered to be located within the inundation areas. The ACCDC and additional new records from the Department of Environment and Conservation were incorporated with the records collected during the 2006 and 2007 field surveys and the combined record of observations is presented in Table 2.

Table 2 Records of 28 Vascular Plants of Interest in the Proposed Area of Inundation as of April 2010

Scientific Name	Common Name	Number of Observations outside Area of Inundation (Minaskuat Inc. 2008)	Number of Observations Greater than 5 km from Lower Churchill River (ACCDC)	Number of Observations inside Area of Inundation (Minaskuat Inc. 2008)	Number of Observations Less than 5 km from Lower Churchill River (ACCDC)
Acer spicatum	Mountain maple	4	1	3	0
Botrychium lanceolatum	Triangle moonwort	0	2	1	0
Botrychium matricariifolium	Daisyleaf moonwort	0	2	1	1
Botrychium multifidum	Leathery grapefern	0	3	2	2
Carex buxbaumii	Buxbaum's sedge	0	6	1	1
Carex crawfordii	Crawford's sedge	1	4	7	0
Carex intumescens	Greater bladder sedge	0	0	1	1
Dryopteris intermedia	Evergreen woodfern	0	0	1	0
Elymus trachycaulus	Bearded wheatgrass	0	24	1	5
Equisetum palustre	Marsh horsetail	0	2	1	2
Glyceria canadensis	Rattlesnake mannagrass	0	3	1	1
Juncus alpinoarticulatus	Alpine rush	1	11	3	3

Scientific Name	Common Name	Number of Observations outside Area of Inundation (Minaskuat Inc. 2008)	Number of Observations Greater than 5 km from Lower Churchill River (ACCDC)	Number of Observations inside Area of Inundation (Minaskuat Inc. 2008)	Number of Observations Less than 5 km from Lower Churchill River (ACCDC)
Malaxis unifolia	Green addersmouth	1	1	1	2
Mentha arvensis	Wild mint	1	5	11	2
Myriophyllum alterniflorum	Alternate-flowered watermilfoil	0	2	3	0
Onoclea sensibilis	Sensitive fern	0	11	7	3
Osmunda cinnamomea	Cinnamon fern	0	0	1	0
Oxalis acetosella subsp. montana	Common woodsorrel	2	0	4	2
Phalaris arundinacea	Reed canarygrass	1	0	1	0
Potamogeton oakesianus	Oake's pondweed	0	2	1	1
Potamogeton richardsonii	Richardson's pondweed	0	1	2	1
Ranunculus abortivus	Kidneyleaf crowfoot	1	16	6	4
Ranunculus lapponicus	Lapland Buttercup	0	7	4	1
Ranunculus pensylvanicus	Bristly crowfoot	1	4	3	2
Solidago canadensis	Canada goldenrod	1	6	1	2
Streptopus lanceolatus	Rose twistedstalk	2	6	3	0
Taxus canadensis	Canada yew	0	0	4	0
Veronica scutellata	Marsh speedwell	2	10	28	3

The sensitivity of the Labrador occurrences of the plant species of interest to flooding from the Project was refined based on the new data provided by ACCDC and the Department of Environment and Conservation. The data in Table 2 was provided to experts on the flora of Labrador (i.e., Claudia Hanel and Susan Meades) to determine which species they believed were represented by a sufficient number of locations outside the proposed areas of inundation such that the overall occurrence of these plants in Labrador would not be compromised by the Project. Based on their assessment, the number of species of interest that may be potentially regionally (i.e., within Labrador) rare in the area of inundation was reduced from 28 to 13. These species include the following:

- Triangle Moonwort (*Botrychium lanceolatum*);
- Daisyleaf Moonwort (*Botrychium matricariifolium*);
- Leathery Grapefern (*Botrychium multifidum*);
- Greater Bladder Sedge (*Carex intumescens*);
- Evergreen Woodfern (*Dryopteris intermedia*);

- Marsh Horsetail (*Equisetum palustre*);
- Rattlesnake Mannagrass (*Glyceria canadensis*);
- Cinnamon Fern (*Osmunda cinnamomea*);
- Common Woodsorrel (*Oxalis acetosella* subsp. *montana*);
- Reed Canarygrass (*Phalaris arundinacea*);
- Oake's Pondweed (*Potamogeton oakesianus*);
- Richardson's Pondweed (*Potamogeton richardsonii*); and
- Canada Yew (*Taxus canadensis*).

These species are considered common in southern Canada and are reaching their northern extent in central Labrador. The remaining species from the list of 28 vascular plants of interest (Tables 1 and 2) were deemed sufficiently abundant beyond the area of inundation such that they would not be compromised by the Project.

The ecotypes (preferred habitat) associated with this subset of plants of interest are presented in Table 3. This information will be used to identify areas where directed surveys can confirm their presence outside of the proposed inundation areas – and further refine the overall list. As a follow-up mitigation measure, if required, the ecotype information will also be used to identify areas where these species can be transplanted to, and will help to identify habitat modifications required to increase the likelihood that these transplantations are successful.

Table 3 Plants of Interest within the Area of Inundation and Associated Habitat

Scientific Name	Common Name	Preferred Habitat (Ecotype)
Botrychium lanceolatum	Triangle Moonwort	Gravel bar
Botrychium matricariifolium	Daisyleaf Moonwort	Gravel bar
Botrychium multifidum	Leathery Grapefern	Gravel bar, Black spruce – feather moss forest
Carex intumescens	Greater Bladder Sedge	Balsam fir/*Hylocomium* forest
Dryopteris intermedia	Evergreen Woodfern	Riparian shrub thicket
Equisetum palustre	Marsh Horsetail	Riparian streamwater/floodplain swamp, Riparian stream marsh, Riparian floating fen, riparian floodplain water/floodplain swamp, Basin marsh, Northern plateau bog
Glyceria canadensis	Rattlesnake Mannagrass	Riparian stream marsh, Riparian channel swamp, Riparian floodplain water/riparian flood plain swamp, Basin marsh, Lacustrine shore marsh, Riparian floating fen
Osmunda cinnamomea	Cinnamon Fern	Transition zone between riparian shrub thicket and black spruce – feathermoss forest
Oxalis acetosella subsp. *montana*	Common Woodsorrel	Spruce/fir - feathermoss forest, Black spruce – feathermoss forest, Riparian thicket
Phalaris arundinacea	Reed Canarygrass	Gravel bar
Potamogeton oakesianus	Oake's Pondweed	Riparian marsh, String fen
Potamogeton richardsonii	Richardson's Pondweed	Riparian floodplain marsh
Taxus canadensis	Canada Yew	Fir/white spruce woodland, Mixedwood, Riparian thicket

References:

Minaskuat Inc. 2008. Rare Plant Survey in the Lower Churchill River Valley. Prepared for the Lower Churchill Hydroelectric Generation Project.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.158**

Information Requested:

The Proponent is asked to:

c. **Provide details as to any additional surveys the Proponent plans to undertake to determine whether the identified native "extreme rare" plants are found in other river systems in Labrador (details should include, but not be limited to, timelines and identification of specific river systems to be surveyed and how these results will be incorporated into the analysis of predicted environmental effects);**

Response:

Additional surveys will be conducted in central Labrador during the summer of 2010 to identify additional locations of the plant species identified in Table 3. As discussed in Minaskuat Inc. (2008), none of these species are listed federally or provincially and their lack of reported observation may be influenced by the relative lack of botanical surveys in this region. Further, these species are considered common in southern Canada and are reaching their northern extent in central Labrador. The main goal of this program will be to find additional populations of the 13 plant species in the vicinity of the Project to gain a better understanding of the distribution of these species outside of the flood zone.

The ecotype preferences of these 13 plant species will be used to guide the selection of suitable areas for these confirmation surveys. A review of the ecotype preferences for these 13 species (Table 3) indicated that large rivers with extensive gravel bars and riparian habitats containing sheltered closed canopy stands of spruce and fir, flood plain pools, wetlands and shrub thickets would be candidate areas to search. Locations would be discussed with the Department of Environment and Conservation but, at the time of writing, suggested locations include Goose River, Traverspine River, and Petit Mecatina River. Also, areas with relatively sheltered ecotypes, such as in the Upper Lake Melville area (e.g., Mud Lake, vicinity of 5 Wing Goose Bay) also provide warmer growing conditions than the surrounding area and are known to support a number of plant species at the northern end of their range. Recent surveys conducted in the vicinity of Happy Valley-Goose Bay for example have yielded some records of four of the 13 species including triangle moonwort (*Botrychium lanceolatum)*, leathery grapefern (*Botrychium multifidum)*, marsh horsetail (*Equisetum palustre)*, and Oake's pondweed (*Potamogeton oakesianus)*. As less than five locations of these plants in Labrador are known (Table 2), they still remain on the list identified in Table 3.

Following completion of the 2010 confirmation surveys, the population status of the 13 plant species will be re-evaluated in consultation with the Department of Environment and Conservation by September 30, 2010. If a particular species is encountered at five locations outside of the area of inundation, it will be removed from this list. Information relative to the number of new locations, the size of these locations, their distribution in relation to each other, and the stability of the habitat in which they are found will be recorded.

References:

Minaskuat Inc. 2008. Rare Plant Survey in the Lower Churchill River Valley. Prepared for the Lower Churchill Hydroelectric Generation Project.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.158**

Information Requested:

The Proponent is asked to:

d. **Provide an analysis of the predicted environmental effects of the Project on plant species identified as "extreme rare", indicating the rationale for such predictions, where data gaps exist, how they affect the certainty of predicted environmental effects, and how the precautionary principle was applied in making predictions.**

Response:

Vascular plant surveys conducted in 2006 and 2007 as part of the Environmental Assessment did not reveal the presence of rare plant species protected under either the *Species at Risk Act (SARA)* or the *Newfoundland and Labrador Endangered Species Act (NLESA)*. A number of plant species of interest were, however, recorded within the flood zone. Based on a review of the most recent collection of plant records in Labrador (as part of the response to this Information Request) this number has been refined to 13 within the proposed area of inundation for the Project. These species are common in southern Canada and reach the northern limit of their range in central Labrador. The concern relates to the objective of maintaining regional biodiversity, a policy of the Newfoundland and Labrador Department of Environment and Conservation.

The confirmation surveys scheduled for the summer of 2010 will help to determine which of these 13 species, if any, are considered to be regionally rare. The surveys will also describe the availability of suitable habitats associated with this residual list for the purposes of mitigation. Mitigation will consist of the relocation of those plants considered to be regionally rare plants from the flood zone to suitable habitat outside of the flood zone. The establishment of populations of these species outside of the flood zone will prevent the loss of these species from Labrador so the effect of flooding is not expected to be significant.

Nalcor has endeavoured to enhance certainty regarding the flora of Labrador through completing reference vegetation surveys on the Goose River (Minaskuat Inc. 2008) and secondly through a plan to conduct additional surveys in 2010 (IR# JRP.158c) in the vicinity of the Project and along other similar river systems in Labrador.

The precautionary principle was applied in several ways:

- The number of species considered in the assessment of the effects of the Project on vascular plants has been increased to include species of interest as well as species listed under the *Newfoundland and Labrador Endangered Species Act* and the Federal *Species at Risk Act*;
- In developing the list of species of interest, species whose status in Labrador was uncertain (status SU, SR and SNR) were considered. In addition, species with ACCDC ranks of S2 and S2S3 were included in the analysis if their Labrador population was focused primarily along the lower Churchill River;
- Plant surveys were conducted on the Goose River system in order to better understand the population status of species that had previously only been recorded in the flood zone of the lower Churchill River;
- New records of plant species of interest in Labrador provided by the Wildlife Division were reviewed to determine if plant species found in the flood zone had been recorded elsewhere in Labrador; and.

- Surveys for plant species of interest as per Table 3 will be conducted at various locations outside of the flood zone in 2010.

These actions have contributed to or will contribute to a higher level of certainty regarding the interaction of the Project and plant species and increasing confidence in likely effects predictions.

References:

Minaskuat Inc. 2008. Rare Plant Survey in the Lower Churchill River Valley. Prepared for the Lower Churchill Hydroelectric Generation Project.

IR# JRP.159

Fluvial Geomorphology (Large-Scale Mass Movements)

Requesting Organization – Joint Review Panel **Information Request No.: JRP.159**

Subject - Fluvial Geomorphology (Large-Scale Mass Movements)

References:

EIS Guidelines, Section 4.4.4.3 (Description of the Existing Environment – Terrestrial Environment)

Related Comments / Information Requests:

CEAR # 281 (Natural Resources Canada)

IR # JRP.55

Rationale:

The EIS Guidelines (Section 4.4.4.3) require the Proponent to describe "[a]reas of potential reservoir shoreline erosion and potential ground instability such as slumping or landslides." (p.27)

The Panel noted Natural Resources Canada's (NRCan) concern that the issue of large-scale mass movement along the proposed Muskrat Falls reservoir is not adequately addressed in the EIS or in the response to JRP.55. For further rationale, the Proponent is directed to NRCan's submission (CEAR #281) which provides a context for the issue of large-scale mass movements and presents geomorphic evidence of the scale of the mass movement problem.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.159**

Information Requested:

The Proponent is asked to discuss the following:

a. **The impact of earth slide–earth flows of 0.5, 5 and 50 Mm^3 on aquatic habitat within the Muskrat Falls reservoir;**

Response:

Earth slide- earth flows have occurred throughout the lower Churchill River in the past and will continue to occur in the future. The net effect from earth slide-earth flows, regardless of size, on aquatic habitat within the Muskrat Falls reservoir is predicted to be not significant. In fact, the existing aquatic habitat is already a function of earth slide-earth flows that have happened historically.

Earth slide-earth flows can be important natural disturbance agents and occur typically in areas of finer material that are subject to erosional forces and disturbance. Material within an earth slide-earth flow typically becomes mobilized and migrates out into the river at rates up to several metres per second (see responses b, d and e below). Earth slide-earth flows occur throughout the lower Churchill River and are considered natural processes. Based on a geomorphology study (Jacques Whitford 1998) and a review of LiDAR imagery collected as part of this Project, approximately 15 to 50 earth slide-earth flows have occurred on the lower Churchill River within the last 3000 years. The most recent event was in March of 2010, when an earth slide-earth flow occurred with an estimated volume of 3.5 Mm^3.

Naturally-occurring earth slides contribute to aquatic biodiversity through the supply of gravel and boulder materials, and woody debris that help to create the variety of habitat types within aquatic ecosystems (Geertsema et al 2009). Earth slides also modify the aquatic environment and may negatively affect aquatic habitat through several interactions including:

- water quality degradation due to increased suspended solids;
- deposition of fine grain material on areas of spawning habitat;
- riparian zone disturbances and changes to riparian cover (increased solar radiation and stream temperatures); and
- creation of physical barriers to fish migration.

The effects of an earth slide-earth flow on the riparian zone within the Muskrat Falls reservoir are predicted to be negligible regardless of the occurrence of a 0.5, 5, or 50 Mm^3 earth slide considering each of the above influences on fish habitat:

1. <u>Water Quality and Deposition of Fine Grained Material:</u> During the formation and operation of the Muskrat Falls reservoir, earth slide-earth flows may affect water quality due to an increase in suspended material. The effects on water quality are predicted to be short term and localized. While localized areas of spawning may be temporarily disturbed by the addition of finer grain materials, new habitat will be created through the potential deposition of gravels and boulders and the redistribution of substrate within the reservoir.
2. <u>Stream Temperatures:</u> Riparian zones can be important features supporting fish habitat by providing overhanging vegetation that provides protection for fish, and helps to regulate stream

temperatures. However, the existing riparian zone in the areas of the lower Churchill River where earth slide-earth flows occur are subject to erosion, and do not generally contribute to the support of fish habitat. In the lower Churchill River, and hence the Muskrat Falls reservoir, the riparian zones in areas where earth slide-earth flows occur are exposed and are areas of sediment input into the river (see Figure 1). Given the nature of the exposed riparian zone, earth slide-earth flows, regardless of their size, are not predicted to have a measurable effect on water temperatures.

3. Physical Barriers to Fish Migration: Massive earth slide-earth flows in certain rivers and streams, including those experienced on the Churchill River historically, have the potential to alter fish migration and movement. Given the physical characteristics of the lower Churchill River including the wide river channel and water depths, a 0.5, 5 or 50 Mm^3 earth slide-earth flow are not predicted to have a measurable effect to fish movement. The recent earth slide-earth flow, estimated to be 3.5 Mm^3 in volume, that occurred on the lower Churchill (Figures 1 and 2), outlines the movement of material into the river and the nature of the river channel after the slide.

While earth slide-earth flows may cause short term, localized changes to water quality and may affect localized areas of aquatic habitat, their potential net effect to the lower Churchill River may be important natural events that contribute to overall aquatic biodiversity.

Figure 1 River Location km 72-73 Showing Former Aquatic Habitat (pre-February 2010)

Figure 2 River Location km 72-73 after Recent Slide (February 2010)

References:

Geertsema, M., L. Highland, and L. Vaugeouis. 2009. Environmental Impact of Landslides. In K. Sassa (eds.). Landslides - Disaster Risk Reduction. Springer-Verlag Berlin Heidelberg.

Jacques Whitford. 1998. Sea Level and Geomorphology of the Churchill River and Strait of Belle Isle (LHP 98-23). Jacques Whitford Environmental Limited report prepared for Newfoundland and Labrador Hydro, St. John's, NL.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.159**

Information Requested:

The Proponent is asked to discuss the following:

b. The potential heights of landslide-generated waves that can be generated by rapid to very rapid, earth slide-earth flows of magnitude 0.5, 5 and 50 Mm^3;

Response:

The potential heights for landslide-generated waves that can be generated by rapid to very rapid earth slide-earth flows of magnitude 0.5, and 5 Mm^3 could be up to 2.5 m and 3.7 m respectively. To determine the potential height of a landslide generated wave as a result of a 50 Mm^3 landslide, a review was conducted to identify a site within the Muskrat Falls reservoir that had a suitable volume of material. A site was identified approximately 3 km upstream of the proposed Muskrat Falls generating facility. Using the post impoundment water depths in this area, a 50 Mm^3 earth slide-earth flow was predicted to result in a solitary type wave with a maximum amplitude calculated to be 4.5 m. This is a theoretical calculation based on an instantaneous transfer of the entire volume of the landslide into the river and is considered an unlikely and improbable event.

A literature review was undertaken to determine various methods that have been developed to estimate the maximum wave amplitudes of earth slide-earth flow generated waves. Two journal publications presented empirical equations which have been used to derive estimates of landslide generated waves (Fritz et al. 2004 and Zweifel et al. 2006). Both models were developed in laboratory settings.

Fritz et al (2004) developed an empirical model to determine the maximum wave crest amplitude from landslide generated waves using the following equation;

$$ac = (1/4) \times F^{1.4} \times S^{0.8} \times h$$

Where;

F is the Impact Froude number;
S is the Relative Slide Thickness; and,
H is the Stillwater depth.

This equation was then modified by Zwiefel et al. (2006), as shown below, to incorporate the mass of the failed material (M). This model was subsequently used in generating the predicted wave amplitudes, stated above.

$$AM = (1/3) \times F \times S^{0.5} \times M^{0.25} \times h;$$

These models assumed that the maximum wave amplitude created was due to an instantaneous momentum transfer from the slide to the water body during wave generation. Landslides are dynamic in nature and may occur over a matter of seconds to days. Therefore, the model results presented here are theoretical and are useful for assessing order of magnitude rather than precise values of potential wave heights. These results presented herein, represent values and are considered unlikely to occur due to the improbability of an instantaneous transfer of momentum occurring which is inherent in the theoretical models used for this information request.

The equations used to develop the model were based on fixed variables that remained constant within the laboratory setting. Many of these variables had to be slightly modified to apply them to this information

request. For example, channel width was based on the fixed width of the flume tank used in the laboratory. In our application of the equation this parameter has been conservatively estimated as the linear length of shoreline through which the mass fails, rather than the width of the surface rupture or the width of the displaced mass. Another example is water depth, where in the laboratory setup water depth was held constant as one moved outside of the influence of the ramp. To apply this variable to the requested scenario, where water depth can be quite variable, the maximum water depth at a known location within the proposed reservoir was chosen (based on HEC-RAS transect model results) to run the model. Another example of how the variables were applied includes slide thickness, as it is difficult to estimate the maximum thickness of a slide that has not yet failed, a conservatively slide thickness was selected as the height of the presumed failure scarp above the Muskrat Fall reservoir full supply level (39 m asl). Finally, the maximum velocity at which a complex landslide could fail was estimated at approximately 3.0 m/s; this value is in line with the upper end of the scale for a very rapidly failing landslide as given by Cruden and Varnes (1996).

References:

Cruden, D.M. and Varnes, D.J. 1996. Landslide types and processes. In Landslide Investigation and Mitigation, Turner, A.K. and Schuster, R.L. (eds.), Special Report 247: Transportation Research Board, National Research Council, National Academy Press: Washington, p. 36-75.

Fritz H. M., Hager W. H., Minor H. -E. 2004. Near Field Characteristics of Landslide Generated Impulse Waves. Journal of Waterway, Port, Coastal and Ocean Engineering, ASCE, November/December 2004.

Zweifel A., Hager W.H., Minor H. -E. 2009. Plane Impulse Waves in Reservoir. Journal of Waterway, Port, Coastal and Ocean Engineering, ASCE, September/October 2006.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.159**

Information Requested:

The Proponent is asked to discuss the following:

c. **The potential impact of these landslide-generated waves on the Muskrat Falls dam structure;**

Response:

As noted in Section 10.5.1.1 of the EIS, slope stability and the effects of landslides are an important consideration when accounting for the effect of the environment on the Project. As part of Nalcor Energy's on-going commitment to safety, a Dam Safety Review that follows the Canadian Dam Association (CDA) Guidelines (CDA, 2007) will also be conducted during the detailed design phase. The Dam Safety Review is a systematic review of all aspects of design, construction, operation, maintenance, processes, and other systems affecting a dam's safety, including–hazards internal and external to the dam and those outside the control of the dam owner. Meteorological events such as intense rainstorms and resulting landslides are specifically noted in the CDA guidelines. Furthermore, although the dam at Muskrat Falls is currently in the conceptual design phase, during the detailed design phase, reservoir wave modeling (including wave attenuation and considering the locations where waves are likely to be generated based on the findings of additional field work) will be completed and, if necessary, any loading created by a landslide-generated wave will be included as a design load for the dam.

The design for the facility will include criteria to account for wave energy transfer from such waves. Therefore, the facility will be constructed to handle this potential phenomenon.

References:

Canadian Dam Association. 2007. Dam Safety Guidelines 2007.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.159**

Information Requested:

The Proponent is asked to discuss the following:

d. How the creation and operation (i.e., water level fluctuations) of the Muskrat Falls reservoir affect the stability of the glaciomarine deposits and the potential occurrence of large-scale earth slide–earth flows; and

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Response:

The creation of the Muskrat Falls reservoir will lead to the inundation of certain glaciomarine deposits within the shoreline slopes along the impoundment causing instability, which may increase the potential occurrence of large scale earth-slide-earth flows. The effect of operating (±0.5 m water fluctuation) the Muskrat Falls reservoir on the stability of the glaciomarine deposits with respect to the potential occurrence of large-scale earth slide-earth flows is predicted to be minimal and not significant.

During creation of the reservoir, the stability of the slopes may decrease due to an increase in the positive pore water pressures within the submerged material, as well as a loss of apparent cohesion within the submerged material (due to a loss of negative pore water pressure – matric suction). In addition, fluvial undercutting along the new shoreline (due to wave action, ice scour, and river flow) is predicted to have an unfavorable effect on the stability of the surrounding slopes.

Once a stable shore line is established within the reservoir, the relatively small water level fluctuations associated with reservoir operation are predicted to have a minimal effect on the stability of glaciomarine deposits. This is because changes in the confining pressure, as well as the pore water pressure regime within such a narrow range (± 0.5 m from full supply level) of affected slope is unlikely to influence the glaciomarine deposits in other parts of the slope.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.159**

Information Requested:

The Proponent is asked to discuss the following:

e. **The geotechnical properties and conditions within the glaciomarine deposits of the lower Churchill River Valley that makes them susceptible to large-scale earth slide–earth flows.**

Response:

The geotechnical properties of glaciomarine deposits of the lower Churchill River Valley that make them susceptible to large-scale earth slide-earth flows include:

- fine grained nature;
- high moisture content;
- low angle of internal friction;
- open structure; and
- high sensitivity.

Within the glaciomarine deposits of the lower Churchill River Valley the scars of approximately 15 to 50 past earth slide-earth flows which have occurred in the last 3000 years have been noted in the field, on aerial photographs, and on LiDAR imagery. In general, glaciomarine sediments of the lower Churchill River Valley are fine grained deposits of clay, silty clay, silt, silty sand, and fine sand (Jacques Whitford 1998). Along the Churchill River, exposures of fine grained marine sediments are reported from opposite Muskrat Island (north bank) to Gull Island Rapids on both shorelines.

The conditions that make the glaciomarine deposits of the lower Churchill River Valley susceptible to large-scale earth slide-earth flows include:

- disturbance;
  - freeze/thaw cycles
  - changes in pore pressure
  - consolidation
- vibration;
  - construction
  - blasting
  - seismic events
- fluvial undercutting; and
- fluctuations in groundwater level.

Within the proposed Muskrat Falls reservoir two main types of slope failure are actively occurring within the glaciomarine deposits: earth slides and complex earth slides - earth flows. Sliding takes the form of both translational (slope parallel) and rotational (slumping) movement. Both are commonly, and naturally, initiated by a combination of fluvial undercutting (erosion from river flow, and ice and/or wave action), and slope saturation/de-saturation (seasonal fluctuations in groundwater levels or excessive infiltration due to heavy rains and/or snow melt). The fine grained nature of the marine soils can encourage these types of failures due to the low permeability often associated with these deposits.

A number of sites which show evidence of large earth slide – earth flow activity are to be investigated during the upcoming field season (2010) to gather more data on the geotechnical properties of the glaciomarine deposits for use in detailed engineering design.

References:

Jacques Whitford. 1998. Sea Level and Geomorphology of the Churchill River and Strait of Belle Isle (LHP 98-23). Jacques Whitford Environmental Limited report prepared for Newfoundland and Labrador Hydro, St. John's, NL.

IR# JRP.160

Groundwater in Mud Lake Area

Requesting Organization – Joint Review Panel **Information Request No.: JRP.160**

Subject - Groundwater in Mud Lake Area

References:

EIS Guidelines, Section 4.4.4.2 (Description of the Existing Environment – Aquatic Environment), Section 4.4.4.3 (Description of the Existing Environment – Terrestrial Environment) and Section 4.5 (Environmental Effects)

Related Comments / Information Requests:

CEAR # 164 (Unidentified)
CEAR # 174 (V. Kerby)
CEAR # 184 (Sierra Club Atlantic)
CEAR # 203 (Hydro-Québec)
CEAR # 205 (Government of Newfoundland and Labrador – Water Resources Management Division)

IR # JRP.63

Rationale:

The Proponent has not provided information with respect to potential impacts to groundwater in the Mud Lake area.

The EIS Guidelines require that the Proponent describe "[w]ater quality and quantity from both surface and groundwater sources, including any saltwater intrusion up the Churchill River or into aquifers" (p.26) and "[g]roundwater movement and aquifer recharge zones." (p.27)

The Proponent acknowledged, in its response to JRP.63 (m) and (r), that "the 3D model did not make any reference to groundwater in the zone of salt water intrusion, specifically in reference to the area of Mud Lake. In response to this concern, AMEC will be conducting a study in the fall of 2009 and generating a 3-D numerical groundwater model and a detailed technical report for the area of Mud Lake."

Requesting Organization – Joint Review Panel **Information Request No.: JRP.160**

Information Requested:

The Proponent is asked to provide the results of the AMEC groundwater study conducted in the Fall of 2009, including the 3-D numerical groundwater model and a detailed technical report for the area of Mud Lake. The Proponent should discuss any predicted impacts to the water quality and water quantity on the Mud Lake area and present mitigation as appropriate.

Response:

The Lower Churchill Project Baseline Water Quality and Salt Water Intrusion Study, Mud Lake, Newfoundland and Labrador (AMEC 2010), hereafter referred to as the Study (Appendix D).

The 1980 Environmental Impact Statement for the project (LCDC, 1980) identified the Churchill River below Muskrat Falls as potentially susceptible to salt water intrusion from Goose Bay during the temporary reduction in river flows that would occur during the process of reservoir impoundment. To estimate the extent of any salt water intrusion (defined as the section where salinity increases by approximately 2 parts per thousand) that could occur, a three-dimensional numerical model of the Churchill River and Goose Bay estuary was set up and run by Hatch (Hatch 2008a), using DHI MIKE 3, a hydraulic modeling package that simulates flows in rivers, lakes, estuaries, bays and seas. The model results indicate a potential for temporary salt water intrusion up the Churchill River, to a point approximately 2 km upriver of the confluence of the Channel from Mud Lake at its maximum extent during impoundment of the Gull Island Reservoir. A possible implication of this temporary salt water intrusion is an impact (i.e., reduced water quality) to groundwater used by the residents of Mud Lake. It should be noted that the model (Hatch 2008b) was run with the assumption that there was no compensation flow release. However, Nalcor Energy has since decided to begin compensation release at the initiation of impoundment, which is expected to further limit the extent of the modeled salt water intrusion into the Churchill River during reservoir impoundment. Reservoir impoundment is a one-time event for each facility and is of relatively short duration (see Table 3 within IR# JRP.28b).

The main objective of the Study (AMEC 2010) was to determine the potential for salt water from Goose Bay to enter the shallow groundwater aquifer that is used by the residents of Mud Lake as a drinking water source during the process of reservoir impoundment. Specific components of the Study included:

- Conduct a water quality survey to assess the baseline conditions of the drinking water at each accessible home in Mud Lake.
- Install and survey monitoring wells at various locations within the Community of Mud Lake to gauge water table elevations.
- Install pressure transducers in the monitoring wells to determine any change of groundwater levels resulting from tidal impacts.
- Create a groundwater flow map to illustrate groundwater elevations, surface water elevations and groundwater flow direction.

Baseline water quality was collected for numerous residences throughout the community of Mud Lake and is presented in the report.

In October 2009, AMEC installed six shallow monitoring wells at various locations within Mud Lake. The newly installed monitoring wells were surveyed to a relative elevation to confirm the groundwater flow direction and

the recharge conditions of the shallow aquifer underlying the community of Mud Lake. In addition, several surface water features surrounding the community, including the Churchill River, were surveyed to determine relative elevations. Pressure transducers were installed in the monitoring wells for a period of 43 hours to determine any change of groundwater levels resulting from tidal impacts. Based on survey results, a groundwater flow map illustrating groundwater elevations, surface water elevations and groundwater flow direction was created.

The findings of the Study demonstrate that even under high tide conditions, the aquifer that is supplying groundwater to the residents of Mud Lake is being recharged from precipitation falling on the higher ground to the south of Mud Lake, on the central areas of the Island, and on the peninsula between the Channel and the Churchill River. From these recharge areas; groundwater is consistently flowing towards either the Churchill River or the Channel. At no time during the monitoring period was there groundwater flow from either the Channel or the Churchill River inland towards the resident's wells. Therefore, salinity conditions of the Churchill River as described by Hatch (2008b) during the impoundment of the reservoir, will not affect the groundwater quality of the shallow wells located in Mud Lake under normal conditions.

Note: In IR# JRP.63m, the proposed scope of the AMEC detailed technical report for the area of Mud Lake included generating a 3D numerical groundwater model. However, based on review of topographic maps for the study area, and confirmed through observations made by AMEC during the site reconnaissance visit in August, 2009, it was concluded that the drinking water source for Mud Lake community residents is from shallow land based groundwater wells and nearby surface water (i.e., the Channel). Typically, groundwater flows from areas of topographic highs to areas of topographic lows. Therefore, the aquifer that is supplying groundwater to the residents of Mud Lake is being recharged from precipitation and surface water flowing from the upland areas, and discharging into the Channel and the Churchill River, creating a groundwater divide. This groundwater divide disconnects any potential interaction between the river and the drinking water sources – therefore, a 3-D numerical groundwater model was deemed redundant/unnecessary. Instead – groundwater flow maps presenting field measurements were produced and interpreted for the purposes of assessing potential salt water intrusion to impact drinking water supply in Mud Lake.

References:

AMEC. 2010. Lower Churchill Project Baseline Water Quality and Salt Water Intrusion Study, Mud Lake, Newfoundland and Labrador. Prepared for Nalcor Energy, Hydro Place, 500 Columbus Drive, St. John's, NL. 17pp + 11 appendices.

Hatch. 2008a. Salt Water Intrusion 3D Model Study. Prepared for Newfoundland and Labrador Hydro Lower Churchill Project. October 2008.

Hatch. 2008b. Salt Water Intusion 3D Model Study Addendum No. 1. Prepared for Newfoundland and Labrador Hydro Lower Churchill Project. January 2009.

IR# JRP.161

Economy, Employment and Business

Requesting Organization – Joint Review Panel **Information Request No.: JRP.161**

Subject - Economy, Employment and Business

References:

EIS Guidelines, Section 4.3.4 (Project Description – Construction), Section 4.4.4.7 (Description of the Existing Environment – Economy, Employment and Business) and Section 4.5.1 (Environmental Effects)

Related Comments / Information Requests:

CEAR # 282 (Labrador Metis Nation)
CEAR # 284 (Nunatsiavut Government)
CEAR # 285 (Hydro-Québec)
CEAR # 287 (Grand Riverkeeper Labrador Inc.)
CEAR # 289 (Innu Nation)

IR # JRP.5, 12, 29, 39, 106, 131, 132, 133, 140

Rationale:

The Proponent has provided incomplete information in its description of the existing environment and the effects of the Project on the socio-economic environment.

Section 4.3.4 of the EIS Guidelines requires the EIS to show the construction and commissioning schedules for Project elements, based on the most current information available. Subsection 4.3.4 (f) (ii) also requires a description of the anticipated working schedule for Project construction activities. As well, section 4.5.1 notes that "[t]he following should be taken into account when assessing effects of the Project on the socio-economic environment: (…) (c) social and cultural patterns (particular attention shall be given to the comparative adverse and beneficial effects of a major base of employment away from the communities, rotational work schedules, and the presence of large, temporary work forces and contractors in the region)." (p. 33-34) Section 4.4.4.7 requires the Proponent to "describe relevant economy, employment and business elements in the study areas of the VECs, including the following: (…) (d) expenditures in Upper Lake Melville, Labrador and the Province." (p. 30)

In response to JRP.39 (a), the Proponent indicates that information on work schedules is not available at this time and is subject to contract negotiations. Some indication of the Proponent's preferred work schedule (s) is required to meet the Guidelines.

In response to JRP.11, the Proponent indicates that the number of direct person-years of employment has increased by about 70% over the 2006 estimate but that labour costs have increased by only 48%. As the Innu Nation pointed out, an increase in labour costs should not greatly affect the increase in person-years of employment unless the project description has changed and this does not appear to be the case.

The Proponent's response to JRP.5 (a) suggests that the costs of all aspects of the Project were used (and must therefore be available) in the development of the Project's cost estimate. As well, the response to JRP.131 (a) contains detailed information on inputs to the economic model employed by Strategic Concepts Inc. in the application of its model to the Project. However, the response to JRP132 (a) indicates that "the level of detail available on the quantity and value of specific goods and services required for the project is not known at this time." This appears to be a contradiction which should be clarified.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.161**

Information Requested:

The Proponent is asked to:

a. **Identify and describe the anticipated or preferred work schedule/rotation during construction and reservoir clearing and provide a table showing the relative advantages and disadvantages of different schedules;**

Response:

There will be a variety of shift schedules depending on the type of work being carried out and the labour agreements which will be in place; however, Nalcor Energy's (Nalcor) current primary work schedule, used as the basis for estimating project cost and schedule for the Lower Churchill Hydroelectric Generation Project (Project) is a 20 days on, 8 days off schedule. This work schedule is the primary work rotation schedule used by companies who operate in Alberta's oil sands and is familiar to Newfoundland and Labrador-based workers. A summary of the advantages and disadvantages from a socio-economic perspective of the various work schedules identified in IR# JRP.39 is presented in Table 1.

Table 1 Range of Potential Work Rotation Schedules – Advantages and Disadvantages

Schedule	Avg Work Hrs/yr*	Avg Return Trips/yr	Advantages	Disadvantages
20 days on; 8 days off	2,607	~13	- Typical work schedule for Newfoundland and Labrador workers employed on large-scale construction projects in Alberta - Familiarity with schedule may make it more acceptable to workers	- Increased number of worker trips and therefore higher air traffic volumes compared to longer rotations - Increase in air traffic at the Goose Bay Airport - Higher overall project travel cost
4 weeks on; 2 weeks off	2,433	~9	- Provides employment opportunities for more individual workers compared to 20/8 schedule - Longer breaks between work rotations provides workers with more flexibility for family activities (e.g., vacations)	- Decreased number of worker trips and therefore less air traffic at approximately 9 return trips per worker per year - May require more individual workers - Lower overall project travel cost
6 weeks on; 2 weeks off	2,346	~7	- Least amount of worker trips and therefore least amount of air traffic volume.	- Longer work cycles may reduce productivity at tail ends of rotations - Longer work cycles may have potential to increase family and social problems - Scheduled days off required for longer work rotations - Lowest overall project travel cost

Schedule	Avg Work Hrs/yr*	Avg Return Trips/yr	Advantages	Disadvantages
14 days on; 7 days off	2,433	~17	- Potential for higher productivity with short turnaround times - Provides employment opportunities for more individual workers -- May be more acceptable for some workers due to shorter turnarounds	- Requires more workers - Most number of worker trips and therefore highest level of air traffic volume at approximately 17 return trips per worker per year - Highest overall project travel cost

Note:
* Average work hours per year based on working 10-hour days for 7 days/week while on rotation and 6 10-hour days per week for the 6 and 2 rotation schedule.

As previously indicated, Nalcor is of the view that the preferred work rotation is a matter for negotiation during contract negotiations, and also considers that parties undertaking collective bargaining are best able to mitigate any concerns by workers regarding work rotation. This would also be the case with agreements with Aboriginal Groups concerning the Project (e.g., accommodation for cultural leave within the IBA with the Labrador Innu).

References

Construction Sector Council, "Working Mobile: A Study of Labour Mobility in Canada's Industrial Construction Sector", 2005.

Athabasca Regional Issues Working Group, "Report on Mobile Workers in the Wood Buffalo Region of Alberta", December 2007.

Shrimpton, Mark and Keith Storey, "The Effects of Offshore Employment in the Petroleum Industry: a Cross-National Perspective", September 2001.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.161**

Information Requested:

The Proponent is asked to:

b. Clarify the large increase in person-years of employment as a result of increased Project costs and, if that information is accurate, assess its significance on the socio-economic effects of the Project

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Response:

Clarification of Increase in Person-Years of Employment

The large increase in estimated person years of employment required for the Lower Churchill Hydroelectric Generation Project (Project) is due primarily to:

- An advanced understanding of how much the project will cost; and
- Where the money will be spent.

In the first instance, the capital cost has increased – which results in increased employment. In the second instance, the proportion of total costs attributed to labour has increased. Nalcor now has a better idea where the money will be spent – and a greater proportion will be spent on labour and smaller proportion on materials and equipment. Both instances have combined to drive up the estimate of person years of employment.

We believe the Innu Nation, in their letter to the Joint Review Panel (CEAR # 289), misinterpreted the increase in labour costs as an increase in labour rate – which is not the case. The fact is, Nalcor now understands, through advanced cost estimates, that a greater portion of the overall capital costs is needed for labour. Therefore, in the employment forecast update – this equates to a direct increase in positions to be filled for the Project.

<u>Background</u>

Employment estimates presented in the economic impact analysis section of the Environmental impact Statement (EIS) were based on preliminary information on Project components and how the Project would be constructed. These EIS employment estimates were based on studies completed in 1999/2000, which were the best available information at the time when the analysis of the economic impacts was conducted.

More recent engineering and technical studies contributed to the current description of the project, as registered and as assessed in the EIS. The original employment estimates provided in the EIS were not updated based on the refined project scope on which the EIS was based until the Response to IR# JRP.11 was developed. The estimates presented in that Response are more accurate for the following general reasons:

- The more current engineering and technical studies introduced changes to the layout and configuration of Gull Island in particular, which increased the estimated cost of the Gull Island facility;
- These studies also provided the information required to quantify the previously un-quantified components, breaking each down into labour, materials and equipment requirements.

An outcome of the more detailed analysis indicated an increase in labour requirements for the Project.

In addition to the above, natural evolution of the Project capital costs estimates have provided better insight on where the actual costs will accrue relative to labour, equipment and materials. More detail on this is outlined in Attachment A. While components of the EIS capital cost estimate were prepared using a bottom-up approach, the split between labour, equipment, and materials were not determined for all aspects of the Project. This approach is typical of screening or feasibility level estimates.

In the intervening time between submission of the EIS and the submission of Nalcor's responses to various IRs, including IR# JRP.5 and IR# JRP.11, a bottom-up capital cost estimate based upon the results of the engineering and technical studies completed during Phase 2 of the Gateway Process was completed (additional information on the capital cost estimate and how it progresses is provided later in this response).

Summary of the Change – EIS estimates to Current

A summary of the differences in the employment impacts that were presented in the EIS and those that were presented in IR# JRP.11 are summarized in Table 2 and Table 3.

Table 2 Employment Impacts Comparison (EIS vs. IR# JRP.11) (person years)

	Gull Island	Muskrat Falls	Total
EIS			
Direct Project employment	5,939	3,239	9,178
Direct NL employment	3,869	2,100	5,969
Indirect NL employment	1,989	1,480	3,468
Induced NL employment	3,671	2,107	5,778
Total NL employment	**9,529**	**5,687**	**15,215**
Revised (IR# JRP.11)			
Direct Project employment	11,063	4,469	15,532
Direct NL employment	7,231	2,922	10,154
Indirect NL employment	2,806	1,628	4,434
Induced NL employment	5,144	2,578	7,722
Total NL employment	**15,181**	**7,128**	**22,310**
% Changes			
Direct Project employment	86%	38%	69%
Direct NL employment	87%	39%	70%
Indirect NL employment	41%	10%	28%
Induced NL employment	40%	22%	34%
Total NL employment	**59%**	**25%**	**47%**

Table 3 Sources of Increased Direct Labour Requirement (person years)

Project Component	GI	MF	Total
Civil Works	1,529	695	2,224
Electrical and Mechanical Works	757	189	946
Construction Facilities and Support	703	83	786
Transmission	125	(1)	124
Project Management and Engineering	2,060	290	2,350
Sustaining Capital	(50)	(25)	(75)
Total Construction Direct Employment	**5,124**	**1,231**	**6,355**

As Table 3 indicates, the main sources of the increase in the labour requirement for the Project are civil works, and project management and engineering, which together account for over 70 percent of the increase. The civil works employment increase is primarily the result of the change in location of the diversion tunnels and approach channel as well as a change in dam design. The increase in project management and engineering is the result of a re-allocation of the project management and engineering between Gull Island and Muskrat Falls as well as an overall increase in the project management and engineering function. The increase in electrical and mechanical works construction employment is a result of the design change in the power house. The original EIS analysis was based on the previous configuration of four turbines while the revised analysis reflected the revised Project description of five turbines. Finally, the increase in construction facilities and support employment is a result of an increase in the camp size and other support facilities, which are consistent with the facilities described in the EIS. A contingency was also added which contributed to the increased capital costs, and a portion of that contingency was applied against labour estimates required to construct the Project.

The Gull Island employment estimates had the largest increase, however, the Muskrat Falls employment estimates also increased. The Muskrat Falls project component employment estimate has increased due to the overall capital cost increase and the inclusion of contingency in the estimate.

In summary, the increase in employment can be attributed to the refined project definition and the resultant higher capital cost estimate ($6.5 billion versus $4.8 billion). As indicated in IR# JRP.5, the capital cost estimate submitted as part of IR# JRP.11 incorporates the results of applicable engineering / technical and site investigation feasibility studies completed during Phase 2 of Nalcor's Gateway Process, and is commensurate with the level of project definition. This capital cost estimate presented represents the latest information available to Nalcor at the time of preparing the response and was not available when the original economic impact analysis was completed for the EIS.

Significance on Socio-Economic Effects

The increase in the expected amount of employment resulting from the Project is a positive change for the regional and provincial economies as it will result in more employment opportunities for both residents of Labrador and the island portion of Newfoundland and Labrador and will result in increased tax revenues for the Government of Newfoundland and Labrador and the Government of Canada. The effect of increased employment is a positive change in employment levels and rates and a positive change in taxation levels. The potential socio-economic effects resulting from the increased employment are manageable given the mitigation measures identified in the EIS, including the fact that the majority of workers will be housed in the construction camp, with minimal negative consequences for the communities in Upper Lake Melville. Based on this expected increase in employment, the size of the camp has been increased in the basis of design to a maximum capacity of 2,500 from an original design of 2,000.

References

Association for the Advancement of Cost Engineering International, "AACE International Recommended Practice No. 17R-97 – Cost Estimate Classification System", 1997.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.161**

Information Requested:

The Proponent is asked to:

c. **Explain the apparent contradiction in the responses to JRP.131 (a) and JRP.132 (a), where information referenced in JRP.132 (a) is stated to be not available but was apparently used in the economic model discussed in JRP.131 (a).**

Response:

There is no contradiction between its responses to IR# JRP.131a and IR# JRP.132a.

Paragraph 2 in the response to IR# JRP.131a explains the Strategic Concepts Inc. (SCI) model for measuring economic impacts of large resource projects on the economy of Newfoundland and Labrador states:

> *"The model used to measure economic impacts, the Strategic Concepts Inc. (SCI) model, was developed specifically for Newfoundland and Labrador-based resource projects and has been applied to the majority of large resource projects proposed or occurring within the province. The economic model is based on the principal of tracking expenditures through the economy and applying coefficients to determine direct, indirect and induced impacts on employment, incomes, gross domestic product, and taxation. The economic impact parameters used in the analysis were gathered from a number of sources including Statistics Canada, Canada Revenue Agency, various provincial government departments and agencies, and from economic impact assessments on other projects in Newfoundland and Labrador. Many of these assessments were based on actual development and operating expenditures where vendor identification was used to develop estimates for local supply capabilities and value added assumptions. As an example, SCI has conducted economic impact analyses on the Iron Ore Company of Canada's actual 2003 and 2005 operations. As part of the analysis SCI was provided with actual employment data, financial statements and a breakdown of expenditures by vendor profile. This information was used to calibrate SCI's economic model. Later a comparison of results generated between real and expected expenditures was made in an effort to calibrate and validate SCI's economic impact model."*

The reference to "actual employment data, financial statements, and a breakdown of expenditures" is with respect to Iron Ore Company of Canada's actual 2003 and 2005 operations – the subject of the preceding sentence and is presented as a broad statement reflecting the SCI model and methodology.

Paragraph 3 in the response to IR# JRP.131a indicates that the input to the Project model was the "construction year expenditure profile and a single year's operating costs." This represents aggregate level parameters for major Project components, and was the best level of data available at this stage of Project planning. Furthermore, the items listed in IR# JRP.132 are types of goods and services required whereas the aggregate estimates used in the SCI model were based on aggregates for project components (e.g., civil works, electrical and mechanical). For example IR# JRP.132 identifies items such as cranes, instrumentation and fireproofing, which are used across project components. Therefore, direct comparison of the aggregate data used in the SCI model to the individual goods and services listed in IR# JRP.132 is not appropriate.

To summarize, aggregate information for the Project is input into the model, which is calibrated with results from other projects, and predictions are then made for direct, indirect, and induced effects on a regional, provincial, and national basis. No contradiction in the responses exists.

ATTACHMENT A

INFORMATION RESPONSES
LOWER CHURCHILL PROJECT

JOINT REVIEW PANEL

Economy, Employment and Business

IR161

May 2010

Capital Cost Estimate Evolution

This section of the response is intended to provide background information on the evolution of capital cost estimates for large projects.

During the lifecycle of all projects, such as the Project, it is typical for the capital cost estimate to evolve as the project definition matures, as illustrated in Figure 1. The greater the amount of information on the project, the more effort and longer time is required to produce the resultant more detailed and accurate capital cost estimate. This process results in a natural lag between the completion of technical studies and the updating of the capital cost estimate.

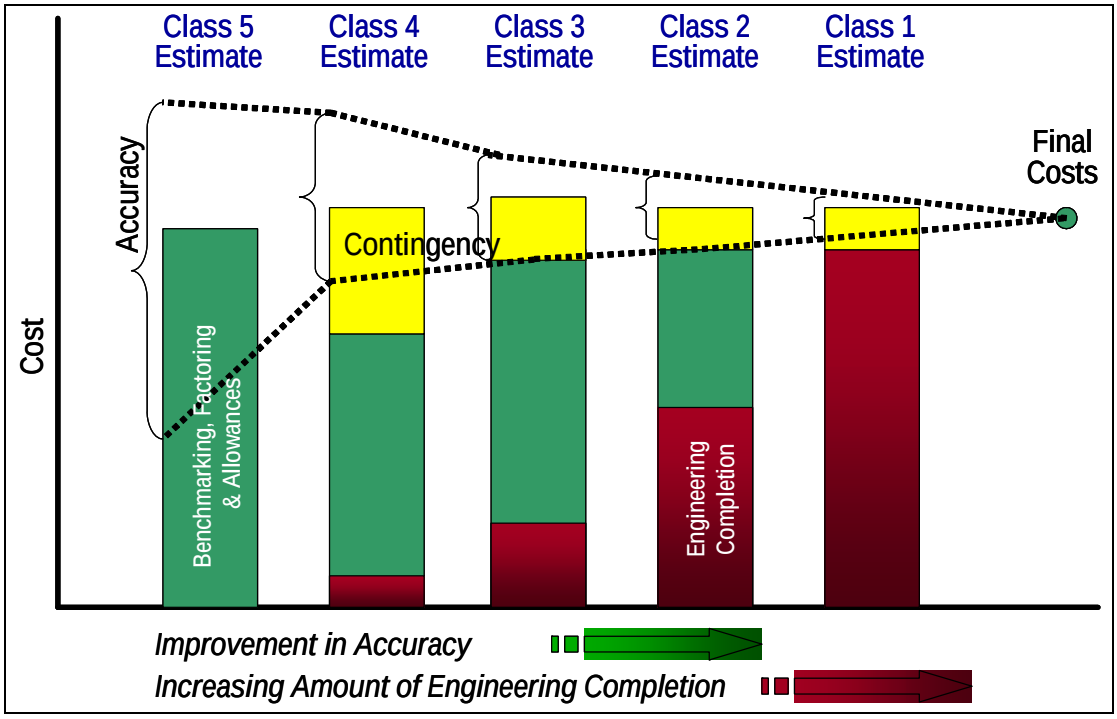

Figure 1 Cost Estimate Maturity Model (Nalcor)

The completion of the feasibility studies during Phase 2, which forms the basis of the project definition contained in the Environment Impact Statement, introduced a significant amount of physical layout and configuration changes in the Gull Island facility. These layout and configuration changes provided the input required to allow the updating and refinement of the Gull Island portion of the capital cost estimate in critical areas. Similarly the results of various risk studies by Nalcor has resulted in the inclusion of a contingency provision within the capital cost estimate to account for management of project risks and uncertainties. The net result of these changes is increase in the total Project capital cost estimate from $4.8 billion to $6.5 billion. The resultant increase in employment can be attributed to both the higher capital cost estimate and a more matured estimate for the Gull Island portion of the Project. This is explained below.

As discussed in IR# JRP.5, Nalcor has adopted the estimating best practices of the Association for Advancement to Cost Engineering International (AACEI) (1997) for use in planning the development of the Project. AACEI is recognized within the engineering, procurement and construction industry as the leading authority on cost estimating standards, practices and methods. AACEI's Cost Estimate Classification System, shown in Figure 2, provides guidelines for applying the general principles of estimate classification to project cost estimates.

Nalcor has based their approach on AACEI's Cost Estimate Classification System to map the level of estimate maturity required for each of the gate decisions within the Nalcor's Gateway Process.

	Primary Characteristic	*Secondary Characteristic*			
ESTIMATE CLASS	**LEVEL OF PROJECT DEFINITION** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical +/- range relative to best index of 1 [a]	**PREPARATION EFFORT** Typical degree of effort relative to least cost index of 1 [b]
Class 5	0% to 2%	Screening or Feasibility	Stochastic or Judgment	4 to 20	1
Class 4	1% to 15%	Concept Study or Feasibility	Primarily Stochastic	3 to 12	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Mixed, but Primarily Stochastic	2 to 6	3 to 10
Class 2	30% to 70%	Control or Bid/ Tender	Primarily Deterministic	1 to 3	5 to 20
Class 1	50% to 100%	Check Estimate or Bid/Tender	Deterministic	1	10 to 100

Notes: [a] If the range index value of "1" represents +10/-5%, then an index value of 10 represents +100/-50%.
[b] If the cost index value of "1" represents 0.005% of project costs, then an index value of 100 represents 0.5%.

Figure 2 AACEI Cost Estimating Classification System (1997)

The capital cost estimate used for the original economic impact analysis in the Environment Impact Statement was based on technical and feasibility-level studies completed in 1998/99, which were adjusted to reflect comparable construction cost for 2007. Using the AACEI's Cost Estimate Classification System (AACEI 1997), this cost estimate was considered a Screening or Feasibility level estimate and characterized as a Class 5 estimate. This estimate met the needs of decision Gate 1 of Nalcor's Gateway Process.

IR# JRP.162

Dam Break

Requesting Organization – Joint Review Panel **Information Request No.: JRP.162**

Subject - Dam Break

References:

EIS Guidelines, Section 4.5.2 (Accidents and Malfunctions)

Related Comments / Information Requests:

CEAR # 289 (Innu Nation)

IR # JRP.96, 145

Rationale:

Section 4.5.2 of the EIS Guidelines requires that "[t]he Proponent will identify and describe the potential accidents and malfunctions related to the Project (…) potential consequences (including the potential environmental effects), the worst case scenarios and the effects of these scenarios" (p. 34).

Requesting Organization – Joint Review Panel **Information Request No.: JRP.162**

Information Requested:

The Proponent is asked to provide the following:

a. **A copy of the Upper Churchill dam failure study, when it becomes available, and updated dam break model with inundation mapping for cascading dam failure scenarios involving the Upper Churchill, Gull Island and Muskrat Falls;**

Response:

A cascading dam failure scenario involving the Upper Churchill, Gull Island and Muskrat Falls is highly unlikely, considering the level of quality control involved in current day design, construction, operation and maintenance that will be carried out for the dams and associated structures for the lower Churchill Hydroelectric Generation Project (Project) and is currently carried out for the Upper Churchill.

Nalcor Energy – Churchill Falls (NE - CF) and Nalcor Energy – Lower Churchill Project (NE – LCP) operate as separate affiliates of Nalcor Energy (Nalcor) and, as such, are completing separate dam break models. However, the NE - LCP Team has been consulting with NE- CF throughout their completion of a dam break study. A draft report has been provided to NE-LCP for review and consideration in the detailed design phase. The dam break study includes cascading dam failure scenarios involving the Upper Churchill, Gull Island and Muskrat Falls and associated inundation mapping and, as such, an update of the Lower Churchill Dam Break study is not required. It is anticipated that the final report for the dam break analysis will be completed in fall 2010. Once this report is finalized it will be provided to the Panel.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.162**

Information Requested:

The Proponent is asked to provide the following:

b. An outline of integrated emergency planning for these scenarios;

Response:

In the event of a dam failure at Upper Churchill, released water could enter the Churchill River and result in a cascade failure of the Gull Island dam, the Muskrat Falls dam, or both. While such an event is highly unlikely given the level of quality control involved in current day design, construction, operation and maintenance typically carried out on dams and associated structures, cascade failure dam safety and emergency preparedness will be major considerations in the Project.

Integrated emergency planning for a cascade failure scenario will be developed using guidance from the Canadian Dam Association's (CDA) Dam Safety Guidelines (CDA 2007) Section 4 (Figure 1).

Figure 1 Section 4, Dam Safety Guidelines CDA 2007

4. EMERGENCY PREPAREDNESS....39
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Nalcor Energy – Churchill Falls (NE - CF) and Nalcor Energy – Lower Churchill Project (NE – LCP) operate as separate affiliates of Nalcor Energy and, as per the Dam Safety Guidelines (CDA 2007), the downstream dam owner (i.e., NE-LCP) will be included as a downstream stakeholder in the Emergency Response Plans (ERPs) for the upstream dams (i.e., NE-CF). Accordingly, NE – CF will include NE – LCP (Gull Island and Muskrat Falls generating stations), as well as other downstream stakeholders such as the community of Happy Valley – Goose Bay, in its ERPs for the Churchill Fall's dams. Likewise, the ERP for the Gull Island dam will include consideration of the Muskrat Falls generating station as a downstream stakeholder.

NE - CF and NE - LCP will each establish a formal ERP for each dam under their jurisdiction at Upper Churchill, Gull Island and Muskrat Falls, documenting the procedures that operations staff will follow in the event of a potential emergency at a dam. Each ERP will be held and regularly updated by the respective affiliate of Nalcor. Each ERP will outline prioritized key emergency response roles and responsibilities and required notifications and contact information. Each ERP will include procedures for timely and reliable identification, evaluation and classification of existing or potential emergencies. Depending on the type of emergency (including cascade failure), each ERP will clearly indicate the criteria or trigger points for notifications and include a notification flow chart. The ERP will include inundation maps for areas covered by the plan. The inundation maps will indicate

flood stages, flood and flood peak arrival times, and areas that will be inundated. Staff will be trained in the application of the ERP.

NE - CF and NE - LCP will also each prepare and maintain an Emergency Preparedness Plan (EPP) for use by external agencies. These external agencies will be determined through a public consultation process which is standard in developing a dam break EPP. The EPPs will describe the hazards, the associated notifications to be issued, and in general terms the actions expected of other responders. In the event of a cascade failure initiated at Churchill Falls, as per the CDA guidelines (CDA 2007), NE - CF will notify the Gull Island and Muskrat Falls generating stations, as well as the appropriate municipalities and other responders as outlined in the EPP. The exact format of this notification will be determined during the development of the EPP.

The EPPs will provide the basic information that allows for (i) planning by all downstream stakeholders, including NE – LCP (in the event of a dam failure at Churchill Falls), the municipalities, Royal Canadian Mounted Police, emergency measures organization(s), provincial agencies, telephone and transportation companies, and other parties that would be affected by a major flood; and (ii) coordination of efforts by federal, provincial, and municipal levels of government.

Development of the EPPs will include communication between the Upper Churchill, Lower Churchill and operations staff and other agencies and effected parties. NE – CF and NE - LCP will be responsible for development of the EPPs, which, for each, generally involves the following steps:

1. Identify those situations or events that would require initiation of an emergency action, and specify the action to be taken and by whom.
2. Identify all jurisdictions, agencies, and individuals who will be involved in responding to an emergency, and draft a notification flowchart that shows who should be notified, in what order, and in general terms what other actions are expected of downstream agencies.
3. Develop a draft of the EPP.
4. Hold coordination meeting(s) with all parties on the notification list so that they can review and comment on the draft EPP.
5. Carry out an appropriate exercise based on the draft EPP and then revise the EPP on the basis of the lessons learned. The dam owner will also review the internal ERP to incorporate any relevant lessons learned.
6. Make final revisions to the EPP.
7. Obtain necessary regulatory approval and then finalize and distribute the EPP.

The EPPs will be issued to those key response agencies affected, and all registered copies will be updated on an annual basis.

A sample of an existing Nalcor integrated emergency planning document (ERP/EPP) (Appendix E).

References

Canadian Dam Association. 2007. Dam Safety Guidelines 2007.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.162**

Information Requested:

The Proponent is asked to provide the following:

c. A dam breach analysis for construction phase cofferdams; and

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Response:

A dam breach analysis for the cofferdams was completed by Hatch (Hatch 2010) (Appendix F). A breach of the cofferdams during the construction phase is highly unlikely, considering the level of quality control for the design and construction that will be carried out. The cofferdam design crest elevations will be confirmed by flood and ice studies to ensure that overtopping during construction phase remains improbable. It should be noted that the dam breach analysis has been completed based on the conceptual design for the coffer dams. As per normal regulatory procedures, a dam breach analysis will be completed based on the detailed design and submitted to the Department of Environment and Conservation, Water Resources Division, for approval prior to the start of construction.

References

Hatch. 2010. Lower Churchill Project – Supplemental Dam Break Analysis.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.162**

Information Requested:

The Proponent is asked to provide the following:

d. Estimates of economic losses from dam failure (i.e. not just residential dwellings).

Response:

An estimate of economic losses from dam failure is summarized in Table 1 and is based on the analysis included in the appended Hatch (2010) report. The economic loss was based on dam break scenarios associated only with the Project and does not include economic loss resulting from a cascade failure scenario involving the Upper Churchill. The economic loss due to dam failure included the loss of roads, transmission lines, residential homes and Blackrock Bridge (Hatch 2010).

Table 1 Summary of Total Incremental Economic Damage Estimates

Flow Scenario	Dam Failure Scenario	Damage Estimate
"Fair Weather" Conditions[1]	Post Gull Island, Failure of Gull Island Main Dam	$142,000,000
	Post Gull Island and Muskrat Falls, Failure of Gull Island Main Dam	$141,000,000
	Post Gull Island and Muskrat Falls, Failure of Muskrat Falls North Roller Compacted Concrete (RCC) Dam	$124,000,000
	Post Gull Island and Muskrat Falls, Failure of Gull Island Main Dam and Muskrat Falls North RCC Dam	$164,000,000
Probable Maximum Flood	Post Gull Island, Failure of Gull Island Main Dam	$54,000,000
	Post Gull Island and Muskrat Falls, Failure of Gull Island Main Dam	$54,000,000
	Post Gull Island and Muskrat Falls, Failure of Muskrat Falls North RCC Dam	$53,000,000
	Post Gull Island and Muskrat Falls, Failure of Gull Island Main Dam and Muskrat Falls North RCC Dam	$87,000,000

Note:
[1] The "Fair Weather" dam breach scenario assumes that the dam fails during a normal operating condition. Inflows from the Upper Churchill project and local tributaries were held constant in this case.

References

Hatch. 2010. Lower Churchill Project – Supplemental Dam Break Analysis.

IR# JRP.163

Cumulative Effects

Requesting Organization – Joint Review Panel **Information Request No.: JRP.163**

Subject - Cumulative Effects

References:

EIS Guidelines, Section 4.5.3 (Cumulative Effects)

EIS, Volume IIB, Section 5.7.1.2 (Disruption of Movement) and Section 5.15 (Cumulative Environmental Effects)

Canadian Environmental Assessment Agency. *Cumulative Effects Assessment Practitioners' Guide*. 1999. Available online at: http://www.ceaa-acee.gc.ca/default.asp?lang=En&n=43952694-1&toc=hide.

Canadian Environmental Assessment Agency. *Addressing Cumulative Environment Effects under the Canadian Environmental Assessment*. Operational Policy Statement. 2007. Available online at: http://www.ceaa-acee.gc.ca/default.asp?lang=En&n= 1F77F3C2-1

Related Comments / Information Requests:

CEAR # 277 (Fisheries and Oceans Canada)
CEAR # 287 (Grand Riverkeeper Labrador Inc.)
CEAR # 289 (Innu Nation)
CEAR # 290 (Innus of Ekuanitshit)

IR # 24S, 44, 97, 97S, 122

Rationale:

With respect to cumulative effects, the EIS Guidelines require the following from the Proponent:

> The Proponent shall identify and assess the Project's cumulative environmental effects. Cumulative effects are defined as changes to the environment due to the Project where those overlap, combine or interact with the environmental effects of other existing, past or reasonably foreseeable projects or activities. (…)
>
> The Proponent shall (…) (c) Describe and justify the choice of projects and selected activities for the cumulative effects assessment. These shall include past activities and projects, those being carried out and future projects or activities likely to be carried out; (p. 35)

In its response to JRP.97 (a), the Proponent states that baseline studies included as part of the EIS "provide a comprehensive picture of the existing environment in the CEA Area that has been, in part, influenced by the construction and operation of all past and present projects".

According to the Cumulative Effects Assessment (CEA) Practitioner's Guide (CEAA, 1999), past actions often become, in practice, part of the existing baseline conditions. However, it is important "to ensure that the effects of these actions are recognised". The approach taken by the Proponent does not provide a sufficient understanding of how past projects, activities and events (including but not limited to the Churchill Falls project) have shaped current environmental conditions within the Assessment area

With respect to previous hydroelectric generation projects on the Churchill River, the Proponent lists, in response to JRP.44 (c), the specific environmental effects of the Churchill Falls project that are known to overlap with the lower Churchill River area. However, there is limited discussion in the Proponent's response of the environmental conditions that existed in the Assessment area before any hydroelectric development projects

occurred. In the absence of specific monitoring programs, Innu Nation suggests that the Proponent make use of a variety of other sources of information, such as maps, research observations, Traditional Knowledge and hydrological records (references provided by Innu Nation, CEAR # 289, p. 60-63).

With respect to the choice of projects and activities selected for inclusion in the CEA, reviewers suggested that additional projects or activities should be considered by the Proponent in the CEA:

- Mining of mineral sands (e.g. Grand River Ironsands project);
- Remediation of contamination at the Department of National Defence's facilities in Happy Valley-Goose Bay;
- Construction of additional transmission lines in Labrador in relation to the export of power from the Project (including for transmission access through Quebec);
- Aluminum smelter;
- Uranium mining; and
- Ongoing dumping of raw sewage in the Churchill River.

While the emphasis should be placed on those projects with the greatest certainty of occurring, the Canadian Environmental Assessment Agency's Operational Policy Statement on addressing cumulative effects (2007) mentions that hypothetical projects (i.e. those for which there is considerable uncertainty whether they will ever proceed) may be discussed, at least on a conceptual basis, because they may contribute to future environmental planning.

With respect to the Proponent's CEA for the Terrestrial Environment, the EIS considers three potential effects resulting from the Project on the KIs (i.e. change in habitat, change in health and mortality) (Volume IIB, Section 5.15). Whereas the disruption of movement is not one of the three potential effects considered, it is unclear as to how this was taken into account specifically within the CEA for caribou, as well as for other migratory species. For example, the response to JRP.97 discusses the CEA area for the Red Wine Mountain and George River caribou herds, stating that "due to the threatened status of caribou and its nature as a species that is likely to have a large portion of its population in one geographic area at one time, the Red Wine Mountain (RWM) Caribou Herd's recent range defines the CEA area for caribou. The CEA examines the George River Herd in this CEA area, given the similar habitat relationships when individuals from this herd overwinter there". However, this CEA area does not appear to include migration routes of these herds. In addition, the EIS states that "disturbance resulting in habitat loss may also force Caribou to travel alternate routes" (Volume IIB, Section 5.7.1.2) and suggests that this issue is relevant for the George River herd, but no cumulative effects assessment of disruption of movement is provided. While the Proponent provides a justification for the exclusion of the Lac Joseph caribou herd from the environmental assessment in its response to JRP.122, as noted by the Innus of Ekuanitshit, the Proponent does not appear to have assessed the potential for cumulative impacts on the Lac Joseph Caribou herd or provided a justification as to why this is not necessary, particularly with respect to migration patterns.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.163**

Information Requested:

The Proponent is asked to:

a. **describe how past projects, activities and events have affected current ecological and socio-economic conditions. In particular, the Proponent is asked to discuss the environmental conditions that prevailed in the Assessment area prior to hydroelectric developments on the Churchill River.**

Response:

In accordance with standard environmental assessment practice, the Lower Churchill Hydroelectric Generation Project's (Project) environmental effects were assessed using the existing environment as the baseline (pre-Project conditions), which captured the environmental and socio-economic effects of previous developments and activities. In particular, features of the biophysical environment (e.g., fish mercury levels, and affected aquatic and terrestrial habitat), as well as the human environment, have been described and included in Chapter 2 of Volumes IIA and III of the Environmental Impact Statement (EIS) as representing baseline conditions for environmental effects assessment (including a consideration of cumulative environmental effects) within the Assessment Areas as defined in the EIS. Therefore, a review of environmental effects from past developments does not add to the baseline condition descriptions presented in the EIS, nor does it result in a need to re-evaluate any of the environmental effects predictions made in the EIS.

The Churchill River is a regulated river, and the effects of this regime on the lower section of the Churchill River have been monitored and are understood. Please refer to parts (b) and (c) in the response to IR# JRP.44 for a detailed description.

The following discussion on how past projects, activities and events have affected current ecological and socio-economic conditions incorporates information pertaining to the lower Churchill River from Lutterman (2007), and other relevant sources (Gillespie and Wetmore 1973; Goudie and Whitman 1987) as were referenced by Innu Nation.

Effect of past hydroelectric developments on current ecological and socio-economic conditions in the Assessment Areas

The three previous hydroelectric developments in the Churchill River watershed are: Menihek Generating Station on Menihek Lake in western Labrador; Twin Falls on the Unknown River; and the Churchill Falls Power Station on the Churchill River. The known effects of the Churchill Falls Power Station on the lower section of the Churchill River were described in Table 4 of IR# JRP.44 for hydrology, fish habitat, fish, avifauna, economy, employment, communities, land and resource use, and climate/air quality. Effects to ice processes, flow regime, water velocity, salt water intrusion, water temperature, bank erosion, fish habitat, fish mortality, fish predatory behavior, methylmercury levels and consumption advisories, annual net revenues from electricity sales, employment, and physical infrastructure have been described in the response to IR# JRP.44. With respect to the other two hydroelectric developments, the response to IR# JRP.44 indicated there is no evidence to suggest that any effect would be perceptible in the lower Churchill River. The following information has been summarized from the response to IR# JRP.44.

The operation of the Menihek Generating Station would be expected to alter the downstream hydrology such that the natural discharge regime has been moderated and some thermal changes would also be likely. Given

the location of the generating station high in the watershed, and up-gradient of the Smallwood Reservoir, it is highly unlikely that any effect from the Menihek Generating Station would be perceptible in the lower Churchill River.

Similar to the Menihek Generating Station, there are no sources to document any environmental effects of the Twin Falls Generating Station on the lower Churchill River. With the closing of the station in 1974 and the permanent opening of the spillway gates, some flow was restored to the Unknown River. Likewise, there is no evidence to suggest that any effect would be perceptible in the lower Churchill River.

The Churchill Falls Power Station has affected the existing aquatic habitat within the lower Churchill River by regulating seasonal flows. The Churchill Falls Power Station regulates the drainage from over 75 percent of the total watershed area, and consequently, this has reduced the natural flow variability of the Churchill River. The current flow through the Churchill Falls powerhouse ranges between approximately 500 and 2000 m^3/s, with an average of about 1400 m^3/s. All water is discharged back into the Churchill River once passed through the turbines. As a result, compared to natural conditions, flows in the Churchill River are now higher in winter and lower in late spring and summer. As an illustration of downstream flow effects, the highest average monthly flows at Muskrat Falls have decreased (in June) and the lowest average monthly flows (in April) have increased, compared to flows before the Churchill Falls Power Station became operational. This has resulted in a less variable flow regime over the course of the year, both seasonally and monthly. Based on water velocity and water level measurements, made at a series of transects across the lower Churchill River, the existing range in water level fluctuations is estimated at 2.5 m.

This change in flow regime in the lower Churchill River has affected aspects of the aquatic environment within the main stem, including water velocity, and ice processes. The operating regime of the Churchill Falls Power Station has reduced the peak high flows associated with the spring freshet, while adding to the typical low-flow period through mid-winter. Fish populations therefore, experience a lower range of velocities and a more consistent area of habitat as compared to conditions that existed prior to development of the Churchill Falls Power Station.

The portion of the lower Churchill River downstream of the Churchill Falls Power Station tailrace to Winokapau Lake now remains ice-free long into the winter months. Prior to the existing development, an ice cover would form on Winokapau Lake, initiating the progression of the ice cover upstream towards (and perhaps past) the present tailrace location. With the Churchill Falls dam in place, the progression of ice cover development is slower, likely delayed due to the thermal retention of the Smallwood Reservoir. In addition, as the water flows through the power station itself, it is warmed slightly, which also contributes to the maintenance of a small open water area at the tailrace.

The downstream effects of the Churchill Falls Power Station are mostly related to the change in flows and the movement of mercury from the upstream reservoirs to the lower Churchill River. Fish mercury data are available for three locations within the lower Churchill River watershed: Gull Lake; Winokapau Lake; and the estuary. Mercury levels at these sites were influenced by the existing upstream Smallwood Reservoir. Overall, these data suggest that flooding associated with the Smallwood Reservoir, now more than 35 years old, will not contribute measurably to fish mercury levels in the lower Churchill River. Lake whitefish mercury concentrations in Winokapau Lake, downstream from the Smallwood Reservoir, were up to 1.18 µg/g, approximately nine times background regional levels, six years after flooding. A similar trend was observed for lake whitefish downstream from the Robert Bourassa Reservoir in Quebec; Schetagne et al. (2003) concluded that fish passage through turbines stunned or killed fish, allowing downstream whitefish to become piscivorous. This change to piscivory resulted in increased mercury levels in lake whitefish. While Winokapau Lake is 65 km downstream from the

Churchill Falls Power Station, whitefish migration from Winokapau Lake to the Churchill Falls tailrace was demonstrated by radio telemetry studies in 1998 and 1999. These unusual increases in mercury levels in lake whitefish were not observed in Gull Lake (200 km downstream from Churchill Falls), nor for fish that were previously piscivorous in Winokapau Lake, such as northern pike (Nalcor Energy 2009a).

Methylmercury concentrations in Winokapau and Gull Lake of lower trophic level fish species (lake whitefish, brook trout, ouananiche, longnose sucker, white sucker) and higher trophic level species (northern pike, lake trout) have declined over time and are approaching background levels (Nalcor 2009b). Smallwood Reservoir is, therefore, no longer causing increases in fish mercury concentrations.

The diversion of the Churchill River through the Churchill Falls Power Station influenced the environmental parameters that influence riparian vegetation development along the lower portion of the river. For example, prior to the diversion of the Churchill River, the river descended Churchill Falls itself, a large bedrock cliff. There was an almost constant mist within the area, allowing habitat areas to form, called 'spray zones'. Following the diversion, there would have been a reduction in the extent of the spray zone and the habitat associated with it (Lutterman 2007). Reduction or control of extreme seasonal flooding events can also alter floodplain vegetation by limiting disturbance and allowing colonizing plants to strongly establish themselves. Studies have shown that the reduction of flooding events can allow succession of floodplain vegetation, which in turn can lead to a lesser degree of biodiversity (Lutterman 2007; Petts 1984). Lutterman (2007) studied riparian vegetation along the lower Churchill River to evaluate the effects of the Churchill Falls development. The general findings of the study were that the lower Churchill River maintained a diverse riparian vegetation community, and that the only visible effect, based on personal communications, was that the lower zone of riverside beaches had become bare. This was attributed to increased daily fluctuation and low late summer flows (Lutterman 2007).

The processes of shoreline erosion and bed degradation are often accelerated in the reaches downstream of dams as a result of erosion, as the river develops a new equilibrium between material transport and deposition (Northwest Hydraulic Consultants 2008; Petts 1984; Williams and Wolman 1984). For further discussion of the effects of impoundment on sedimentation, please refer to the responses to IR# JRP.149, IR# JRP.152 and IR# JRP.153.

Baseline information was not collected on the sediment loading of the lower Churchill River prior to any of the hydroelectric developments discussed in the previous paragraphs. However, residents of Rigolet and North West River did mention increased shoreline erosion, and noted the loss of banks and trees along the river when the Churchill Falls Power Station was built (Sikumiut 2009). Increased shoreline erosion along the Churchill River was also noted during interviews with elders conducted by Lutterman (2007). Interviewed residents mentioned more exposed shorelines in some areas due to a perceived reduction in water level (Lutterman 2007; Sikumiut 2009). Based on the information obtained from the interviews it is unclear where these effects were located. If the observations were on the lower Churchill River, the phenomenon may have been a result of increased deposition of sediment in downstream reaches due to accelerating beach creation (Collier et al. 1996).

The fish assemblage that currently exists in the Churchill River is generally similar to assemblages observed in other, unregulated, rivers of Labrador. Changes in flow regime associated with previous developments would not have resulted in the elimination of a particular species from the watershed.

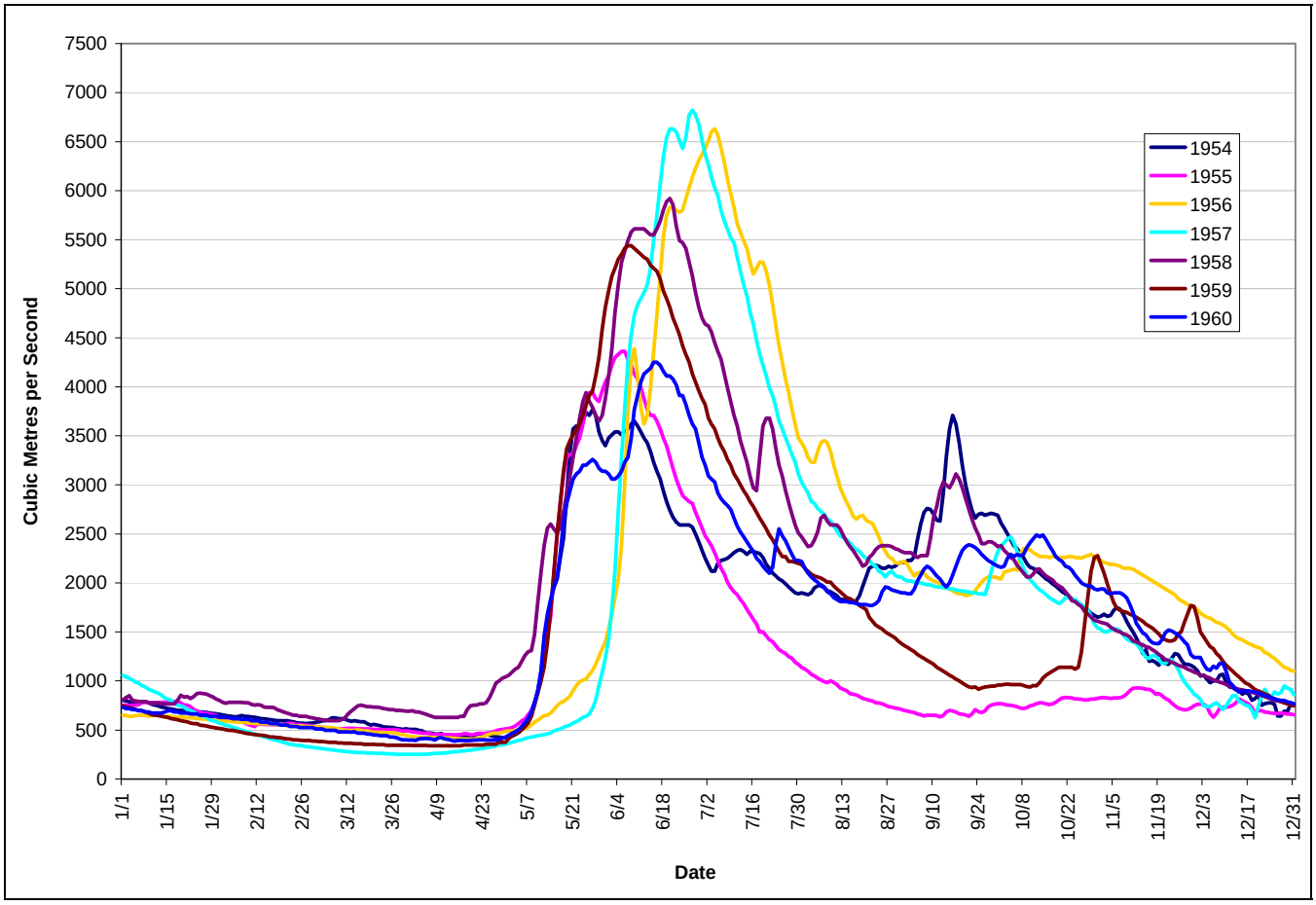
Environmental conditions that prevailed in the Assessment Area prior to hydroelectric developments on the Churchill River

As indicated previously, the Project's environmental effects were assessed using the existing environment as the baseline (pre-Project conditions) in accordance with standard environmental assessment practice. The

environmental and socio-economic effects of previous developments and activities have become part of the baseline environment. However, a review of existing, known sources of data collected prior to the existing hydroelectric developments is provided in this response. All of the existing hydroelectric projects were developed prior to existing environmental assessment legislation, and hence, there are limited baseline data prior to development. The first hydroelectric development on the Churchill River, the Menihek Generating Station, was built in 1954. Environmental conditions that prevailed in the Assessment Area are described, where information is available, but much of the biophysical data starts with the developments.

Aquatic Environment

The hydrologic data available from the Muskrat Falls station prior to any large hydroelectric development on the Churchill River are presented in Figure 1. The figure presents daily flow data from 1954 to 1960 and shows the annual variability associated with an unregulated river. The lower Churchill River became regulated in 1961 with the development of Twin Falls.

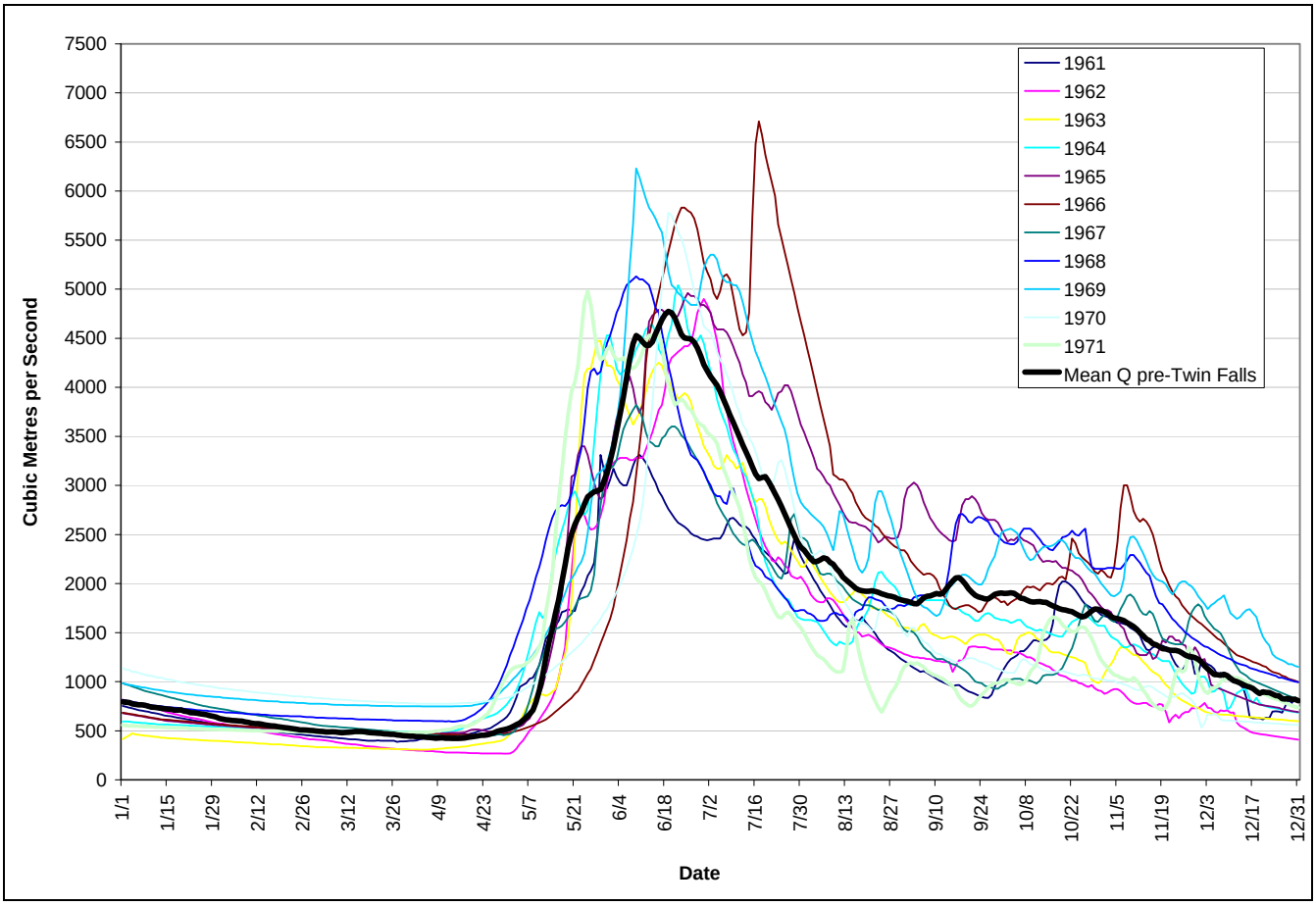


Source: Environment Canada website http://www.wsc.ec.gc.ca

Figure 1 Daily discharge (m^3/s) Recorded at Muskrat Falls, 1954 to 1960

Hydrographs, as measured at Muskrat Falls, of the mean daily discharge prior to Twin Falls (1954 to 1960) and the daily discharge from 1961 to 1974 with the operation of the Twin Falls facility are shown in Figure 2. As shown, the facility appears to have had minimal regulation effect on the lower Churchill River. Prior to regulation, the Unknown River supplied approximately 35 percent of the discharge to Muskrat Falls (Lutterman 2007). Following decommissioning of the facility, some flow was restored to the Unknown River as a result of

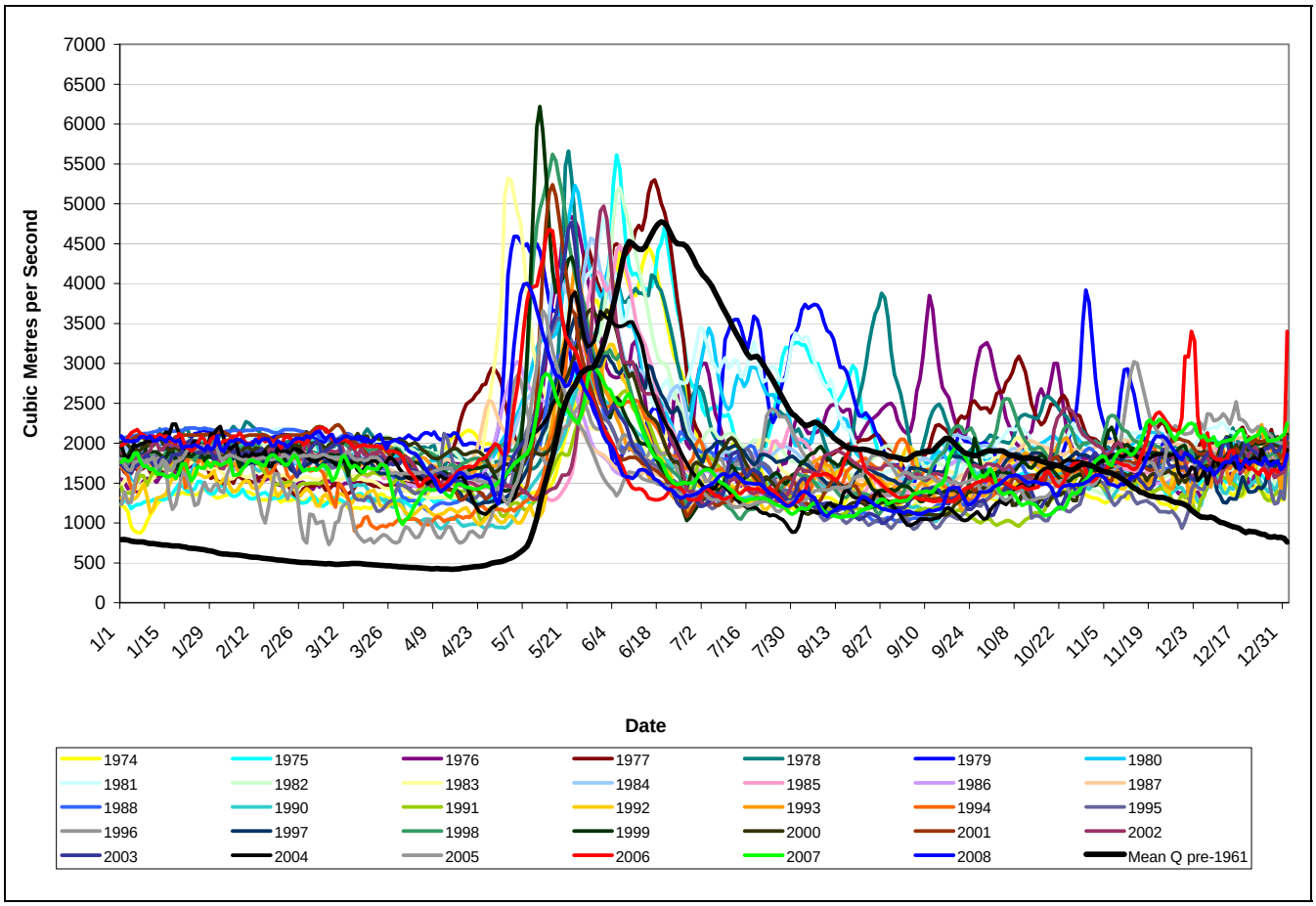
the gates being permanently opened; however, the Ossokmanuan Reservoir was subsequently diverted into the Smallwood Reservoir for use in the Churchill Falls Power Station.



Source: Environment Canada website http://www.wsc.ec.gc.ca

Figure 2 Comparison of mean daily flow (m^3/s) pre-Twin Falls development to annual hydrographs post-Twin Falls (1961 to 1971)

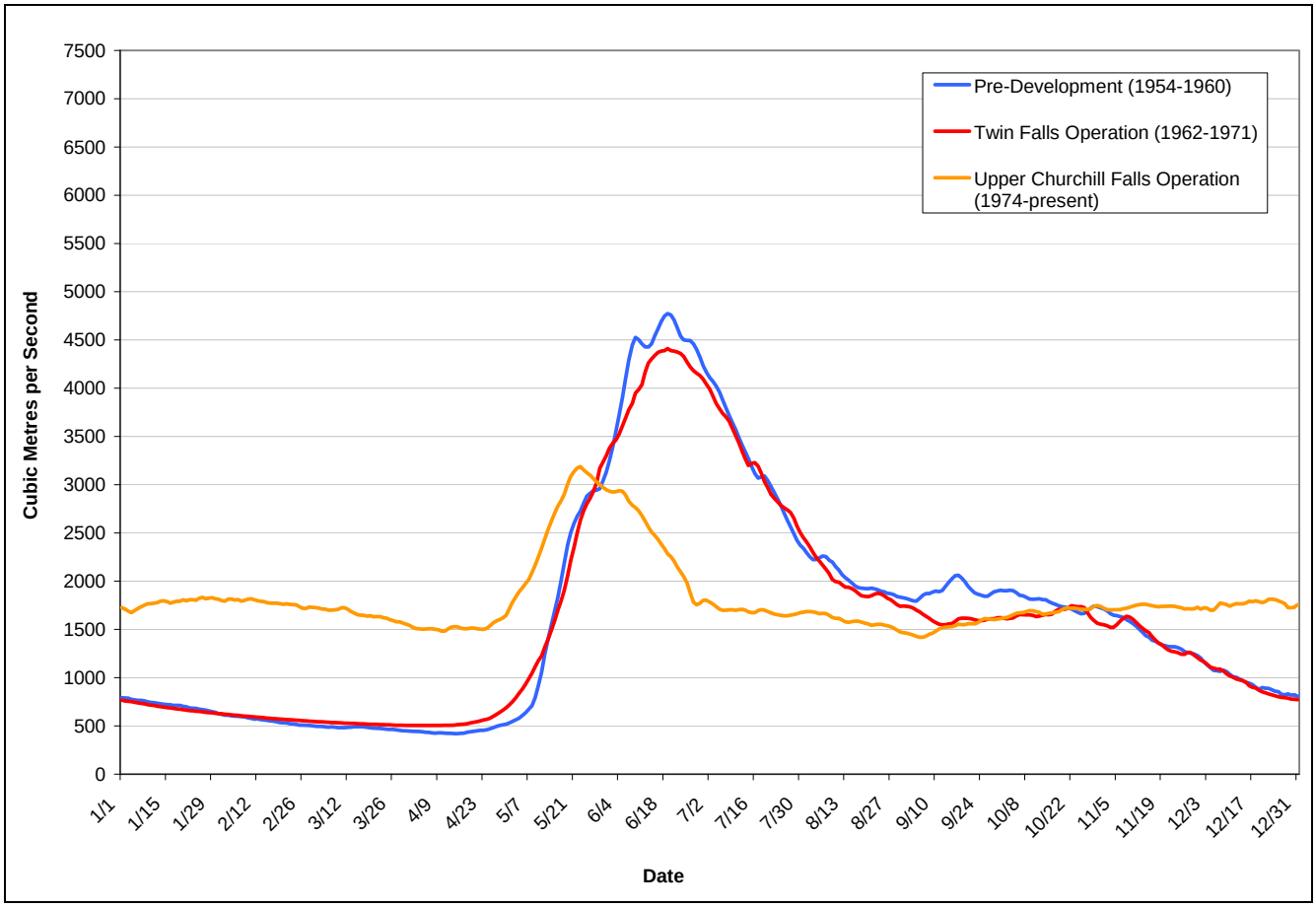
The mean daily discharge of the lower Churchill River, as measured at Muskrat Falls, prior to any major development (1954 to 1960) and the daily discharge during the operation (1974 to present) of the Churchill Falls Power Station are presented in Figure 3. As shown, the Churchill Falls Power Station regulates the lower Churchill River. The winter low flows have nearly tripled, and the spring high flows have been reduced by approximately 30 percent (Bobbitt and Akenhead 1982). In addition, the Churchill River now experiences average flow rates that are approximately 12 percent higher than the natural state (Lutterman 2007) as a result of the diversions.



Source: Environment Canada website http://www.wsc.ec.gc.ca

Figure 3: Comparison of Mean Daily Flow (m^3/s) pre-Twin Falls Development to Annual Hydrographs Post-Upper Churchill Falls (1974 to 2008)

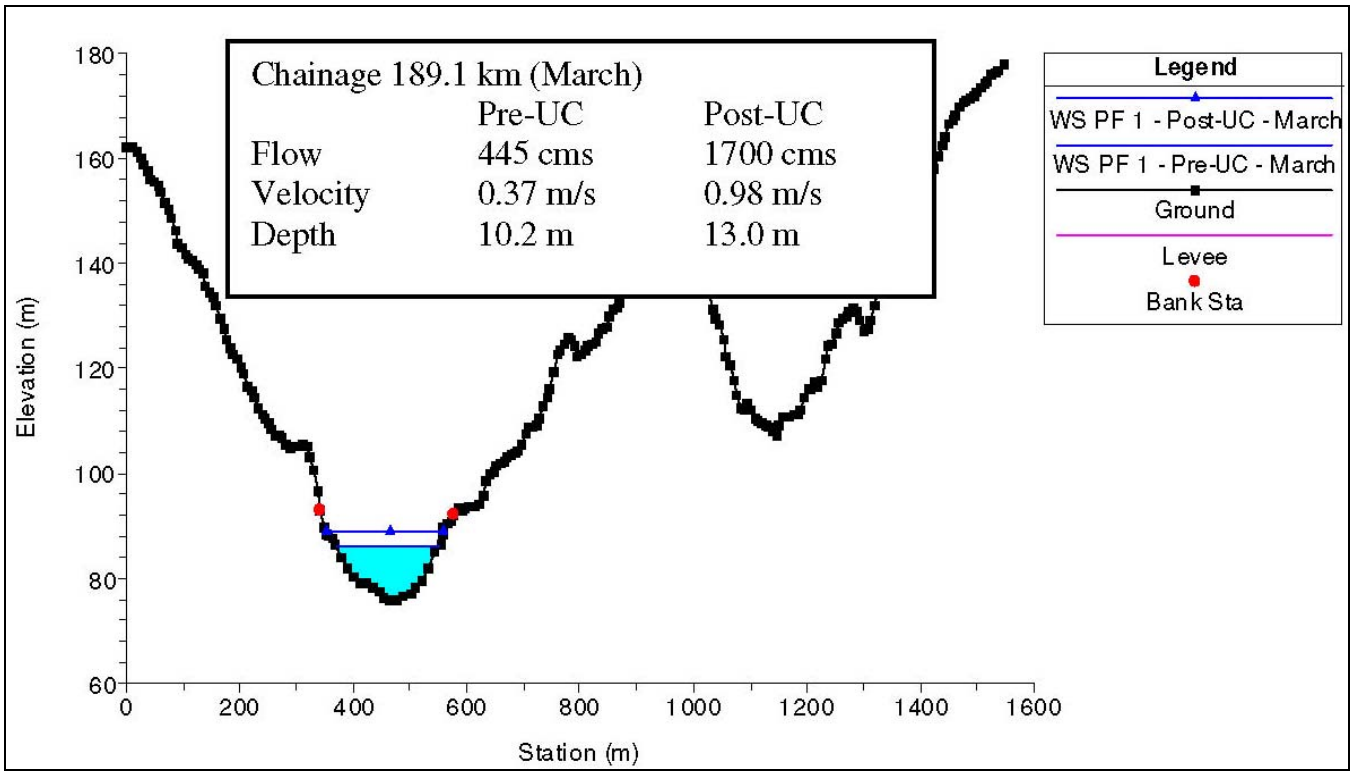
A summary comparison of the degree of regulation is provided in Figure 4. As shown, the Twin Falls development appears to have had little influence on the mean flow regime of the lower Churchill River, while the Churchill Falls Power Station has changed the flow regime of the lower Churchill River since its development in 1974.



Source: Environment Canada website http://www.wsc.ec.gc.ca

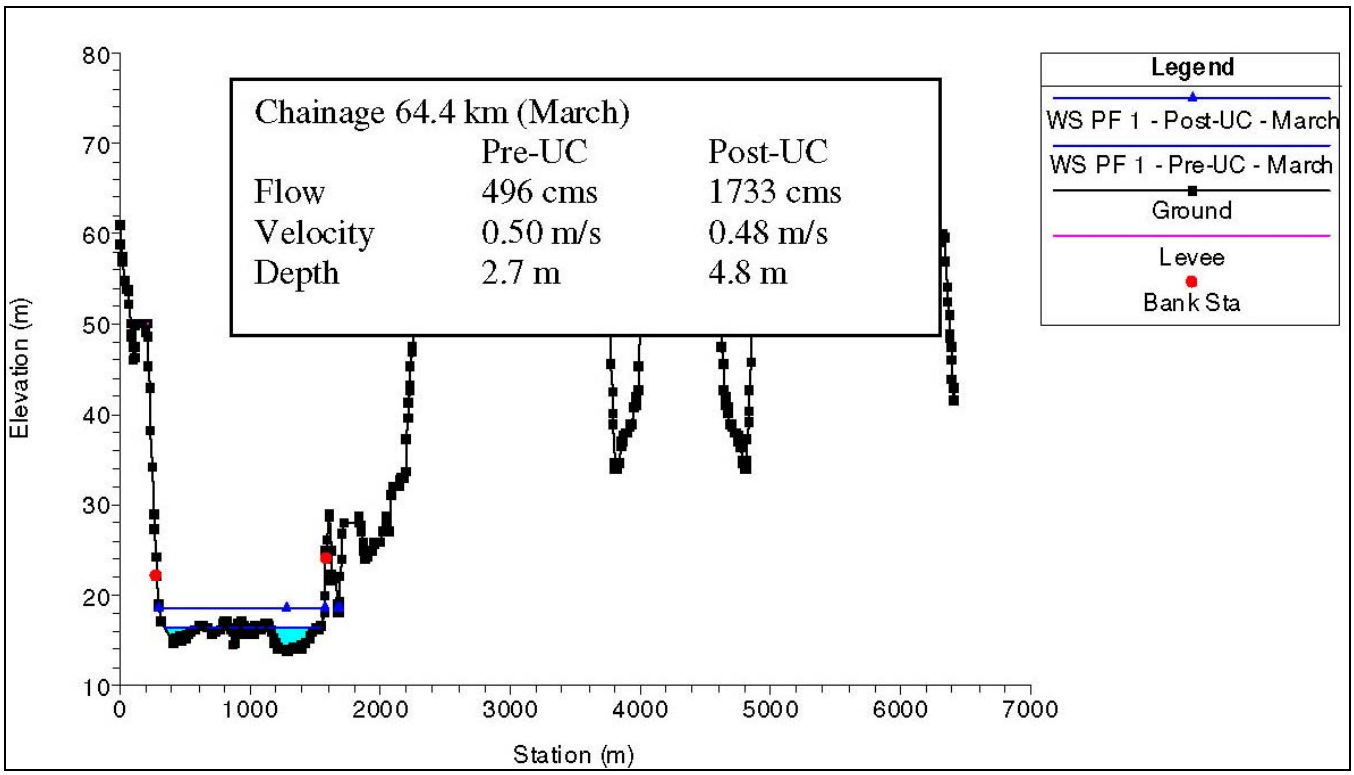
Figure 4 Comparison of Mean Flow Regime (m^3/s) between Pre-development, Twin Falls Operation and Upper Churchill Falls Facility Operation

Flow regulation generally works to diminish annual flow variability. In the case of the lower Churchill River, the Churchill Falls Power Station has increased winter low flows compared to pre-project and has buffered (i.e., reduced) the spring high flows. The ability to store water within the Smallwood Reservoir during heavy precipitation and snowmelt conditions has reduced the frequency and severity of extreme flooding events. Known discharge values were used to model the water levels during spring high flows, and winter low flows for the pre- and post-Churchill Falls periods. Figures 5 through 8 present the relative difference in wetted perimeter relative to pre- and post-development of the Churchill Falls Power Station as generated using Hydrologic Engineering Center – River Analysis System modeling and data from the lower Churchill River.



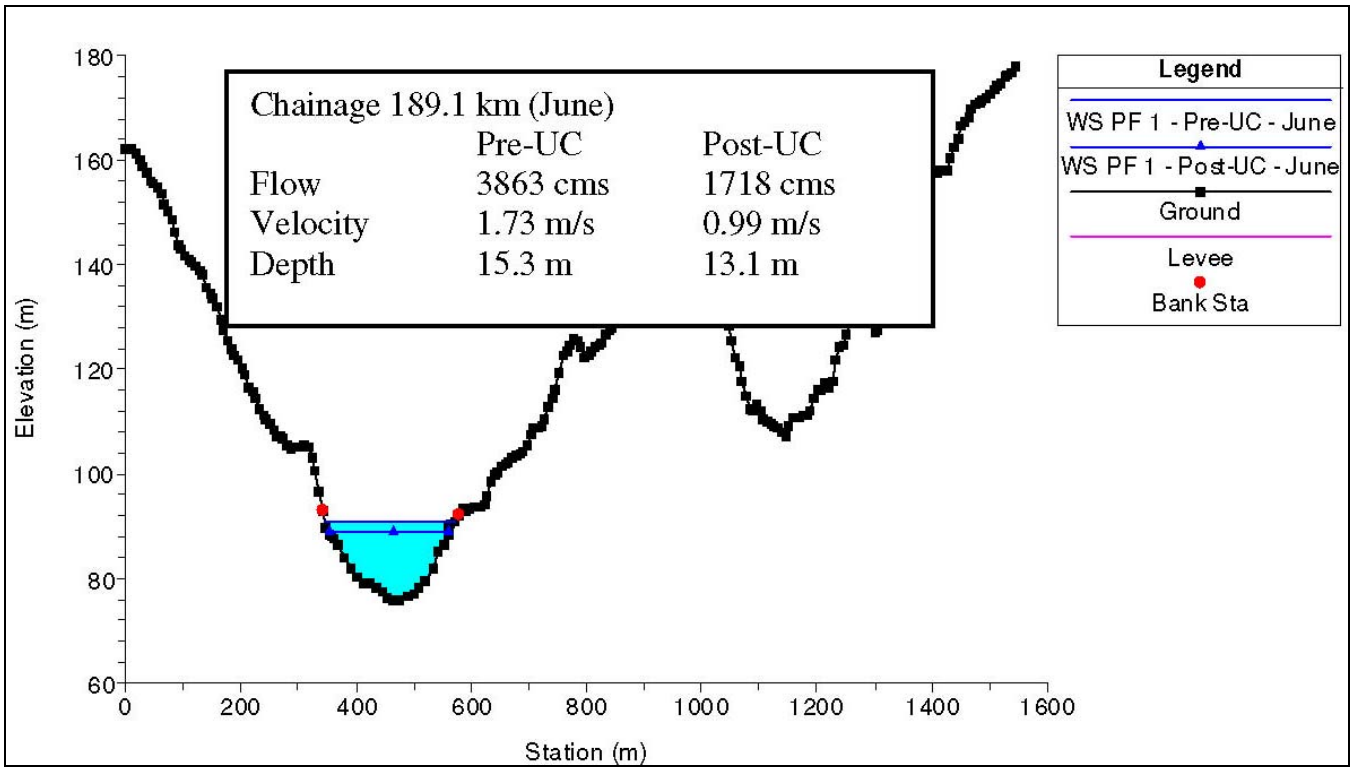
Source: Hatch Ltd. 2008

Figure 5 **Cross Section at River Chainage 189.1 (Gull Island Reservoir). Winter Low Flows Downstream of Lake Winokapau Pre- and Post-Churchill Falls Development**



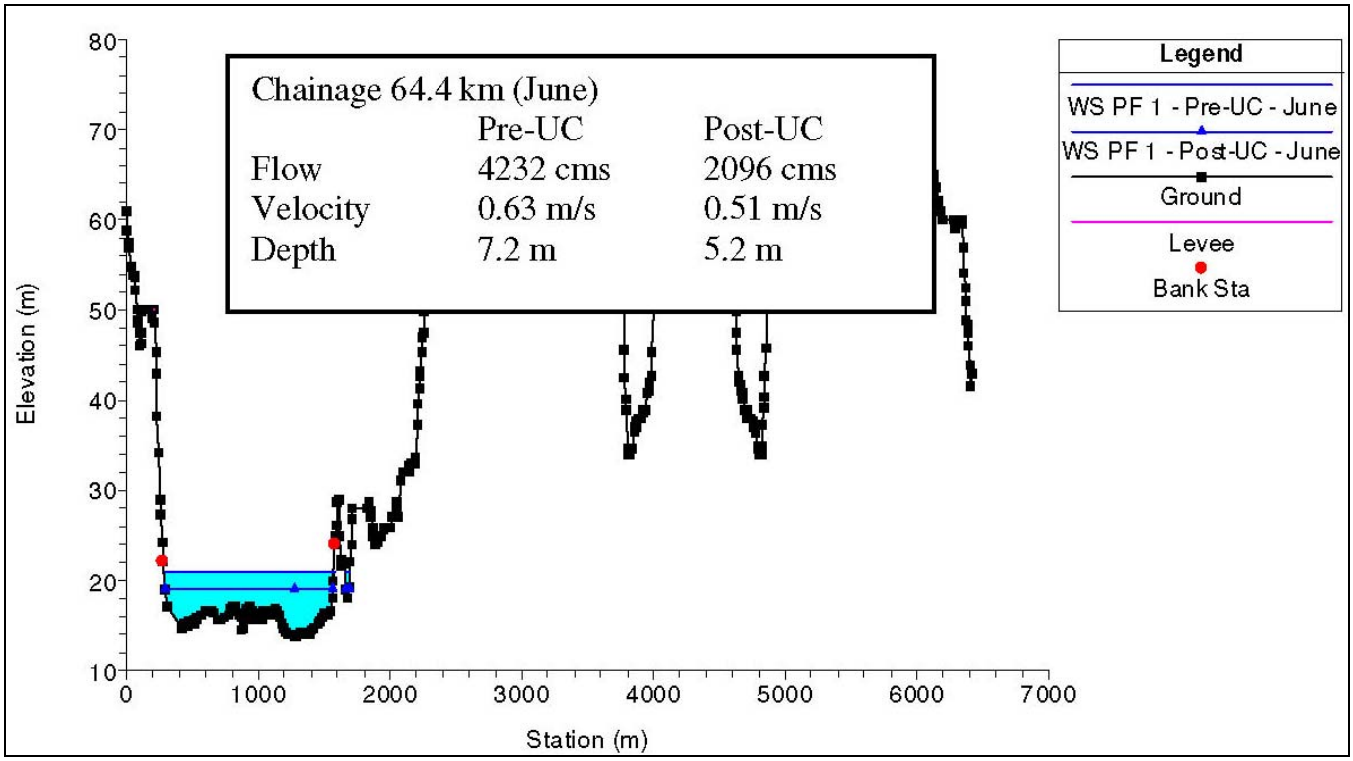
Source: Hatch Ltd. 2008

Figure 6 **Cross Section at River Chainage 64.4 (Muskrat Falls Reservoir). Winter Low Flows Upstream of Muskrat Falls Pre- and Post-Churchill Falls Development**



Source: Hatch Ltd. 2008

Figure 7 **Cross Section at River Chainage 189.1 (Gull Island Reservoir). Summer High Flows Downstream of Lake Winokapau Pre- and Post-Churchill Falls Development**



Source: Hatch Ltd. 2008

Figure 8 **Cross Section at River Chainage 64.4 (Muskrat Falls Reservoir). Summer High Flows Upstream of Muskrat Falls Pre- and Post-Churchill Falls Development**

There was no known baseline sampling of the fish assemblage or methylmercury concentrations in fish or other aquatic organisms within the lower Churchill River prior to the existing hydroelectric developments.

Terrestrial Environment

While much of the terrestrial landscape within the lower Churchill River watershed remains undisturbed by human activity, there are a variety of changes that have occurred in terms of the diversity of species, their abundance and distribution over the last approximately 60 years. Also relevant to this discussion is the difference in the understanding of the terrestrial environment over this period. Prior to hydroelectric development on the Churchill River in the 1950s, western science investigations were few or only just being initiated. Conversely, trapping, hunting and other traditional land use activities were still relatively common compared to today, as was ecological knowledge and awareness. Some examples of these differences are presented below.

Bergerud et al. (2008) describe the start of research on the migratory George River Caribou Herd with the first aerial survey completed in April 1954. At that time, the herd was believed to be recovering from low numbers and was estimated at 4,200 animals. The George River Herd has increased since that time. The range of the George River Caribou Herd during the 1950s and 1960s was north of the lower Churchill River watershed (Bergerud et al. 2008), so the wintering occupation by animals from this herd in the Assessment Area described in the EIS was not documented at that time.

The RWM were once regarded as the core area for the sedentary caribou associated with the RWM Caribou Herd (Brown and Theberge 1985). The herd was estimated at 880 individuals in 1958 (Bergerud 1967). Since that time, the herd has apparently shifted away from the northern part of its range and now extends south of the Churchill River (Schmelzer et al. 2004). The herd declined to about 87 animals in 2003 (Schmelzer et al. 2004).

A review of the range and abundance of sedentary caribou associated with the Lac Joseph Herd by Bergerud et al. (2008) describes the importance of the upland area now occupied by the Smallwood Reservoir for calving. These authors noted a decline in this herd after the creation of this reservoir in 1972.

Following widespread decline in the nineteenth and twentieth centuries from trapping pressure, beaver were reported to have returned to its former range and were more abundant in the Assessment Area beginning in the 1950s (Budgell 1981). Conversely, marten were in decline in the 1950s (Northcott 1961) and porcupine were considered scarce, with no observations reported by Northland Associates Ltd. (1980) during surveys in the lower Churchill River valley. The last confirmed observation of a wolverine in Labrador occurred in 1955 (Fortin et al. 2005).

Waterfowl were probably more abundant in the Assessment Area during the 1950s. Gillespie and Wetmore (1973) completed aerial surveys throughout the Labrador-Ungava Peninsula in 1970, 1971 and 1972. One of their objectives was to establish baseline conditions for waterfowl, to evaluate effects of flooding and loss of habitat associated with the Churchill Falls Power Station project. In comparison with areas further north and east, these authors believed that much of the better waterfowl breeding habitat in southern Labrador was being lost by the formation of the Smallwood Reservoir. Goudie and Whitman (1987) estimated that approximately 1,400 km^2 of waterfowl habitat was lost in the flooding of the Smallwood Reservoir. In combination with downstream effects such as reduced runoff in several rivers, these authors estimated a possible reduction of 10 percent of waterfowl habitat present in the central Labrador region.

Several wildlife species are new to the lower Churchill River watershed since the 1950s. Moose were not documented in the lower Churchill River watershed until a sighting was reported near Minipi River in 1961

(Mercer and Kitchen 1968). Moose moved into western Labrador by 1949 (Folinsbee 1974) and 12 animals were introduced on the south coast of Labrador by the provincial government in 1953 (Mercer and Kitchen 1968).

There are species of avifauna currently using the habitat within the Churchill River watershed that were not found in the area in the 1950s, or their populations have increased. In comparison with recorded observations in the detailed "Birds of the Labrador Peninsula" (Todd 1963), species such as Ring-necked Duck, Red-tailed Hawk and Mourning Dove were rarely, if ever, observed during the 1950s. Todd (1963) described Osprey as a regular breeder in the lower Churchill River; however, a continent-wide decline occurred thereafter due to the unrestricted use of pesticides at that time (Poole 1989).

Communities

In the 1950s there were four communities in the Assessment Area, including Goose Bay, Happy Valley, North West River, and Mud Lake. Families began moving into Churchill Falls in 1969. Happy Valley and Goose Bay were incorporated as a single community in 1973.

Goose Bay was established in the early 1940s when an Air Force Base was developed "to co-ordinate and supplement the North Atlantic Ferry Command via the Atlantic Bridge" (Plaice 2002) for Canadian, British and American forces. After the Second World War, the base continued to serve as an important refueling location for trans-Atlantic flights, a base for the North American Aerospace Defense Command (NORAD) and as part of the Distant Early Warning (DEW) system and Strategic Air Command during the 1950s. Goose Bay began to expand in the 1950s, largely due to an increased American presence and investment. Between 1951 and 1958, an extensive building program added housing, schools, a hospital, as well as recreational and shopping facilities (Plaice 2002).

The first settlers to the area came from coastal Labrador and the Island of Newfoundland to work on construction of the Goose Bay Air Force Base (now known as 5 Wing Goose Bay). In accordance with the requirement to be at least 8 km from the base, a site was selected in 1942 that was initially referred to as "Refugee Cove". In 1955, the site was renamed Happy Valley (Encyclopedia of Newfoundland and Labrador 1991). During the 1950s, the main employer in the region was the base and the many spin-off services and industries related to it. In 1951, the Grenfell Mission opened a nursing station in the community, which was replaced by the Paddon Memorial Hospital in 1963.

The Town of North West River is situated on the southeast end of Grand Lake. Prior to construction of the Goose Bay Air Force Base in the 1940s, North West River was the largest community in Hamilton Inlet. Construction of the Goose Bay Air Force Base in the 1940s caused several families to relocate from North West River to that community for work, a pattern that continued throughout the 1950s. The Town of North West River became an incorporated community in 1958.

From the 1950s on, Innu began to settle around North West River and, for many years, the area on the opposite side of the river where they camped was considered part of North West River. However, in 1979 it separated to form its own municipality, which they named Sheshatshiu (Minaskuat 2009).

Mud Lake is situated southeast of Happy Valley-Goose Bay near the mouth of Churchill River on a channel that connects Mud Lake with Hamilton Inlet. Because there is no road access, getting to and from the community requires traveling across the river by boat in summer and over the ice during winter (Minaskuat 2009).

Land and Resource Use

Other than the economic activities described above for the various communities (e.g., wage-employment related to construction and operation of the Goose Bay Air Force Base), the main types of land and resource use

on-going in south-central Labrador in the 1950s were harvesting practices that were deeply rooted in the cultural backgrounds of the area's residents. Included, for example, was fur-trapping and subsistence hunting, fishing and gathering by the various Labrador and Quebec Innu Bands, and by the Settler population residing near Lake Melville and other coastal areas (Brown and Gray 1951; Tanner 1978; Tanner and Armitage 1986; IEDE/Jacques Whitford 2000; Innu Nation 2007). While the non-Aboriginal population and the new-comers to the region employed in the various construction trades were likely involved in some form of recreational and subsistence harvesting (i.e., caribou and bird hunting and fishing), due to the structured work-schedules of employees, it is likely that the nature and extent of these activities in the 1950s was limited.

The Innu of Labrador and Quebec (previously known as Montagnais and Naskapi Indians) are an Amerindian population who refer to this area as Nitassinan (meaning Our Land), which comprises much of the Québec-Labrador peninsula (Mailhot 1997). Traditionally, the Innu were a nomadic people, whose movements throughout the interior and coastal regions corresponded to the seasons and the cycles of the wildlife and other resources they relied upon (Tanner 1978). The Innu harvested a wide range of terrestrial and marine species for food and clothing, as well as several types of plants for food and medical purposes (Rogers and Leacock 1981; Innu Nation 2007).

By the beginning of the twentieth century, the Churchill River and its watersheds were becoming less used by Labrador Innu and more by Settlers from western Lake Melville (JWEL 1998; IEDE/JWEL 2000; JWEL/IELP 2001). Despite this gradual decline in use, archaeological evidence demonstrates that the area continued to be used by Labrador Innu for harvesting, albeit at a reduced rate, into the 1950s and later (IEDE/JWEL 2000). While primary land-use information related to Québec Innu use of the lower Churchill River watershed in the 1950s probably exists (Deschênes 1983), access to it is restricted. Thus, only limited, publicly available data were found for this review and response. Nevertheless, the information at hand indicates that trapping remained part of the economy throughout the 1950s. In the fall of 1950, for example, Innu from Sept-Îles, Mingan and Natashquan were trapping along a route that extended south to north across the lower Churchill River watershed, just west of Winokapau Lake.

Throughout the first half of the twentieth century and into the 1950s, the lower Churchill River and its watershed was an area that was trapped primarily by Settlers from western Lake Melville (JWEL 1998; IEDE/JWEL 2000; JWEL/IELP 2001). In the early 1950s, it was reported that there were at least 40 tilts, used as base-camps, scattered along the Churchill River between Birch Lake and the mouth of the river; as well, there were dozens of over-night cabins situated along the shores of waterbodies contained within the lower Churchill River watershed (Brown and Gray 1951). There were a number of Settler tilts and traplines scattered throughout the lower Churchill River watershed, extending along practically the full length of the river, from an area east of Muskrat Falls, and west to Churchill Falls. Given the extent of trapping known to have taken place in the area at that time and earlier (JWEL 1998; IEDE/JWEL 2000; JWEL/IELP 2001), it is reasonable to assume that the information recorded at the beginning of the 1960s also applied to the previous decade.

Despite a search of sources, no detailed information was located to confirm the nature and extent of any non-Aboriginal land and resource use of the lower Churchill River watershed during the 1950s. However, it is likely that some degree of recreational and subsistence harvesting did occur.

Historic and Archaeological Resources

The lower Churchill River was not surveyed for archaeological resources until 1974 (Tuck 1981). Thus, no detailed archaeological information is available for the lower Churchill River and the watershed prior to hydroelectric development on the river.

Economy, Employment and Business

Employment, economy and business in the region during the 1950s had changed significantly from that which existed during the first half of the century and earlier. As discussed above, prior to construction of the Goose Bay Air Force Base in the 1940s, the economy of the Aboriginal and non-Aboriginal population of south/central Labrador was largely subsistence-based (i.e., hunting and fishing), combined with a system that made available a wide range of food-items and equipment through trade of fish and/or furs. At that time, little cash changed hands (Kennedy 1993). In 1941, for example, it was reported by an American Serviceman that:

> "Labrador imports the necessities of living with the exception of what can be obtained by hunting and fishing. Farming is non-existent except for a few small garden patches. Food products, textiles, steel, iron, and machinery all come from outside. The Hudson Bay Company has a virtual monopoly on all trade…" (Them Days 1987a).

However, once construction of the Goose Bay Air Force Base began, people from coastal Labrador and from the Island of Newfoundland, and elsewhere, traveled to Goose Bay for work, a trend that continued into the 1950s. Leonard McNeill, a fisherman from coastal Labrador, reported that he came to North West River in 1950 to look for work. Even though there were "swarms of cod", as he put it, because the prices were extremely low ($3.00 a quintal or 112 lbs.), it was not profitable to continue fishing. He also mentioned that furbearing animals were extremely scarce at that time and the prices were low. In 1951, he received employment at Goose Bay with a contracting company and decided to stay, despite the fact that he found the lifestyle of the larger centre unappealing (Them Days 1987b). The pattern of in-migration by workers continued, and by the end of the 1950s, the population of the area had grown to 2,861. In the late 1950's, the Royal Air Force from the United Kingdom began using Goose Bay Air Force Base as a training area for their bombers. Over time, other countries became interested in the advantages of training in the area and made use of the airspace and facilities (http://www.happyvalley-goosebay.com/home/history_of_the_base.htm).

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Requesting Organization – Joint Review Panel **Information Request No.: JRP.163**

Information Requested:

To the extent that information is available to the Proponent, the Proponent is asked to:

b. justify whether or not the projects or activities suggested by reviewers should be included in the CEA and, if so, whether or not it may influence CEA conclusions. Specifically, the Proponent should consider uranium mining in the CEA. For hypothetical projects, the Proponent should discuss how they may contribute to and influence future environmental planning in the region, to the extent that their impacts may overlap with those of the Project.

Response:

As indicated in the response to IR# JRP.97, the screening process used for the Cumulative Effects Assessment (CEA) in the EIS is appropriate and addresses the requirements in the Guidelines. With respect to the specific list of projects and activities identified by reviewers for inclusion within the CEA, two of these projects or activities, namely the construction of additional transmission lines in Labrador in relation to the export of power from the Project (including the potential for transmission access through Quebec) and the ongoing dumping of raw sewage in the Churchill River, were considered within the EIS as part of the CEA, and are therefore not further discussed in this response (please refer to the EIS, Volume IA, Section 9.9, Table 9-7).

Construction of additional transmissions lines in Labrador in relation to export of power from the Project was included as a project for consideration in the CEA within the EIS for the following Key Indicators: Atmospheric Environment (Volume IIA, Sections 3.11.2 to 3.11.4); Terrestrial Environment (Volume IIB, Section 5.15.2); George River Caribou Herd (Volume IIB, Section 5.15.4.1); Red Wine Mountains Caribou Herd (Volume IIB, Section 5.15.4.2); Moose (Volume IIB, Sections 5.15.3.1 and 5.15.4.2); Black Bear (Volume IIB, Sections 5.15.3.1 and 5.15.4.4); Beaver (Volume IIB, Sections 5.15.3.1 and 5.15.4.6); Porcupine (Sections 5.15.3.1 and 5.15.4.7); Canada Goose (Volume IIB, Sections 5.15.3.1 and 5.15.4.8); Surf Scoter (Volume IIB, Sections 5.15.3.1 and 5.15.4.9); Ruffed Grouse (Volume IIB, Sections 5.15.3.1 and 5.15.4.10); Wetland Sparrows (Volume IIB, Section 5.15.4.12); Harlequin Duck (Volume IIB, Sections 5.15.3.1 and 5.15.4.14); Other Species of Concern (Volume IIB, Sections 5.15.3.1 and 5.15.4.15); Economy (Volume III, Sections 3.5.6 and 3.8.1); Employment (Volume III, Sections 3.6.6 and 3.8.2); Business (Volume III, Sections 3.7.6 and 3.8.3); Physical Infrastructure and Services (Volume III, Sections 4.5.6 and 4.8.1); Social Services and Infrastructure (Volume III., Sections 4.6.6 and 4.8.2); Community Health (Volume III, Sections 4.7.6 and 4.8.3) Land and Resource Use (Volume III, Sections 5.5.7 and 5.6.2.2), and Cultural Heritage Resources (Volume III, Sections 6.5.6 and 6.6). The response to IR# JRP.97f illustrates the proposed route for the Labrador Island Transmission Link (HVdc Transmission Corridor).

Ongoing dumping of raw sewage in the Churchill River was included within the "General Economic and Infrastructural Development in the Upper Lake Melville Area" project, as described in Table 9-7 of Volume IA. This project was included in the CEA within the EIS for the following Key Indicators: Economy (Volume III, Sections 3.5.6 and 3.8.1); Employment (Volume III, Sections 3.6.6 and 3.8.2); Physical Infrastructure and Services (Volume III, Sections 4.5.6 and 4.8.1); Community Health (Volume III, Sections 4.7.6 and 4.8.3); and Land and Resource Use (Volume III, Sections 5.5.7 and 5.6.2.2).

The Cumulative Effects Assessment Practitioners' Guide (CEA Agency 1999) states that "*future actions that are approved within the study area must be considered; officially announced and reasonably foreseeable actions should be considered if they may affect those VECs and there is enough information about them to assess their*

effects." Hypothetical projects are not required to be assessed because of the greater uncertainty associated with them, and the lack of project details, and therefore the limited usefulness of the assessment. The remainder of the other projects suggested by reviewers (i.e., mining of mineral sands (e.g., Grand River Iron Sands project), aluminum smelter, uranium mining and remediation of contamination at 5 Wing Goose Bay) were therefore not included in the EIS as they were hypothetical at the time that the EIS was prepared, and therefore there would be little value or useful information generated by evaluating those projects. Although hypothetical, these four projects are discussed below to respond to this information request.

With respect to future environmental planning in the region, the referenced hypothetical projects would all be subject to their own individual environmental assessment processes. Environmental assessment is an important tool for environmental planning, providing a process where relevant government agencies can consider project effects in the context of their respective mandates, and identify any mitigation and monitoring that may be required. Because environmental assessment is a planning tool, each project, including the Project, will be subject to terms and conditions applied by these agencies to ensure sustainable development is achieved in the region.

As adequately-detailed information becomes available for these hypothetical projects, agencies responsible for both biophysical and socio-economic planning in the region will determine whether these projects should proceed, and if so, whether these projects create the need for changes or revisions in the current planning regimes. For instance, the Newfoundland and Labrador Wildlife Division will have to consider additional activities or projects when setting harvesting limits for game species in the region. Therefore, provincial and municipal government planning will be more informed by the additional information brought forward in each new application and review process (i.e., such as the potential effects on and requirements for physical, social and economic services and infrastructure). For example, the Project information provided by Nalcor Energy (Nalcor) in the EIS and associated component studies has been provided to government authorities with enough lead time that consideration of the Project can be considered in any regional planning efforts with respect to issues such as infrastructural and service demands. This would also be true of any future large project in the region that would be subject to environmental assessment.

The following provides an explanation of how, if approved and carried out, the referenced hypothetical projects may contribute to and influence future environmental planning in the region, to the extent that their impacts may overlap with those of the Project. Note that none of this discussion alters the conclusions provided in the cumulative effects assessment contained in the EIS.

Mining of Mineral Sands

With respect to mining of mineral sands in the Churchill River watershed, it is important to distinguish between exploration activities and development activities. In 2005, Grand River Ironsands Inc. (formerly Markland Resource Development Inc.) registered a proposal with the Newfoundland and Labrador Department of Environment and Conservation to conduct exploration activities within the lower Churchill River from Muskrat Island to the mouth of the river. They were granted environmental approval to conduct this program in August 2005 with a number of conditions, including that they not use the suction dredging option, that all sampling take place on land and at least 100 m from the river water mark, and that sample size be restricted to 20 cubic metres. Based on publicly available information, the core drilling and bulk sampling occurred in 2005 to 2006 (Grand River Ironsands Inc. 2007). This activity was not included within the CEA for the Project as it was considered a past activity and, assuming the conditions of release were complied with, there would have been no residual effects, and therefore, no cumulative effects.

Mining (versus exploration) of mineral sands within the Churchill River watershed is still considered a hypothetical project for the purposes of CEA (CEA Agency 1999). While it appears that Grand River Ironsands is active in developing investment/funding for this venture and has been engaging local stakeholders in discussions, it is considered a hypothetical project because a mining development project has not yet been registered with any governments and a project description is not publicly available. The concept of the project includes dredging to a depth of 20m 144 km^2 of the Churchill River bed near Happy Valley-Goose Bay. This dredging would require in-river activities. Sands would be dried and processed through a gravity spiral and a magnetic separator to remove metals before being returned to the river or on land (Grand River Ironsands 2009). The construction and operation of the Project should not prohibit the future exploitation of mineral sand resources should this mining project proceed. If it proceeds, this project could have overlapping socio-economic effects (i.e., cumulative environmental effects on Economy, Employment, and Business, Communities, and Land and Resource Use) and overlapping environmental effects with the aquatic environment (depending on whether approval is received to work in the water). The relevant planning and regulatory authorities may use this information to plan additional requirements (if any) for physical infrastructure and social services, training needs for local and/or regional labour force (depending on labour force requirements), increased levels of enforcement or revised management regimes for fish resources, and appropriate mitigation for loss or alteration of fish habitat (if any).

Remediation Project at 5 Wing Goose Bay

On-going remediation activities have been occurring at 5 Wing Goose Bay since the early 1990s, with the Goose Bay Remediation Project being initiated in 2004. These activities were included in the CEA under the heading of General Economic and Infrastructural Development in the Upper Lake Melville Area which included "miscellaneous civil works on Base" (i.e., 5 Wing Goose Bay) (See the EIS, Volume IA, Table 9-7). Many of these activities have been related to site investigations, testing and monitoring. Larger scale activities have only occurred in a few locations, mainly the Upper Tank Farm and the Stillwater No. 4 Trench (DND 2009). As stated in Table 9-7, Volume IA of the EIS, due to the limited physical nature of this activity, biophysical cumulative environmental effects were not anticipated nor assessed. Potential for cumulative environmental effects with socio-economic VECs was considered in the assessment.

The latest, largest remediation project was not included in the EIS because it was hypothetical at the time of EIS preparation. In July of 2009, following submission of the EIS for the Project, the Government of Canada announced that $300 million in funding for the remediation project under the Federal Contaminated Sites Action Plan had been approved. An Environmental Screening of the remediation project pursuant to CEAA was submitted in February 2010 (AMEC Earth and Environmental 2010) and the decision has recently been made that the project can proceed with appropriate mitigation in place. While this project was therefore not included within the CEA, Nalcor is confident that the inclusion of this project in the CEA for the Project would not alter any of the effects conclusions, as described below.

The environmental assessment for the remediation project (AMEC 2010) considered the potential for cumulative effects with the Project. While there is no apparent overlap in the physical footprints of the two projects, the environmental assessment (AMEC 2010) identifies the following potential cumulative biophysical environmental effects: short-term/temporary increases in heavy vehicle traffic which could result in increased noise and dust levels and possible effects on fish and fish habitat. An Environmental Management Plan (EMP) will be developed by DND to address these issues, and with mitigation in place the air quality effects from the remediation project are predicted to likely remain within regulatory limits and effects to fish and fish habitat are not likely to be significant (AMEC 2010). Note that based on Nalcor's review of the environmental assessment for the remediation project, the potential for effects on fish and fish habitat in the Churchill River as a result of

the remediation project appear to be indirect only and localized (i.e., there appears to be no works planned within the Lower Churchill River itself, although there may be some requirement for in-water works in water courses that flow into the Lower Churchill River).

Although not identified in the remediation project environmental assessment (AMEC 2010), there could be some overlap from a socio-economic perspective, as the proposed remediation project would generate employment and business opportunities over the same time period as construction of the Project. Full-scale clean-up activities are scheduled to occur from present to 2020, although the number of local jobs and contracts to be generated from these activities was not explicitly stated in the environmental assessment (AMEC 2010). The relevant planning and regulatory authorities may use information from the environmental assessments of both projects to plan additional requirements (if any) for physical infrastructure and social services, training needs for the local and/or regional labour force (depending on labour force requirements), and appropriate mitigation for controlling air emissions. The ultimate result of this remediation project should be an improvement of environmental quality within and around 5 Wing Goose Bay. In summary, the cumulative effects of the Project in combination with the remediation project at 5 Wing Goose Bay are expected to be not significant and this is consistent with the cumulative effects prediction included within the EIS.

Aluminum Smelter

The aluminum smelter is still considered a hypothetical project, and can be considered an induced project. As stated in the response to IR# JRP.97d, the potential induced development in Labrador that may arise if the Project proceeds is likely to be related to opportunities for residential, commercial/business and industrial development. The likelihood of such induced development cannot be predicted with any certainty. If and when such development may occur is not known. However, any such development that occurs will be subject to applicable government approvals, and require environmental assessment and an evaluation of their cumulative effects, as applicable. If it proceeds, a project like this could have overlapping socio-economic effects (i.e., cumulative environmental effects on Economy, Employment, and Business and Communities) particularly if there were an overlap in construction timeframes. There could also be over-lapping biophysical effects with respect to air quality (depending on nature of operations), terrestrial habitat (depending on location), and aquatic environment (depending on the location and nature of operations). The relevant planning and regulatory authorities may use this information to plan additional requirements (if any) for physical infrastructure and social services, training needs for the local and/or regional labour force (depending on labour force requirements), airshed-based emission limits, increased levels of enforcement or revised management regimes for fish and wildlife resources, and appropriate mitigation for loss or alteration of fish and/or wildlife habitat (if any). As well, any proponent constructing an aluminum smelter in Labrador would require a supply of energy, and therefore a contracting arrangement with Nalcor. Accordingly, there could be an opportunity for Nalcor to work with any developers, where feasible, to optimize socio-economic benefits and reduce adverse environmental effects.

Uranium Mining

If the uranium mine proceeds, it would be located on lands that fall under the jurisdiction of the Nunatsiavut Government. On April 8, 2008, the Nunatsiavut Government implemented a three-year moratorium on uranium mining on Labrador Inuit Lands, but continues to allow uranium exploration. The Nunatsiavut Government will review the moratorium by March 31, 2011.

The mine itself would be located well north of the biophysical cumulative effects assessment areas for the Project, and therefore there are likely no cumulative effects. However, there is potential for overlapping socio-economic effects related to Economy, Employment and Business, and Communities, depending on timing and

labour requirements. The relevant planning and regulatory authorities may use this information to plan additional requirements (if any) for physical infrastructure and social services. Based on publicly available information, mine development could entail construction of a road from North West River to the mine site and then to Postville, which would be located north and east of the biophysical cumulative effects assessment areas for the Project, greatly limiting the potential for any cumulative effects. However, if the project proceeds, there could be an overlap with socio-economic effects with respect to Land and Resource Use, Economy, Employment and Business and Communities. The nature of these effects during mine development would depend on the timing of the mining project in relation to the construction of the Project. The relevant planning and regulatory authorities may use this information to plan additional requirements (if any) for physical infrastructure and social services, increased levels of enforcement or revised management regimes for fish and wildlife resources, and training needs for the local and/or regional labour force (depending on labour force requirements).

Conclusion

With the exception of the two projects that were already assessed in the EIS as part of the CEA, the rationale for not including the remaining projects within the CEA was their hypothetical nature, and/or lack of interactions with the Project (e.g., uranium exploration activities) and/or status as a past activity (e.g., mineral sands exploration activities). With the exception of the remediation project at 5 Wing Goose Bay, there is still insufficient project information available to effectively assess the potential for cumulative environmental effects from any of the remaining hypothetical projects. This is particularly the case with respect to the potential for cumulative biophysical environmental effects where the range of potential effects can vary substantially based on project design including siting of infrastructure and technology selection. Based on the limited information available at this stage, it is not appropriate to include them, and inclusion of these hypothetical projects within the CEA would not alter the results of the cumulative effects assessment for the Project.

References:

AMEC Earth & Environmental. 2010. Environmental Assessment, 5 Wing Goose Bay, Newfoundland & Labrador. Report Prepared for Defence Construction Canada.

CEA Agency. 1999. Cumulative Effects Assessment Practitioners Guide. Accessed online at http://www.ceaa.gc.ca/013/0001/0004/index_e.htm

DND. 2009. Backgrounder: Goose Bay Remediation Project. Accessed online at http://www.dnd.ca/site/news-nouvelles/news-nouvelles-eng.asp?cat=03&id=2883

Grand River Ironsands. 2007. The Ironsands of Labrador. Accessed online at http://grandriverironsands.com/Grand%20River%20Brochure%202%20-%20May%202007.pdf

Grand River Ironsands. 2009. Public Presentation. Accessed online at http://grandriverironsands.com/Public%20Presentation%20-%20December%202009.pdf

Requesting Organization – Joint Review Panel **Information Request No.: JRP.163**

Information Requested:

The Proponent is also asked to:

c. **explain and provide rationale for the methodology used in the CEA to assess the impacts to migration patterns as a result of the Project in combination with other projects, activities, or events, given the limited spatial boundaries of the CEA area. The Proponent should be specific with respect to the migration patterns of the Lac Joseph, George River and Red Wine Mountain caribou herds, as well as any other migratory KI that would benefit from such a discussion.**

Response:

The spatial boundaries selected for the cumulative effects assessment (CEA) are considered appropriate in capturing all likely cumulative effects on the Terrestrial Environment, including caribou and disruption of movement. The CEA Area used for the caribou herds are larger than the CEA Areas used for the other terrestrial KIs and reflects the full range of the RWM Caribou Herd. The CEA boundaries for migratory KIs provide a balance between capturing cumulative effects and not masking their magnitude (i.e., selecting a CEA Area of appropriate size to properly evaluate effects and not hide the extent of interactions). Inclusion of the full range of the George River Caribou Herd would have encompassed a much larger area and resulted in a broad, generalized and unfocussed assessment. In contrast, the CEA Area selected is of sufficient size to capture potential changes on the landscape including the possible disruption of caribou movements.

With respect to the CEA for the Terrestrial Environment, the EIS considers three potential effects resulting from the Project on the KIs (i.e., change in habitat, change in health and mortality) (Volume IIB, Section 5.15). As stated in Volume IIB, Section 5.7, change in habitat refers to a number of interlinked issues including the alteration or loss of habitat, and habitat fragmentation. These habitat changes can result in displacement of individuals from a migration route or from important habitat, indirect mortality through increased predation, increased intra-specific competition or occupation of lower quality habitat leading to lowered fitness, all of which can have consequences for the abundance of KI populations. For caribou specifically, Volume IIB, Section 5.7.1, discusses three interlinked issues related to change in habitat: habitat loss, disruption of movement and increased predation. Thus while the term 'change in habitat' has been used throughout the assessment for caribou, it also refers to issues related to disruption of movement, such as during migration. This approach was also applied to the CEA to capture issues related to disruption of movement, although the assessment is necessarily at a higher level given the more general information available regarding the effects of other project and activities within the CEA Area.

As indicated in Volume IIA (Section 2.4.1.2) only the George River Caribou Herd is considered a migratory population, whereas the Lac Joseph and RWM Caribou Herds are considered sedentary populations of boreal caribou. Female caribou from sedentary herds do not migrate to common calving grounds but rather disperse at calving (away from other females) (Bergerud et al. 2008). However, caribou from sedentary herds do move seasonally between areas and/or habitats. There is conflicting opinion in the literature (Volume IIB, Section 5.7.1.2) as to whether the existing projects and activities considered under the context of the CEA (e.g., transmission line rights-of-way, roads, forest clearings or military training) may be disrupting movement of caribou. But regardless of whether they have or are influencing the movements of migratory or sedentary boreal caribou, these animals are still moving across or through zones of disturbance associated with these

activities or features. In terms of the migratory George River Herd, these caribou often overwintered in the lower Churchill River watershed in recent years, extending in a southeast direction, south of the Churchill River (Volume IIA, Figure 2-17). Similarly, the sedentary RWM Herd has telemetered caribou that have consistently overlapped with and/or crossed features associated with other projects (Volume IIA, Figure 2-24). As indicated in the response to IR# JRP.122, some telemetered caribou (estimated less than 5 percent of locations) from the Lac Joseph Herd have entered the lower Churchill River watershed (near Churchill Falls) from the west in recent years. The limited amount of overlap between this herd and that of the projects under review in the CEA lead to the conclusion that potential influence on movements are not likely.

The influence of other projects on the movements of other migratory Key Indicators (KI) was also considered in the CEA. Moose for example, which were described in Volume IIA, Section 2.4.5.2 as making seasonal movements in and out of the lower Churchill River valley based on telemetry research by Nalcor (Minaskuat Inc. 2009) and others (Folinsbee 1974; Northland Associates 1980), were described in Volume IIB (Section 5.15.4.3) as influenced by forestry activities and access roads that affected their distribution. Black bear were shown in the telemetry research (Minaskuat Inc. 2009b) to make seasonal movements or migratory patterns that were influenced by human activities such as access to areas of solid waste (e.g., Landfill for the Town of Happy Valley-Goose Bay) or storage of foodstuffs (e.g., construction camps for the upgrade of the Trans-Labrador Highway). Canada Goose breeding in Labrador migrate within the North Atlantic Flyway and winter along the coast (Volume IIB, Section 5.15.4.8). Therefore, effects on the population anywhere in the breeding, moulting, migration, or wintering range for Canada Goose may have implications for the population in the lower Churchill River watershed. Similarly, the Olive-sided Flycatcher which breeds in northeastern Canada as far as the lower Churchill River watershed (Dunn and Alderfer 2007, NatureServe 2007, Internet site), is a species that has been affected by human disturbance. Although loss of breeding habitat is a possible cause for the decline of this species, its preference for fragmented habitat suggests that other factors are involved such as loss or alteration of wintering habitat (Volume IIA, Section 2.4.16.2). In summary, the influence of this Project and others considered within the CEA, will likely be more prominent on seasonal migration movements of species that are resident year-round, compared to those which only breed within the CEA Area.

References:

Dunn, J.L. and J. Alderfer (Eds). 2007. Field Guide to the Birds of North America. Fifth Edition. National Geographic Society, Washington, D.C.

Folinsbee, J. 1974. The Moose (*Alces alces)* in the Churchill River Valley, Labrador. Newfoundland Wildlife Service.

Minaskuat Inc. 2009. The Lower Churchill Hydroelectric Generation Project Environmental Baseline Report: Moose (Alces alces) – Final Report. Prepared for Nalcor Energy LCP 535746, St. John's, NL.

Minaskuat Inc. 2009b. Black Bear (*Ursus americanus)* in the Lower Churchill River Watershed – Final Report. Prepared for Nalcor Energy LCP 535747, St. John's, NL.

NatureServe. 2007. NatureServe Explorer: An Online Encyclopedia of Life. Version6.2. NatureServe, Arlington, Virginia. Available at http://natureserve.org/explorer.

Northland Associates. 1980. Lower Churchill Development Studies. Prepared for Lower Churchill Development Corporation, St. John's, NL.

IR# JRP.164

Monitoring and Follow Up

Requesting Organization – Joint Review Panel **Information Request No.: JRP.164**

Subject – Monitoring and Follow-up

References:

EIS Guidelines, Section 4.6.1 (Mitigation) and Section 4.6.4 (Monitoring and Follow-up Programs)

Related Comments / Information Requests:

CEAR # 277 (DFO)
CEAR # 285 (Hydro-Québec)
CEAR # 287 (Grand Riverkeeper Labrador Inc.)
CEAR # 289 (Innu Nation)
CEAR # 291 (Sierra Club Atlantic)
CEAR # 292 (Environment Canada)

IR # JRP.65, 106, 108, 112, 112S, 113

Rationale:

Section 4.6.4 of the EIS Guidelines requires that "The EIS shall describe the environmental and socio-economic monitoring and follow-up programs to be incorporated into construction, operation and maintenance activities. (…) The Proponent shall describe how the results of monitoring and follow-up programs will be used to refine or modify the design and implementation of management plans, mitigation measures and Project operations. (…) The proposed approach for monitoring shall be described (…) The Proponent shall describe plans to maintain communications and working relationships with the affected communities, Aboriginal organizations, municipalities and government agencies throughout the life of the Project. The intent of these plans is to involve those groups in monitoring and follow-up programs, including in the identification and work towards the reduction of adverse physical, biological or socio-economic effects, and enhancement of beneficial effects. (…)" (p.39&40).

With respect to mitigation measures, Section 4.6.1 of the EIS Guidelines requires that "[t]he rationale for and effectiveness of the proposed mitigation and enhancement measures should be discussed and evaluated. (…) The proponent shall identify who is responsible for the implementation of these measures and the system of accountability" (p.37).

The EIS and subsequent responses provide little information on effects monitoring, follow-up and adaptive management for project-related impacts on many aspects of the socio-economic environment, including land and resource use. Such information is required for each program that is needed, as per the EIS Guidelines.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.164**

Information Requested:

a. **The Proponent is asked to provide the information required by the EIS Guidelines regarding effects monitoring, follow-up and adaptive management programs needed for management of project-related impacts on the socio-economic environment, including land and resource use. This is to include lines of responsibility, accountability and proposed approaches for each program that is needed and proposed involvement of affected parties. Where the Proponent suggests that a government department or agency would carry out the monitoring or follow-up, the Proponent is asked to report on the willingness and capacity of the department to take on this role.**

Response:

The final design of both biophysical and socio-economic follow-up and monitoring programs will, as appropriate, be dependent on consultation with relevant government agencies, communities and stakeholders. Such programs will also be consistent with the terms and conditions of permits and approvals, and commitments made in any Impacts and Benefits Agreement (IBA). As a result, proposed follow-up and monitoring programs must be described in a more general manner so as not to pre-suppose the needs or interests of other involved parties.

Nalcor Energy (Nalcor) has been consulting with other groups for several years with a view to increasing the level of awareness regarding the Project and also to highlight issues and opportunities concerning the Project. These efforts have been undertaken with various government agencies, communities, and other interested stakeholders. While service and infrastructure issues are managed by municipal, provincial, and federal government departments and agencies,

Nalcor recognizes that it has an important role to play in mitigation of the socio-economic effects of the Lower Churchill Hydroelectric Generation Project (Project). First and foremost, Nalcor seeks to enhance the positive effects of the development by implementing appropriate policies and strategies for matters that is within its control. Examples of these approaches range from Nalcor's basic planning process, which are consistent with global best practices for megaprojects, through to procurement and employment policies, which are intended to optimize employment and business opportunities.

Nalcor maintains a high level of focus on socio-economic effects that are or will be directly attributable to the Project and that are within its ability to control or mitigate. It further recognizes that matters will arise that are not within its control, and will participate in a more indirect, facilitative manner, reflecting the more indirect linkage of these issues to the Project. As described in the response to IR# JRP.146, financial benefits from the Project will accrue to the provincial and federal government, so it would be inappropriate for Nalcor to assume responsibility for issues that are within the mandate of other provincial agencies. Such an approach would be a counterproductive duplication of effort. For the same reasons, Nalcor does not propose to fund other agencies who receive funds from the provincial or federal governments.

Table 1 provides further detail on follow-up programs that Nalcor intends to implement, the information proposed to be collected, and the expected recipients of the data.

Table 1 Proposed Socio-economic Follow-up Programs to be Conducted by Nalcor

Effect	Objectives	Information to be Collected and Reporting Frequency and Duration	Agencies Reporting to
Economy, Employment and Business			
Distribution of Project expenditures	Measure proportion of Project expenditures made within the Province and Labrador. Identify further opportunities for supplier development Identify capacity conflicts for other developments	Project expenditures by amount, type, location and type of contractor (e.g., Aboriginal/non-Aboriginal). Data will be collected and compiled by Nalcor and reported to government on a quarterly basis This is expected to continue through the Construction phase of the Project	• NL Dept. of Natural Resources • Newfoundland and Labrador (NL) Department of Innovation, Trade and Rural Development • Regional Economic Development Boards • Labrador North Chamber of Commerce • Municipalities
Distribution of employment benefits	Measure proportion of Project employment involving residents of the Province and Labrador. Understand effectiveness of employment policies and identify opportunities for improving policies Identify training opportunities Identify resource conflicts with other developments	Project employment by number employed, location of primary residence, occupational category, gender, Aboriginal status. Data will collected and compiled by Nalcor and reported to government on quarterly basis. Nalcor to conduct exit surveys with respect to reasons for leaving. This is expected to continue through the Construction phase of the Project.	• NL Dept. of Natural Resources • Women's Policy Office • NL Dept. of Labrador and Aboriginal Affairs • NL Department of Human Resources, Labour and Employment • NL Department of Education
Distribution of business expenditures to businesses in NL	Measure proportion of Project expenditures to Provincial and Labrador businesses. Identify supplier development opportunities Identify conflicts with other developments	Project expenditures to businesses by amount, location, type (e.g., sector; Aboriginal, non-Aboriginal) reported to government on a quarterly basis. This is expected to continue through the Construction phase of the Project.	• NL Department of Innovation, Trade and Rural Development • Regional Economic Development Boards • Labrador North Chamber of Commerce • Municipalities • NL Dept. of Natural Resources • Dept. of Labrador and Aboriginal Affairs

Effect	Objectives	Information to be Collected and Reporting Frequency and Duration	Agencies Reporting to
Community Health			
Changes in community health related to employment	Understand employment challenges	Nalcor to conduct exit surveys with respect to reasons for leaving. Duration: Construction Phases	• NL Dept. of Natural Resources • Women's Policy Office • Dept. of Labrador and Aboriginal Affairs • NL Department of Human Resources, Labour and Employment
Changes in community health related to mercury levels	Establish baseline exposure of humans to mercury Monitor mercury levels in fish as Project proceeds.	Data collected by Nalcor prior to Project commencement; and fish mercury data collected and compiled by Nalcor on an annual basis for the first 10 years following impoundment, frequency thereafter determined by results, relative to baseline levels. Duration: Pre-construction, Construction and Operation Phases	• Health Canada • DFO • Dept. of Labrador and Aboriginal Affairs • Labrador Grenfell Health • Indian and Northern Affairs Canada (INAC)
Land and Resource Use			
Access to community of Mud Lake	Communicate ice conditions during formation and break up; seasonal ice testing.	Nalcor will monitor (measure ice thickness) and communicate information regarding ice conditions during formation and break-up at select locations on the lower Churchill River. Duration: Operation Phase	• Local Improvement Committee, Mud Lake • RCMP • Municipalities of Happy Valley-Goose Bay and Northwest River • Sheshatshiu Band Council
Reduction of culturally sensitive plant species	Areas of relocated Canada Yew plants will be evaluated.	Details of the timing and methods of follow-up efforts will be determined in consultation with the NL Wildlife Division. Follow-up to determine that relocated plants have been successfully established in the new locations. Duration: Construction and Operation Phases	• Wildlife Division, NL Dept. of Environment and Conservation
Cultural and Heritage Resources			
Disturbance to Historic and Archaeological Resources	Identify any additional Historic and Archaeological Resources; pre-construction Stage I HROA on route of any permanent access roads.	There will be a Historic and Archaeological Resources Contingency and Response Plan in place so that all Project personnel are aware of the procedures to follow if Historic and Archaeological Resources are discovered inadvertently during Project construction or operation and maintenance. The plan will include follow-up to assess the condition of any new sites or materials discovered. In addition, Nalcor will conduct a pre-construction Stage 1 HROA of the route of any permanent access roads once the centre-line has been surveyed and marked. Duration: Pre-construction, and Construction Phases	• Provincial Archaeology Office, Dept. of Tourism, Culture and Recreation

In addition to the follow-up programs presented in Table 1, where commitments have been made, Nalcor will follow-up and report on the implementation of those commitments to the appropriate government agencies and community stakeholders. Please refer to Table 8-1 of Volume III for list of these commitments.

The monitoring and follow-up programs described in Table 2 are those for which Nalcor does not have the mandate, expertise, or ability to design or implement in relation to the likely socio-economic effects due to the Project. These programs would likewise be part of the responsible agencies' overall planning process, and would not be specific to the Project.

It is important to note that all of the socio-economic effects to be addressed by these follow-up programs have been predicted in the EIS not to be significant. To assist in determining the accuracy of these predictions, Nalcor will provide available information to the relevant agencies as indicated in Table 2 to assist with their monitoring and follow-up efforts. Nalcor will continue to consult regularly with the relevant agencies and organizations who administer social services and infrastructure to provide Project information and to identify and discuss potential Project-related implications for local social services and infrastructure and ways to address those issues.

As outlined in IR# JRP.108, funding for service providers, if required, would be determined and administered by the Government of Newfoundland and Labrador. This would be indicated as appropriate in relevant monitoring and follow-up programs. In all cases, the effects being monitored would be within the normal mandate of these government agencies.

It is expected that government agencies will fulfill their mandates, and will have sufficient time to plan and prepare for the Project. The mandated government agencies presented in Table 2 have offices in Happy Valley-Goose Bay, providing local leadership and capacity to fulfill the various roles for which they are responsible.

Table 2 Proposed Socio-economic Follow-up and Monitoring Programs to be Conducted by Government Agencies

Effect	Responsible Agency	Nalcor's Role	
		Objectives	**Information to be Collected by Nalcor and Reporting Frequency and Duration**
Changes to Physical Infrastructure and Services	• Newfoundland and Labrador (NL) Housing Corporation • NL Department of Transportation and Works (Trans Labrador Highway and Port) • Goose Bay Airport Corporation • Dept. of Labrador and Aboriginal Affairs • Dept. of Transportation and Works • Labrador Grenfell Health • Municipal Governments (Happy Valley-Goose Bay; North West River) • Local Improvement Committee (Mud Lake) • Band Council (Sheshatshiu)	Provide government and community agencies with information to facilitate their planning regarding the provision of physical infrastructure and services Duration: Construction and Operation Phases	Project activities and plans (employment, traffic volumes, heavy loads, solid waste); activities and plans communicated on a quarterly basis

Effect	Responsible Agency	Nalcor's Role	
		Objectives	Information to be Collected by Nalcor and Reporting Frequency and Duration
Changes to Social Services and Infrastructure	• Labrador School Board • Labrador Grenfell Health • RCMP • Indian and Northern Affairs Canada (INAC)	Provide government and community agencies with information to facilitate their planning regarding the provision of social infrastructure and services. Provide government and community agencies with information to facilitate their planning regarding the provision of community health services. Duration: Construction and Operation Phases	Project activities and plans (employment); activities and plans communicated on a quarterly basis.
Land and Resource Use (Changes in land use and harvesting patterns)	• Lands Branch, NL Dept. of Environment and Conservation • Wildlife Division, NL Dept. of Environment and Conservation • Department of Fisheries and Oceans (DFO)	Provide government agencies with information to facilitate their planning regarding land and resource use. Duration: Construction and Operation Phases	Project activities and plans (employment, status of any Project infrastructure that can result in changes to access); activities and plans communicated on a quarterly basis.

On an ongoing basis, Nalcor will evaluate the effects of the Project on local communities by participating in and seeking input from the government agencies, committees/groups and others groups that are identified during consultation on the Project. Such groups might include the following:

1. Central Labrador Chamber of Commerce
2. Central Labrador Economic Development Board
3. Minister's Advisory Committee on Labrador Transportation
4. Labrador Grenfell Health
5. Labrador School Board
6. Labrador and Lake Melville Tourism Association

Working together, Nalcor and the appropriate authorities will help identify issues, identify appropriate mitigation, and adaptively manage Project effects on Social Infrastructure and Services, consistent with the Adaptive Management Process outlined in the Response to IR# JRP.112. Such authorities will also be able to provide baseline information on Social Infrastructure and Services to help evaluate whether changes in use and demand for social services and infrastructure are attributable to the Project.

In all cases, Nalcor will contribute to sustainable management of land and resources in the region through regular reporting and sharing of information with appropriate government agencies. Regular updates and communication on planned Project activities by Nalcor to all levels of government agencies as outlined in Table 1 will also assist in regional economic planning.

With respect to the capacity and willingness of agencies to undertake monitoring and follow-up, Nalcor notes that the agencies listed have legislated responsibilities for the services listed, or have been created with specific

mandates. The monitoring and follow-up programs suggested in the EIS as well as in the response to this Information Request are understood to fall within the normal course of planning and operations for these departments, agencies, and entities, and Nalcor therefore has no reason to believe that they would lack the resources or capability to participate in these programs.

Nalcor also understands that these agencies are actively participating in the environmental assessment process. They have been provided with all relevant documentation, including the EIS, have played an active role by submitting Information Requests, and have received Nalcor's responses, including Nalcor's views on capacity funding. To date, no concerns have been raised regarding any agency's ability or willingness to undertake its mandate.

Requesting Organization – Joint Review Panel **Information Request No.: JRP.164**

Information Requested:

The Proponent is asked to:

b. **JRP.112 asked the Proponent "(...) to provide table(s) that summarize all proposed monitoring and follow-up programs (...)". In its response to JRP.112, the section on Monitoring presents some examples of monitoring programs. Based on the list of permits, approvals and authorizations that may be required for the Project (response to JRP.24, table IB-G-1), the Proponent is also asked to provide a table of the proposed monitoring programs for these permits, including, to the extent that information is available, the regulating agency, frequency, duration and geographic extent, reporting, and the Proponent's role for these different monitoring programs.**

Response:

Nalcor will monitor and report as required by the permit issuer. The proposed monitoring programs for the permits presented in Table IB-G-1 of Volume IB of the EIS (updated in response to IR # JRP.24) are provided in Table 3. In the majority of cases, inspection by government agencies is required to ensure compliance with the permit, and monitoring as defined in the Guidelines may not be applicable. Depending on the permit, approval or authorization, Terms and Conditions could stipulate monitoring be conducted (e.g., as per a Section 35(2) *Fisheries Act* Authorization that requires a monitoring program). This will become known at the time of permit issuance. The details regarding frequency, duration, geographic extent, and reporting will be defined (if required) when the permit is issued and, therefore, detailed information is not available at this time. For many of the permits, relevant government agencies will conduct inspections for compliance with standards and/or permit-specific Terms and Conditions. In these cases, the role of Nalcor is to comply with applicable legislation and Terms and Conditions of the permit, or direct contractors to do same, with documented evidence of compliance.

To the extent the specific information regarding monitoring requirements is available with respect to the regulating agency, frequency, duration and geographic extent, reporting, and Nalcor's role for these different monitoring programs, that information is provided in Table 3.

Table 3 List of Permits, Approvals and Authorizations that may be Required and Associated Compliance Monitoring and/or Inspection Requirements and Nalcor's Role

Approval/Certificate/ License/Permit/Inspection	Regulating Agency	Compliance and/or Inspection Requirements and Nalcor's Role
Government of Newfoundland and Labrador		
Release from the Newfoundland and Labrador *Environmental Protection Act*, Part X, Environmental Assessment	Environmental Assessment Division, Newfoundland and Labrador Department of Environment and Conservation (NLDEC)	Follow-up programs have been proposed by Nalcor (please refer to the response to IR #112). The Panel will make recommendations regarding follow-up.
Development Permit to build on and develop land, whether Crown or privately owned, within the building control lines of the Trans Labrador Highway (Quebec Border to Goose Bay) Protected Road Zoning Plan (PRZP)	Newfoundland and Labrador Department of Government Services (NLDGS), on behalf of Newfoundland and Labrador Department of Municipal Affairs (NLDMA)	Nalcor to comply with conditions as outlined in permit.
Authorization to "enclose, mark off or take possession of" Crown land requiring permission under one of the following Sections of the *Lands Act*: - Section 3, Lease of Crown Land; - Section 4, Grants of Crown Land; - Section 5, Easement; or - Section 6, Licence to Occupy.	NLDEC, Lands Branch	Land survey to be conducted to the satisfaction of the Minister, and a plan together with other information that the Minister may require shall be registered within 12 months. Inspections/reporting are not a requirement under this license.
Certificate of Approval – Septic System with daily flow of less than 4,546 litres, and Final Approval Certificate	NLDGS, on behalf of Newfoundland and Labrador Department of Health and Community Services (NLDHCS)	Interim inspections during construction; final inspection required prior to system operation and backfill. All components of system to be left uncovered for inspection. There is typically a 10 day notice required by NLDGS so scheduling arrangements can be made by the inspectors.
Certificate of Approval – Septic system with daily flow greater than 4,546 litres	NLDGS, on behalf of NLDEC	Interim inspections during construction; final inspection required prior to system operation and backfill. All components of system to be left uncovered for inspection. There is typically a 10 day notice required by NLDGS so scheduling arrangements can be made by the inspectors.
Certificate of Approval for Commercial Building under National Building Code, National Fire Code of Canada (NBCC), and NFPA101 Life Safety Code	NLDMA, Office of the Fire Commissioner	During construction, the equipment and any equipment or components installed are subject to inspection by the Office of the Fire Commissioner and to provisions of Part 8 of the NBCC.
Application for Building Registration (for each building to be constructed)	NLDGS	NLDGS conducts compliance inspection once building is constructed. One inspection required provided there are no issues.

Approval/Certificate/ License/Permit/Inspection	Regulating Agency	Compliance and/or Inspection Requirements and Nalcor's Role
Food Establishment Application (for Construction Camps and operations)	NLDGS, on behalf of NLDHCS	Initial inspection required before licence is issued. Inspections are on-going thereafter, depending on risk (high risk – 4/year; medium risk – 2/year; low risk – 1/year):
Building Accessibility	NLDGS	Interim inspections during construction; final inspection once construction is complete, before the building can be occupied. Frequency of inspections is normally dependent on the size of the project, and are conducted when the building is registered. Smaller buildings may only require one interim inspection.
Electrical Permit – required for any electrical work undertaken or installations completed during the Project	NLDGS	Inspections by NLDGS will be ongoing
Notice of Intent for Reservation of Shoreline	NLDEC	Nalcor to comply with terms and conditions attached to the lease/licence to be determined by Lieutenant-Governor in Council.
Waste Oil – Handling and Disposal	NLDEC	Nalcor to comply with terms and conditions attached to the Certificate of Approval, including requirements for staff training and contingency plans, to be determined by the Minister of Environment and Conservation. Storage facilities require inspection and logging of results by Nalcor for each day of operation. Certificates of used oil analysis are required for transferred product. A record of product transferred to an authorized collector is to be maintained. Volumetric information on the used oil shall be submitted to NLDGS by January 31 of each year.
Waste Management System, Certificate of Approval	NLDEC	Nalcor to comply with terms and conditions attached to the Certificate of Approval to be determined by the Minister of Environment and Conservation. Nalcor will be responsible for annual reporting of volumes of waste collected, stored, treated, transported or disposed. The local NLDGS office will carry out regular inspections.
Certificate of Approval - Collection and transportation of hazardous/special waste	Regional Operator: NLDGS Province-Wide Operator: NLDEC	Nalcor to comply with terms and conditions attached to the Certificate of Approval to be determined by the Minister of Environment and Conservation. Nalcor will be responsible for annual reporting of volumes of waste collected, stored, treated, transported or disposed. The local NLDGS office will carry out regular inspections.
Permit for Access off any Highway	NLDMA	Nalcor to comply with conditions as outlined in permit.

Approval/Certificate/ License/Permit/Inspection	Regulating Agency	Compliance and/or Inspection Requirements and Nalcor's Role
Authorization for construction of branch/access roads off the Trans Labrador Highway	NLDMA	Nalcor to comply with conditions as outlined in permit.
Authorization for restricting access.	NLDEC, Lands Branch Newfoundland and Labrador Department of Natural Resources (NLDNR), Forestry Branch	Nalcor to comply with conditions as outlined in permit. Inspections/reporting are not a requirement under this license.
Fuel Storage & Handling – Temporary Storage Remote Locations	NLDEC	Nalcor to comply with terms and conditions attached to the Certificate of Approval, including requirements for staff training and contingency plans, to be determined by the Minister of Environment and Conservation.
Fuel Storage & Handling – A Permit Flammable & Liquid Storage & Dispensing (above or below ground) & for Bulk Storage (above ground only)	NLDEC and NLDMA (Office of the Fire Commissioner)	Nalcor to comply with terms and conditions attached to the Certificate of Approval, including information on the equipment used for collecting or transporting the used oil, to be determined by the Minister of Environment and Conservation. Records will be maintained by Nalcor; reporting is required only when there is an issue.
Fuel storage tanks ≤2,500 L and connected to a heating appliance	NLDEC	Systems will be inspected by a licensed inspector and registered with NLDEC, before being put into service. Nalcor to comply with certificate of registration, including inspections as per CSA-B139. Inspected every five years by licensed inspector.
Certificate of Approval – Used oil storage system	NLDGS	Nalcor to comply with terms and conditions attached to the Certificate of Approval, including requirements for staff training and contingency plans, to be determined by the Minister of Environment and Conservation. Nalcor will be responsible for annual reporting of volumes of waste collected, stored, treated, transported or disposed. The local NLDGS office will carry out regular inspections.
Permit for Constructing a Non-domestic Well (ex: monitoring wells; utility wells; etc)	NLDEC, Water Resources Division	Nalcor to submit completion reports; and comply with any requirements outlined in terms & conditions of permit.
Water Use License (for water use from any body of water, including groundwater and surface water)	NLDEC	Nalcor to submit Water Use Reports.
Permit to Construct/Permit to Operate Water and Sewerage Works	NLDEC	Nalcor to submit completion reports, and comply with any requirements outlined in terms and conditions of permit.
Operating Permit/Fire Season – Crown or private land for a company or individual to operate during forest fire season	NLDNR, Forest Resources Division	Nalcor to comply with terms and conditions of the permit.

Approval/Certificate/ License/Permit/Inspection	Regulating Agency	Compliance and/or Inspection Requirements and Nalcor's Role
Permit to Cut Crown Timber – A permit is required for commercial or domestic cutting of timber on Crown land	NLDNR, Forest Resources Division	Nalcor to comply with terms and conditions of permit and to submit information in compliance with cutting permit returns, containing the information and shall be made at the times as specified.
Letter of Advice to New Construction Project or Industrial Enterprise	NLDGS	Nalcor to comply with terms and conditions of permit.
Authorization pursuant to the Protected Road Zoning Regulations (PRZR) and the Protected Road Zoning Plan (PRZP) implemented by the Trans Labrador Highway (Quebec Border to Goose Bay)	NLDMA	Nalcor to comply with conditions as outlined in permit.
Operating Permit	NLDNR, Forest Resources Division, Local District Office, North West River	Nalcor to comply with conditions as outlined in operating permit, with a copy required to be on site.
Commercial Cutting Permit & associated conditions	NLDNR, Forest Resources Division, local district office, North West River	Nalcor to comply with terms and conditions of permit, and submit information in compliance with cutting permit returns, at the times as specified (e.g., quarterly returns reporting volume cut; comply with Ecological Protection Guidelines, where relevant).
Permit to Alter a Body of Water		
Schedule A – Culvert	NLDEC, NL Water Resources Management Division	Completion reports, plus any requirements outlined in terms and conditions of permit (specific to each permit, to be determined once application is submitted)
Schedule B – Bridge		Completion reports, plus any requirements outlined in terms and conditions of permit (specific to each permit, to be determined once application is submitted)
Schedule C – Dam		Completion reports; monitoring and reporting in accordance with Canadian Dam Association Guidelines; plus any requirements outlined in terms and conditions of permit (specific to each permit, to be determined once application is submitted)
Schedule D – Fording		Completion reports, plus any requirements outlined in terms and conditions of permit (specific to each permit, to be determined once application is submitted)
Schedule E – Pipe Crossing/Water Intake		Completion reports, plus any requirements outlined in terms and conditions of permit (specific to each permit, to be determined once application is submitted)
Schedule F – Stream Modification or Diversion		Completion reports, plus any requirements outlined in terms and conditions of permit (specific to each permit, to be determined once application is submitted)

Approval/Certificate/ License/Permit/Inspection	Regulating Agency	Compliance and/or Inspection Requirements and Nalcor's Role
Schedule G – Small Bridges Schedule H – Other works within 15 m of a body of water (i.e., wharf, boathouse, infilling, landscaping, dredging, debris removal, drainage works, settling ponds, other minor works)	NLDEC, NL Water Resources Management Division	Completion reports, plus any requirements outlined in terms and conditions of permit (specific to each permit, to be determined once application is submitted) Nalcor has signed a Memorandum of Agreement with Water Resources Management Division for Real-Time Water Quality and Quantity Monitoring for the Project. There are a number of real-time monitoring stations along the Churchill River (installed in September 2008) to monitor/report the water quality and quantity to collect baseline information (prior to start of Project). This Agreement will continue well into the future, in consultation with NL Water Resources Management Division, with monitoring taking place during the construction and operation phases as well. The number and location of real-time stations will change as the Project moves from baseline to construction to operation.
Registration – all elevating devices	NLDGS, Engineering Services Division	Inspection completed upon installation. A certificate of inspection is issued when deemed acceptable for service. Annual inspections thereafter.
Quarry Development Permit – A permit is required to dig for, excavate, remove and dispose of any Crown quarry material	NLDNR, Mines and Energy Division	Periodic inspections, as per terms and conditions established in permit Annual renewal of permit through application
Control of Nuisance Wildlife Black Bear Protection Permit/Permit to Destroy Problem Animals	NLDNR, Forest Resources Division	Nalcor to obtain written permission of Minister to control nuisance animals, and comply with any terms and conditions issued. All incidents of nuisance wildlife encounters to be reported. Required to have copy of permit on site.
Signs – Highway Services Fingerboard Signs, Approval	Newfoundland and Labrador Department of Transportation and Works (NLDTW)	Nalcor will obtain prior approval in writing from the Minister of Transportation and Works
Permit for highway signs – other than fingerboard	NLDGS	Nalcor will comply with conditions as outlined in permit
Permit to Operate Temporary Diesel Generator	NLDEC, Pollution Prevention Division	Initial inspection to appropriate American Petroleum Institute or Underwriters' Laboratories of Canada standards, or any other standards acceptable to NLDEC. The required frequency of inspections may be changed at the discretion of the Director.
Government of Canada		
Release from *Canadian Environmental Assessment Act*	Canadian Environmental Assessment Agency, Minister of Environment	Follow-up programs have been proposed by Nalcor (please refer to the response to IR #112). The Panel will make recommendations upon completion of the environmental assessment process.

Approval/Certificate/ License/Permit/Inspection	Regulating Agency	Compliance and/or Inspection Requirements and Nalcor's Role
Approval under Part 1, Section 5 of the *Navigable water Protection Act* (NWPA) for any work to be built of placed in, on, over, under, through or across any navigable water Fish habitat creation/placement of boulders or islands within Gull Island Plateau to create additional fish habitat will require an Approval under the NWPA	Transport Canada	Nalcor will comply with terms and conditions attached to the approval, and will submit plans to Transport Canada. If substantial interference is determined, then public notice will be required through local newspapers and Canada Gazette.
Fish Habitat Authorization – For works or undertakings affecting fish habitat, require quantification of harmful alteration, disruption or destruction (HADD) and fish habitat compensation strategy for approval and authorization	Fisheries and Oceans Canada (DFO)	Monitoring program requirements issued after Panel Hearing completed; environmental effects monitoring (EEM) included as a condition of the Authorization. Nalcor will conduct monitoring and reporting. Frequency, duration, geographic extent and reporting to be determined as the Compensation Plan is developed.
Application for a Water Lot Lease	DFO	Nalcor will comply with conditions as outlined in lease.
Permit to Transport	Transport Canada	Nalcor will comply with conditions as outlined in permit.
Report Mechanism/Response	DFO – Canadian Coast Guard	Nalcor to report incidents of accidental spills in Canadian waters as per the *Canada Shipping Act*.
Application For License To Install and Operate a Radio Station in Canada	Industry Canada Communications	Nalcor will comply with conditions as outlined in licence. Inspections/reporting are not a requirement under this license.
Magazine License, Temporary	Natural Resources Canada	Inspections/reporting are not a requirement under this license.
Municipal Government		
Approval to dispose waste in municipal landfill	Relevant municipality	Nalcor to comply with terms and conditions of the Certificate of Approval issued to the municipality to operate a solid waste landfill.